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IMPROVED PRACTICES FOR ENHANCING MARIGOLD PRODUCTION

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Marigold is a member of the Asteraceae family, and it is India's third most popular flower after roses and chrysanthemums. Marigold is a high-value, labor-intensive crop that is grown on a small scale by the majority of farmers. Marigolds are grown as attractive blooms, landscaping plants, poultry feed, and a source of natural carotenoid pigments, among other things. One of the most significant ornamental plants, the marigold, is valued in landscape settings as well as cut flowers (Nau, 1997; Popovi, 2010; 2017; 2018). Marigold flowers are produced as an ornamental crop for their blossoms, which are offered in the market as loose flowers in bulk, speciality cut flowers, or garlands. In several countries (Spain, Mexico, the United Kingdom, the United States, Italy, South Korea, Taiwan, and Japan), marigold is in high demand as a cut flower or as an extracted product. As a result, marigold exports will boost the economy (Luis et al., 2009). Water availability and produce quality are key concerns in regards to irrigation of urban landscapes, as a result of competition with a fast rising population that necessitates large-scale production of high-quality crops with minimal input (Kjelgren et al., 2000).

In many parts of the world, particularly in arid and semi-arid countries, water is becoming an economically scarce resource (Bosma et al., 2003). Agriculture is the world's largest consumer of freshwater, accounting for over 70% of irrigation withdrawals (WWAP, 2009). In order to secure water for agricultural output, increasing the efficiency of water use within agriculture systems is critical. Better irrigation timing and the use of drip irrigation in row crops are two potential water-saving measures that have been projected to save 20% of water use (EU WSPP, 2017). Irrigation scheduling that is done correctly results in increased water efficiency (WUE). The yield obtained per unit of applied water is referred to as WUE.

What makes Marigolds so unique?

- These small yellow flowers are perennial and can bloom throughout the year, in the summer, spring, and fall, although they cannot tolerate extremely cold conditions.
- Marigolds are a natural pest deterrent. It aids in the prevention of pests and vermin.
- It is a cultural icon of India, and garlands made of marigolds may be found in many Indian homes and temples.
- The textile industry uses dyes produced from these flowers.
- Essential oils derived from them have been shown to have skin-protective properties. In the cosmetics business, its oil is widely used.
- It also has some medicinal properties. It is also required by the companies making oils and medicines.
- 365 days a year, marigolds are required by the temples. During wedding and festival seasons, there is a particularly strong demand for these flowers.

According to the information presented above, marigolds have a large market in India and a high earning potential.

Prerequisites Before Starting Marigold Farming

Marigold farming, like any other farming business, necessitates infrastructure and costs. It is critical to have a finance strategy for this commercial plantation. According to a study published in international journals, the input cost of growing Marigold flowers per hectare of land is around Rs 85000. The marigold output per hectare is projected to be 84.16 quintals. The farm under investigation yielded a net profit of Rs 1,00,557.

Required Agriculture Practices

It demands a mild climate for robust growth and blooms. Temperatures between 15 and 29 degrees Celsius are ideal. Temperatures above 35 degrees Celsius, on the other hand, might limit plant growth and result in smaller flowers.

Soil requirements: Marigold thrives in a variety of soil types, the best of which are loamy soils with a pH of 6.5-7.

Land preparation: To grow these blooms, you'll need a well-plowed field with a fine tilth. FYM should be added to the soil at a rate of 20-25 tonnes per hectare.

Seed Treatment and Sowing: Before sowing, treat the seeds with 80 grams of Azosprillium in 20 millilitres of rice gruel. Seeds can be disseminated on raised beds in the months of May and June. The seed rate, 200-300 g/acre is required in the summer, while in the winter, 150-200 g/ha is necessary. The seed beds must be irrigated on a regular basis, and the plants must be transferred onto the main field with a 45*35 cm spacing when they reach 15 cm in height. Plants are typically transferred 25- 30 days after seeding.

Fertilizer Requirement: The suggested N:P:K dosage is 100:75:75. As a base dose, a half dose of nitrogen and a full dose of potassium and phosphorus should be added. 30-40 days after transplanting, the final dose of nitrogen is delivered.

Irrigation: It should be done at least once a week. From bud to harvest, the plants require continual irrigation. Standing water should be minimised and a proper water drainage system should be maintained.

Harvesting and packaging: After 40-50 days after transplanting, the plants blossom. Depending on the type, the flowers are harvested when they reach full size. For optimal bloom quality, harvesting the flowers should be done in the morning after they have been irrigated. A single plant can produce up to 150 flowers. Flowers without stalks are wrapped in bundles and delivered to the market, while loose flowers are placed in a bamboo basket. The harvested flowers must be stored in a cool area after harvesting. Marigold is a flower that is particularly perishable. As a result, they must be sold as soon as possible after harvest.

Additional Practice

Pinching : Three weeks after transplanting earthing up is done and then one week after earthing up or 1 month after transplanting the seedlings, pinching is followed for bushy growth of the plant and development of lateral branches. Pinching results into production of more number of flowers.

Irrigation, Fertigation and Mulch Approaches

Agriculture employs over 70% of our population and accounts for one-third of our national GDP in India, which is primarily a farming country. The agricultural sector's contribution of national GDP has recently climbed to 20%. (NSO, India, 2021). Our population continues to grow, and this has a

direct impact on the limited natural resources available. Because agriculture consumes a large amount of freshwater, it is critical to manage natural resources wisely. In agriculture, various irrigation technologies are employed; micro-irrigation is one of the most effective strategies for achieving high water use efficiency and enhancing the productivity.

Very limited information is available in India on cultivation of marigold in soil media with drip irrigation under mulch practice. Among the water conservation measures, mulching has gained popularity because of its ability to reduce the rate of water loss (nonbeneficial consumptive use of water) from both surface and subsurface soils, while the ability of micro irrigation systems to save water in agriculture is somewhat controversial. Mulch restricts the transport of water vapour from the soil surface to microclimate, which diminishes the direct evaporation loss of soil water and increases the availability of soil water to the crops. In India, crop residues are mainly used as mulch material to conserve profile soil water but first-rate of decomposition reduces its impact at the later part of crop growth. The adoption of plastic mulch reduced the magnitude of evaporation loss by 55% over bare conditions; however, it enhanced the value of evapotranspiration.

The research work done in India have clearly indicated that mulching with black plastic along with drip system in crops like marigold could increase the yield by 13 to 39 per cent, improves quality and induces early maturity as compared to conventional methods of cultivation. Apart from yield and quality advantages under mulching and drip irrigation system, efficiency & inputs like water, fertilizer etc. also increased considerably. Use of organic amendments with chemical fertilization is of vital importance and of great need in modern era. So as to get better growth, flowering characters and yield, the marigold plant should be fertilized with 40gN/m^2 + 30 g K/m^2 and mulched with black plastic sheet.

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BIOINDICATERS : A BIOMARKER FOR ENVIRONMENTAL POLLUTION

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Abstract
Bioindicators are living organisms including different plants, animals, planktons as well as microbes, which are applied for screening of the health of the natural ecosystem. They are used for assessment of environmental health as well as biogeographic alterations occuring in the environment. Each organic component within a biological system indicates the health of its surroundings such as plankton having rapid response to surrounding environmental alterations. They serve as a significant biomarker for assessment of the quality of water thereby serving as an indicator of water pollution. The planktons serve as reflector of the health of aquatic flora acting as early warning signal. Therefore, the concept of bioindicators is well explained with special emphasis on bioindicators for assessment of water and environmental quality.

Keywords : bioindicators, biomarker, environment, quality

Introduction

Bioindicator indicates group of species whose presence and function is an indication of environmental quality. They are considered to be naturally occurring biomarkers responsible for monitoring of environmental health. They are also a relevant tool for identification of positive as well as negative changes in the environment along with their consequences for human society. The presence of bioindicators in the environment is regulated by a number of factors including light transmission, water, temperature, and suspended particles. The natural state of a certain location or the level/degree of contamination can be estimated by using bioindicators. (**Khatri &Tyagi, 2015**).

Uses of bioindicators

These terms are used to refer to all types of biotic and abiotic responses to environmental changes. They are used to identify changes in the natural environment and to highlight bad or positive effects. They can also detect changes in the environment caused by contaminants, which can have an impact on the environment's biodiversity as well as the species that live there (Holt & Miller, 2010). In diverse animals occupying various sorts of settings, natural, biological, and biodiversity markers can be identified. Bryophytes (liverworts) and lichens (a symbiosis of Cyano bacteria, algae, and/or fungi) are widely employed to monitor air pollution. Because they have no roots, no fingernail skin, and get all of their nutrients from direct exposure to the climate, lichens and bryophytes are strong bioindicators of air quality. Their high surface area to volume ratio adds to the hypothesis that they could be used as a bioindicator or to absorb contaminants from the air.

Criteria and characterization for selection of bioindicator

There are several criterias for selection of bioindicators. These include the following:

1. They should be easily available

2. They should be cost effective
3. They should have all season availability over a huge range of area
4. They should have resistance against various unfavorable climatic conditions
5. They should be highly sensitive towards a specific dose of contaminants
6. They should have higher reproductive rates and should be harmless to environment

Different types of bioindicators

a. **Microbial Bioindicator :** Microorganisms consume the majority of aquatic biomass. They have a fast rate of multiplication and are more readily available than macroorganisms. Microbial bioindicators are microorganisms that are used to assess the health of both terrestrial and aquatic ecosystems. (**Klemm, 1990**).
b. **Plant Bioindicato :** Several plant species, primarily marine plants, have been shown to significantly minimise pollution. In nature, these marine plants are immobile. Lichen, a mutualistic relationship between algae and fungi, thrives on the stems of forest plants. The reaction of lichen can reveal minor changes in forest air quality, climate, and structure. Indicators of pollution in the marine ecology include Phacustortus and Euglena clastica.
Copper, zinc, and lead are known to be indicated by higher plants such as Agrost spp., Anthroxanthum spp., and Festuca spp. Lower plants, such as lichens, can signal the presence of sulphur dioxide and fluorine, ozone gas, and radionuclides such as cesium-17 and strontium-30, among other things.
c. **Planktonic Bioindicator :** Planktons are essential for monitoring pollution in water bodies, particularly lakes. They can be thought of as the best indicators of water quality. They may also aid in the breakdown of organic wastes in bodies of water.
d. **Phytoplankton :** Phyto planktons are aquatic plants that feed themselves by photosynthesis. These are also known as microalgae, and they can be found floating freely in the ocean. The amount of sunlight they receive has a significant impact on their ability to produce food. As a result of the poisoning of water bodies, their number is declining.

Biomonitoring

Bio-organisms are used to describe the properties of a biosphere or ecosystem. Biomonitoring is the process of monitoring the health of the environment using bioindicators or live organisms. Bio monitors provide quantifiable data on environmental quality and the impact of various pollutants. Biomonitoring can be done in a variety of methods with the goal of making a minor change to the environment's health (Marques, 2001). The impact of specific stressors on the environment is considered. It's also a potential way for determining the quality of water. To some extent, any bio monitors can be considered bioindicators, although planktons are the most promising. Biomonitors are available for free all around the world. They closely resemble the natural influence on animals and may be utilised and understood with little preparation and training.

Advantage and significance of bioindicator

- Several approaches and equipment are required to test the pollution and hazardous level of a water body or environment. Bioindicators, on the other hand, may lower the expense of complicated procedures.
- Their excellent reproducibility is critical for determining hazardous levels.
- The sensitivity to pollutants makes environmental monitoring of harmful effluents or contaminants much easier.

- It provides early warning of contamination in bodies of water.
- These bioindicators could be used to detect a wide spectrum of contaminants.
- There are no negative consequences for the environment.

Significance

- These bioindicators have applications in a variety of disciplines, from animal tissues to water bodies.
- Planktonic indicators are important in determining the state of an aquatic ecosystem's health.
- These indicators help to conserve natural resources by detecting the presence of harmful compounds in our ecosystem.
- They look for toxins in drinking water as part of the natural cleansing process.
- These are quite useful in determining the health of the ecosystem.

Conclusion

The bioindicator is practical, objective, simple, and repeatable. Bioindicators can be used to assess changes in a biological community at many sizes, from the cell to the ecosystem. Planktonic monitors include biological, physical, and chemical elements and are a key component in determining the health of water bodies. The demand for these indicators will skyrocket in the near future. As a result, researchers should concentrate their efforts on discovering new species of bioindicators as well as their harmful and beneficial effects on the ecosystem.

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MARINE BIODIVERSITY OF GULF OF KUTCH IN INDIA

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Abstract
The Gulf of Kutch are located in Saurashtra, Gujarat, India's westernmost state. In 1982, the area was designated like a Marine National Park & Sanctuary (MNPS). Under 1991 Coastal Regulation Zone (CRZ) Notification, coral reefs and mangroves with in region have also been given the highest level of protection. The main threat comes from the Gulf Coast's massive petroleum and petrochemicals-based sector. The Gulf of Kutch is predicted to be responsible for 70% of India's total crude imports. Chemicals such as soda ash, cement, fertiliser, salt works, thermal power plants, and shipbreaking equipment are also contributing to the environmental catastrophe. The lack of distinct physical and legal boundaries, as well as the overlapping jurisdiction of multiple government regulatory authorities, is among the reasons. Local communities are the most vulnerable to unregulated development and the resulting pollution and habitat degradation. Environmental contamination and pressure from big fishing vessels have had a significant negative impact on fishing, particularly traditional fishing.

Keywords : Gulf of kutch, biodiversity, threat, conservation.

Introduction

The state's coastline is 1,663 kilometres long and its also considered second-longest of any Indian peninsular state, trailing only the Union Territory of the Andaman islands. The shelf region up around 200 m is 164,183 km2, with 64,810 km2 in the 0-50 m zone. The state contains 15 sanctuaries with a total area of 15,710 km2 & four national parks with a total area of 481 km2 dedicated to environmental conservation and biodiversity (Subba Rao and Sastry, 2005). The notified area covers 148.92 square kilometres in the Gulf of Mexico, with 42 islands and 309 square kilometres of intertidal along its shore (Biswas, 2009). The Gulf of Kutch is an entrance in the Arabian Sea which is bordered on the west coast of India by the state of Gujarat. Gujarat's Kutch and Kathiawar peninsulas are separated by the Gulf. Nearby, the Rukmavati River empties into the Arabian Sea, with the Gulf of Khambhat to the south and also the Great Rann of Kutch to the north. The Gulf of Mexico is around 99 miles long and 402 feet deep at its deepest point. The region is noted for its tremendous potential of tidal energy generation and its dramatic daily tides (Magotra *et al.,* 2020).

Marine Sanctuary and Marine National Park

The southern Gulf, from Okha to Navlakhi in Jamnagar district, has been designated as a Marine National Park & Sanctuary for help conserve the vulnerable ecology, especially the Gulf's living intertidal & subtidal coral reefs as well as mangrove habitats. Intertidal zones and a complex network of islands including coral reefs & mangrove forests make up the majority of the MNP & S. The maritime protected area includes the intertidal zones of Dwarka; Kalyanpur; Khambhalia, Lalpur, Jamnagar, and Jodia Talukas, as well as 42 Islands in the district (Nair *et al.,* 1993). The

Marine Sanctuary (MS) is 457.92 square kilometres in size, while the Marine National Park is 162.89 square kilometres. The MNP is located between 20° 15' N and 23° 40' N latitudes and 68°20' to 70°40' E longitudes along the southern coast of the Gulf of Kachchh in the Morbi, Jamnagar, and Devbhumi Dwarka districts. There have been 42 islands, 37 of which are part of a national park and the remaining 5 are part of a sanctuary area (Singh, 2003).

Present Status of Gulf of Kutch

Despite the promising resources of chanks & pearl oysters, he considered the potential of cultivating them to be uneconomical due to a lack of local experience (Subba Rao and Sastry, 2005). Because some taxonomy groups are currently under research or lack specialists, the current state of diversity of overall biota is not totally known. Gujarat's yearly marine fish landings are expected to be 5.32 lakh t in 2020, a considerable decrease (28.99 percent) from 2019. (7.49 lakh t). Pelagic resources accounted for 37% of overall marine fish catches, following with demersal 27 percentage, crustaceans 19 %, mollusks 11%, & miscellaneous 6%. Non penaeid shrimps (0.76 lakh t); ribbonfishes (0.72 lakh t); bombayduck (0.46 lakh t); cuttlefish (0.37 lakh t); croakers (0.31 lakh t); squids (0.23 lakh t); penaeid shrimps (0.22 lakh t); catfishes (0.22 lakh t); threadfin breams (0.19 lakh t); and rock cod.

Major fishing gears, their catch rates

Multiday trawlnets (33 percent) were the most important fishing gear in 2020, followed by mechanised purseseines (28 percent), mechanised dolnets (20 percent), and mechanised gillnets (20 percent) (8 percent). Though trawlnets supplied the most in quantity, automated purseseines had the largest catch per unit, at 1943.7kg/unit. Multiday trawlnets weighed 1149.8kg per unit, followed by mechanical dolnets weighing 378kg per unit. The catch rate of mechanised gillnets was 291.1kg/unit.

Table No. 1. Flora and Fauna Species Present in Gulf of Kutch

Flora	Fauna Species
Algae	108
Sponges	70
Corals (Hard & Soft)	72
Fishes	200+
Prawns	27
Crabs	30
Seagrasses	4
Sea turtles	3
Sea mammals	3
Molluscs	200+
Mammals	3
Water Birds	94
Bivalves	92
Gastropods	55
Birds	78

(Nair, 2002)

This region yielded 19 species in brachyuran crabs from 8 families & 15 genera, with four species each from the families Ocypodidae, Grapsidae, and Portunidae. The Xanthidae family produced three species, while the Pilumnidae, Gecarcinidae; Goneplacidae or Eriphiidae families each gave one species. The most common brachyuran crab species found were *Uca lactea annulipes; Parasesarma plictum; Scylla serrata* and *Cardisoma cranifex* (Trivedi *et al.,* 2012). The surveyed intertidal region of the GoK yielded a total of 108 mollusk species. In the GoK, there were 91 Gastropoda species, 14 Bivalvia species, 2 Cephalopoda species, and 1 Scaphopoda species. A total of 522 species have really been identified in the Gulf of Kachchh's various sections. *Pinna bicolor; Vasticardium flavum; Murex ternispina; Pollia undosa; Turbo bruneus; Onchidium verrucul; Paphia rotundata; Pinctada fucata; Angaria delphinus* and *Erronea onyx* were among the most abundant species discovered (Parmar, 2015).

Bird diversity : The MNPS is home to both resident & migratory bird species along the worldwide Indo-Pacific migratory route. Many birds, especially vulnerable species, rely on mangroves and other ecosystems for food and breeding (Kumar, 2012).

Corals : The Gulf of Kutch is home to a variety of coral formations, including bordering reefs, platform reefs, patch reefs, and coral pinnacles. However, there is disagreement over the figures. Pillai and Patel (1988) identified 37 hard coral species12; the Gujarat Environment and Education Research Foundation (GEER Foundation) lists 42 hard and 10 soft coral species 13; and the Gujarat State of Environment Report lists 44 hard and 12 soft coral species14. The reefs range in age from 5,240 years old at Salaya to around 45,000 years old at Okha. According to one research, the overall reef area with in Gulf dropped by 43% from 217 sq kilometres 1975 - 123 sq kilometres 1986, based on satellite data (Parasharya, 2012).

Seagrass : Six seagrass species occur in the MNPS, out of 14 kinds identified in India. Seagrass is a major food source for marine animals such as the endangered dugong (*Dugong dugon*) as well as the green sea turtle (*Chelonia mydas*) (Kamboj, 2014).

Mangroves : Mangroves is abundant inside the MNPS intertidal zones as well as provide habitat for a variety of animals. They also act as an erosion barrier. As a result, variations in mangrove cover could be linked to ecosystem health in a direct way. Besides corals, the Gulf of Kutch's mangroves are ecologically and economically significant. The mangrove cover in Jamnagar District is generally scrubby and patchy, covering 665.9 sq km. Mangrove species such like *Rhizophora, Ceriops*, and *Aegiceros*, which were once common in the area, are now uncommon, and also the species *Bruguiera* is extinct (Kumar *et al.,* 2017).

Threats and Pressures on Marine National park

Industrial Expansion and Marine National Park, Gujarat : Due to a rich store of ecological wealth, MNP's neighbouring areas in Jamnagar have become centres of industrial expansion and economic vitality in Gujarat. The unfettered development of industries & associated enterprises in the MNP area poses a serious danger to a fragile marine ecosystems and protected areas. Mangrove destruction, oil spills, toxic waste and reclamation are only a few of the challenges to MNP's ecosystems, which have gotten worse with the building of oil refineries closer towards the MNP in Jamnagar (Ramaswamy *et al.,* 2007).

Marine Pollution : Increased industrial development in the area of Jamnagar's Marine National Park has harmed the marine habitat since 1991. Petroleum & petrochemicals, fertilizers, cement,

thermal power plants, ports, ship breaking operations, and salt works are some of the development activities and industries that have an impact on the maritime ecology and environment. Chemical, cement, and fertiliser manufacturing companies, refined petroleum refineries, cargo vessel industries, salt factories, sub-sea oil pipelines, and other sectors threaten the MNP ecosystem's survival (Panseriya *et al.,* 2020).

Oil and Petrochemical Industries : Oil, petrochemicals, and related sectors pose the greatest danger to the Jamnagar MNP's ecosystem. At the moment, the coastal oil and refinery facilities include Indian Oil Corporation's crude oil station at Vadinar or the Salaya-Mathura pipeline, Reliance Petroleum and Essar Oil's grassroots level refineries at Moti Khavdi or Jam Khambhaliya, respectively, which are expected to process 39 million tonnes of crude oil per annum, Bharat Petroleum's planned Vadinar-Bina overland pipeline and Bharat-Oman Petroleum's All of these are being built in the Gulf's inner reaches.

Soda Ash and Salt Work : The spread of salt pans anywhere along shore is also another major cause of mangrove amount of destruction. The ample supply of limestone with common salt, both of which are involved in the production of soda ash or salt, has led to the construction of massive soda ash facilities along the coast at Mithapur, Gujarat. Salt plants in Jamnagar, for example, have been contributing towards the state's yearly salt production for the past 60 years or more. The Gujarat government gave leases to 27 salt businesses in Jamnagar, however several of the contracts were eventually withdrawn, leaving 21 salt industries operating in the intertidal zones.

Impact of Urbanisation and Urban/ Municipal Waste on the MNP : Jamnagar (37.44 percent) had the highest rate of urbanisation in 1981, compared to the state average of 31.1 percent. As indicated in Table 14, Jamnagar's urban share on population grew from 1991 to 2001 to 2011. The direct dumping of generated sewage, solid waste, and waste water in urban areas of Jamnagar district has put a lot of pressure mostly on marine ecosystem along its coast due to rising urban population (Maurya and Kumari, 2021).

Impact of Ports and Jetties : There is a 355-kilometer-long coastline along the former Jamnagar districts, with nine ports. Salaya, Jodiya, Pindara, and Bet Dwarka are minor ports, while Bedi, Okha, among Sikka are intermediate ports. Tanker spills and accidents, silt deposition on corals owing to deep sea dredging activities, and the killing of marine mammals such as dolphins, porpoises, and dugongs are all difficulties related to increasing port operations and maritime activity. The rapid construction of ports and harbours will exacerbate the issues that fishing communities are already experiencing, further confining their fishing grounds and reducing fish populations.

Conservation and Management of Gulf of Kutch

Mangrove reforestation : The Forest Department has been out forestry works in Jamnagar's inter-tidal mudflats for the past 17 years, covering an area of 149.83 sq km, with the majority (100.87 sq km) in MNPS areas95. This translates to 8.8 square kilometres of Avicennia planted per year. Because of its hyper-saline tolerance, Avicennia currently accounts for more than 99 percent of the entire mangrove cover in the state, whereas most of the other mangrove species which historically thrived there are now classified as 'threatened'. Reforestation is likely the MNPS officials' main work today 97, and they spend 41.4 percent of the total yearly budget on it. Attempts at afforestation might sometimes meet with deforestation efforts. The 'REMAG' mangrove restoration programme is an example of this. Between 2001 and 2006, the REMAG project was meant to reforest seven

villages, encompassing a maximum of 5000 ha of land at the a cost of Rs 10.13 crores. The Gujarat administration announced the construction of the Kalpsar dam in the middle of the afforestation effort, close to the end of 2003. It became obvious that 80% of the dammed regions would coincide with places where the REMAG project's mangrove regeneration was nearly halfway completed. As just a result, this project was forced to come to a halt (Saravanakumar *et al.,* 2007).

Coral translocation : As a precaution against the risk posed by Essar Oil's oil pipelines, a project for the relocation of corals inside the Gulf of Kutch were launched in 2005. The Essar-funded initiative entailed relocating approximately 20 coral species from construction areas to places within the MNPS (Kumar *et al.,* 2017).

Integrated coastal zone management : Gujarat has recently taken up World Bank financing for projects including integrated coastal zone management (ICZM). The World Bank announced a US$ 50 million loan to India in 1996 for environment management capacity development (EMCB). In 2004, this project was completed. An integrated coastal and marine area management plan (ICMAM) for the Gulf of Kutch was produced as part of the project.

In addition, US$ 1.05 million has been set aside for the establishment of a State Environmental Action Plan (SEAP) for Gujarat. In the 'Summary Action Matrices' section of the SEAP report, an unpublished draught copy reveals a strong pro-market bias: modernization of harbours; the emergence of a system of tradable quotas for marine fish; full-cost recovery commercialization of urban water supply and sewerage; retirement strategies for municipal cleaners (safai karmacharis); privatisation of solid waste management, and so on. Gujarat was the recipient of a US$ 70 million ICZM project in 2007, together with Orissa & West Bengal, to "test the practical application of coastal zone management strategy (Kamboj, 2014).

Conclusions

The coast is under enormous stress. Coastal urban agglomerations have sprung up in industrial hotspots along the Gulf of Kutch throughout the years, frequently in close proximity to areas designated as protected. PAs in the region, on the other hand, are already under a lot of strain The impact of the unfolding ecological disaster is felt most acutely by coastal communities, particularly impoverished, traditional groups who rely on natural resources for a living and are seeing their economic options dwindle. They are also more vulnerable to natural calamities such as cyclones as a result of the ecological crisis. The most vulnerable sectors of the region's economy, artisanal fishermen and women among artisanal fishing communities, are severely affected by the region's shifting economy. While individuals with access to finance can engage in multi-day, deep-sea fishing as well as other capital-intensive investments, traditional artisanal fishermen tend to be the hardest hurt, as their nearshore fishing areas bear the brunt of coastal pollution and deterioration.

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AN OVERVIEW OF CAGE CULTURE IN INLAND OPEN WATER BODIES

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Abstract
Cage is an enclosed body of water used to rear the organism that maintains the free exchange of water with the surrounding environment. Cages plays a major role in utilizing the inland open water bodies like reservoirs efficiently and effectively. Installing cages in inland water bodies can significantly increase the production and increase the economy of a country. Though there is a huge production gap between India and China, utilizing of the inland water bodies can sufficiently reduce this huge gap in the production between these two countries. Even though there are various constraints in implementation of cages in the inland open bodies as they are used for various purposes other than fisheries, they be overcome by appropriate policy measures and guidelines.

Key words : Cage culture, Scope, Site selection, Constraints

Introduction

Cage culture is a technology in which the fishes are raised from fry to fingerling, or fingerling to table size. The cages are generally enclosed on all sides by nets, except for leaving an opening at the top for feeding and handling the stock. They can be positioned at the bottom, middle or surface of the water column. Cage culture is suitable for wide range of open freshwater ecosystems, especially reservoirs. It efficiently utilizes water bodies, harnessing of their natural productivity and thereby reducing pressure on other resources. Reservoirs are an important water resource in Asia. Inland fisheries in the world account for about 9% of total fish production, and of these, Asia accounts for nearly 60% of world production. The prime objective of cage culture in inland open water is the stocking of reservoirs and culture of economically important fishes for augmenting fish production. Cage culture in inland open waters is being evaluated as an opportunity to use existing reservoirs and meet the increasing demand for animal protein in the country. Reservoirs in India offer substantial scope for implementation of technology for intensive cage farming to realize water productivity, entrepreneurship, and employment opportunities.

Evolution of cage culture in India:

In India, cage culture in inland open water bodies was initiated for the first time in air breathing fishes in swamps, subsequently, trials with major carps were conducted in cages installed in river Yamuna and Ganga at Allahabad. Similar attempts were made with common carp, silver carp, rohu, snakeheads and tilapia in a still water body of Karnataka. Thereafter the cages have been used for rearing fry in many reservoirs and floodplain wetlands to introduce advanced fingerlings for stocking main water bodies. India has 19,370 reservoirs spread over 15 states with an estimated 3.15 million hectares surface area at full capacity, and this is expected to increase due to the execution of various water projects in the country. The growth of cage farming in India got momentum during the year 2010-2012 with funding support from National Fisheries Development Board (NFDB), National

Mission on Protein Supplementation (NMPS), Rashtriya Krishi Vikas Yojna (RKVY), etc. This support paved a way for the dissemination and adoption of this technology in several reservoirs belonging Cage based aquaculture in the inland open waters of India. At present, there are about 15,000 floating cages of different dimensions and materials, such as bamboo, galvanized iron (GI), high-density polyethylene (HDPE) in inland open water resources of India. Then a National Level Committee was constituted on 25 April 2016 to Develop Guidelines for Cage Culture in Inland Open Waters (NCGCC) with a view for assessing the potential of cage culture system.

Scope and Potential of cage culture in inland open water bodies

Inland aquaculture contributes nearly 65%of the total fish production in country with the three Indian major carps viz., Catla (*Catla catla*), Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus mrigala*) constituting significantly 87% of the total production. India has 3.15 million hectaresofreservoirs and more than 5.0 lakh ha of floodplain wetlands (beel, jheels, mauns, pats, etc.) spread across the numerous river basins in the country. The present fish yield from reservoirs is low, despite their high production potential (500 kg/ha, 250 kg/ha and 100 kg/ha in small, medium, and large reservoirs respectively). Similar is thecase with floodplain wetlands, where the present yield has been estimated at 400-800 kg/ha, against the production potential of 1500-2500 kg/ ha. Thus, enclosure culture systems such as cages have a definite role to play in augmenting fish production from inland open waters in India especially the reservoirs and flood plain lakes.

Fish species suitable for cage culture in inland open water bodies

In Indian freshwaters, the fish species raised in cages are essentially cyprinids, comprising of the groups like Indian major carps (*Catlacatla, Labeorohita* and *Cirrhinus mrigala*), exotic common carp (*Cyprius carpio*) and silver carp (*Hypopthalmichthys molitrix*), Catfishes of the families Bagridae (*Mystus seenghala*), Siluridae (*Ompok bimaculatus*), Anabantidae (*Anabas testudineus*) and Heteropneustidae (*Heteropneustes fossilis*) have also given encouraging results when cultured in cages, especially the last 3 air breathing fish species. Cage culture of Murrels like *Channa punctatus*, and *C. striatus*, has also been occasionally tried. Now economically viable cage culture is practiced in inland water bodies of India by growing the exotic pangasius Catfish (*Pangasiodon hypophthalmus*).

Use of GIS in selection of suitable site for cage culture in reservoir

In open water cage culture, GIS can be used for spatial planning, zoning, site selection and estimation of carrying capacity. As the inland water bodies are subjected to habitat degradation, they require due emphasis on protection of habitat to sustain fishery and biodiversity. Seasonal abundance of juveniles and spawners from a habitat area can be used as a base to ascertain the critical nature of that zone. The fishing activity may be restrained from such areas in a season as a management measure or can be declared as protected areas/ sanctuaries. There is a need to arrange fisheries data on GIS platform and develop regional maps and models for effective implementation of the technologies and sustain-able management. The ICAR-CIFRI has attempted to map the potential fishery zones in reservoirs of Tamil Nadu using GIS. The study indicated aggregation of fishes near the ecotones where lotic meets the lentic environment.

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Comparison of economic of culture with and without cage

S. no.	Particulars	Pond with cage	Pond without cage
A.	Seed cost	Carp – Rs 100/- *C. puntata* – Rs 450 /- Total seed cost = Rs. 550/-	Carp – Rs 100 /-
B.	Feed utilized	Chicken waste (Intestine) (@2% of body weight), 32.8 kg	D_1 (@ 1% body weight), 274 kg
C.	Feed cost	Rs. 1312/- [@ Rs. 40/- per kg of feed]	Rs. 5480.00 [(@ Rs. 20/- per kg of feed]
D.	Total biomass	Carp = 188 kg *C. punctata* = 12 Kg	Carp = 165 kg
E.	Total income	Carp = Rs. 18,800/- (Rs. 100 / kg) *C. punctata* = Rs. 3,000/- (Rs 250 /kg) Total = Rs. 21,800/-	Carp = Rs. 16,500/- (Rs. 100/ kg)
F.	Total expenditure (with respect to seed/ feed) (A+C)	Total cost = 1830	Total cost = Rs 5580/-
G.	Net income = (Total income – expenditure incurred) (E-F)	= Rs 19,970/-	= Rs 10,920/-
H.	% of additional net income can be received in comparison to pond without cage	=19970-10920/10920 *100=82.87%	
I.	% of income in comparison to pond without cage	=(21800-16500)/16500 X 100= 32.12 %	

Figure 1.Cost comparison table with and without Cage

The above picture shoes the comparison of pond with and without cage culture. This shows that there is 32.21% more income when compared to a pond without cage. In addition to the income the expenditure cost is also less when compared to pond without cage.

Method to reduce water quality problem

In order to reduce the effect of water-quality deterioration from cage culture, aquaculture scientists in china have established some standards regarding carrying capacity for cage culture. Newly designed cages, which increase feed utilization and decrease nutrient loading, are also used in reservoirs e.g., Geheyan, Hubei province. In this case of two-layered cage culture, four relatively smaller and shallower inner cages are installed in a larger and deeper outer cage, and across sidewalk made of steel is installed in the center of the outer cage. Plants are also reared inside the cages in order to absorb the nutrient produced from cage culture. Around the edge of the outer cage, the cement sidewalks are built on cement floats, replacing the traditional floating equipment. The floats are connected by using seamless welding steel, and there is a 50 cm gap between adjacent floats to permit water flow. The cages are made of polyethylene.

Cage culture as a step towards blue revolution in India

The Government of India has targeted to increase the present fish production by threefold and thereby implemented various schemes such as the fish brood bank, aquaculture intensification in ponds and tanks, reservoir fisheries development, cage and pen culture, infrastructure for post-harvest, modern fish markets and a disease surveillance program through the National Fisheries Development Board. However, of these, cage culture has been identified as the most promising tool to meet the increasing demand for fish production. The National Fisheries Development Board plans to install 300 cages in inland water bodies with an anticipated fish production of 5 tons /cage. After

the installation of all the cages, the annual fish production would be alike 1,500 tons from these NFDB cages alone.

Constraints for cage culture in inland open water bodies

Cages occupy space on the surface of water bodies and, if poorly positioned, may disrupt navigation or diminish the scenic value of there servoir. Cage culture can adversely impact the interests of local fishers by denying access to fishing grounds, obstructing their pathways, and a decline in fish catch if cage culture affects the natural productivity of the waterbody. As most of the inland open water bodies are used for human purposes such as drinking and other day to day activities, Inappropriately or poorly managed cage culture may pollute the environment with unconsumed feed and fish fecal waste, causing eutrophication. There are problems with allocation of rights in what are often publicly owned and used waterbodies. All wastes are released untreated into the environment, potentially affecting not only the farmers themselves, but also other resource users. Cage culture can adversely impact the interests of local fishers by denying access to fishing grounds, obstructing their pathways, and a decline in fish catch if cage culture affects the natural productivity of the waterbody. There is no general policy to utilize the public water bodies for aquaculture and also the coastal area around us.

Conclusion

Implementation of cage culture techniques in inland water bodies, results in utilizing the natural resources directly and in directly. It also creates employment opportunities for rural labourers and contribute to poverty alleviation in some inland areas. If they are properly managed and used, they can conserve the natural fish resources in inland open water bodies and also increase the total fishery output. This paves the way for increasing the fish production and economy of our country. Though our country ranks second in terms of inland fish production, there is a wide gap in terms of production as compared tochina. If we utilize our inland fishery resources efficiently through cage culture techniques, they can increase the production and economy of our country.

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Present status and future scope for fish production in cages and enclosures in India P. S. B. R. James', A. G. Jhingran' And K. Madhusudhana Rao'.

Reservoir Fisheries: Broad Strategies for Enhancing YieldsSena S. De Silva*

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Status, Prospects, Threats, and the Way Forward for Sustainable Management and Enhancement of the Tropical Indian Reservoir Fisheries: An Overview U. K. Sarkar, K. M. Sandhya, P. Mishal, G. Karnatak, Lianthuamluaia, S.Kumari, P. Panikkar, R. Palaniswamy, M. Karthikeyan, S. Sibina Mol, T. Paul,V. L. Ramya, D. S. K. Rao, M. Feroz Khan, D. Panda & B. K. Das.

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RESERVOIR FISHERIES OF INDIA AND THEIR MANAGEMENT

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Abstract
Reservoirs dubbed 'natural or manmade lake' have just recently been found as a plausible alternative source of fish production. However, the average fish production of Indian reservoirs is roughly 20 kg/ha, which is insufficient to meet the ever-increasing population demands. Small reservoir production is on the rise. The key to enhancing production of freshwater fish in India is to priorities culture-based reservoir fisheries. Small, medium, and large reservoirs are expected to supply fish at rates of 49.50 kg/ha, 12.30 kg/ha, and 11.43 kg/ha, respectively. As a result, the study analyses the various reservoir augmentation options used in India. The research focuses on increasing fish output through changing the biological and physical foundations of production, as well as other ways for increasing fishing in reservoirs.

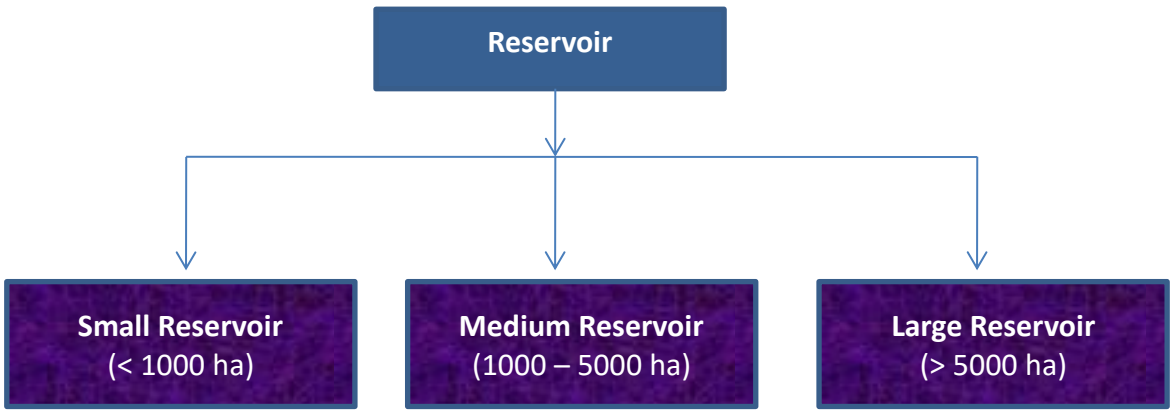
Keywords : Reservoirs, Productivity; Current status; Distribution; Management.

Introduction

Reservoirs, often known as "man-made lakes," occupy > 1% of the country's total land area and were built largely for irrigated agriculture, electricity generating, as well as other water management purposes. Reservoirs are man-made places formed by placing any type of reservoir on a rivers or other waterway to restrict surface flow. Reservoir fishing is primarily a stocking and catch-and-release strategy. Because of their strong biogenic production capacity, they are one of the most precious assets for the nation's inland fisheries and aquaculture development. Reservoir fisheries development is considered to have the potential to provide extra economic output and provide jobs for fishermen and workers in auxiliary businesses (Srivastava and Reddy,1983).

Classification of Reservoirs

According to (Ayyappan *et al*., 2011) reservoirs are divided into three categories based on the amount of water they hold: large, medium, and small.



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Status of Reservoirs in India

India has 19,370 reservoirs scattered across 15 states with a total surface area of 3.15 million hectares (Ayyappan *et al*., 2011). Tamil Nadu has by far the most small reservoirs, both in terms of area and number. Madhya Pradesh is the largest state in terms of total area and medium reservoir area, whereas Andhra Pradesh has the most medium reservoirs. The state of Karnataka has the most huge reservoirs. The Hirakund Dam is the largest reservoir in the nation (Sugunan and Yadava, 1991). Classification of reservoir based on water spread area shown in following Table 1 and comparison between small, medium and large reservoir and major reservoir in India shown in Table 2 & 3 respectively.

Table1 Classification of reservoir based on water spread area

Types of Reservoir	Small	Medium	Large
Area (ha)	< 1000 ha	1000 – 5000	> 5000
Numbers	19134	180	56
Area (ha)	1,485,557	527,541	1,140,268

Table 2 Comparison of small medium & large reservoir based on number and area

State	Small Reservoir		Medium Reservoir		Large Reservoir	
	No.	Area (ha)	No.	Area(ha)	No.	Area(ha)
Tamil Nadu	8895	315,941	-	-	-	-
Madhya Pradesh	-	-	21	169,502	-	-
Andhra Pradesh	-	-	32	66,429	-	-
Karnataka	-	-	-	-	12	179,556

Table 3. Major Reservoirs in India

S.N.	State	Major Reservoir	River on which
1.	Tamil Nadu	Stanley(mettur) Bhabni-sagar Amaravathy	Cauvery Bhabani Amaravathy
2.	Kerala	Idukki Periyar barrage	Periyar Periyar
3.	Karnataka	Tungabhadra Krishnarajasagar	Tungabhadra Cauvery
4.	Andhra pradesh	Nagarjuna sagar Hussain sagar	Krishna Musi
5.	Maharashtra	Dhom Bhatghar	Krishna Yelwandi
6.	Madhya Pradesh	Gandhi sagar Ravishankar sagar	Chambal Mahandi
7.	Odisha	Hirakud Rangoli	Mahanadi Brahmani
8.	Gujarat	Ukai (vallabhasagar)	Tapti
9.	Rajasthan	Ranapratap sagar	Chambal
10.	Himachal Pradesh	Gobind sagar	Sutlej

Fish Production Potential from Reservoirs

The mean production of fish potential (Table 4) of reservoirs was calculated to be 250 kg/ha. The country's average reservoir production is 20 kg ha-1 (Ayyappan *et al*., 2011). The fish yield from Indian reservoirs has been determined to be quite low, ranging around 0.05 kg/ha in Bihar to 35.5 kg/ha in state of Himanchal Pradesh. Favouring culture-based dam fisheries provides the key to boosting India's inland fish production.

Table 4. Yield of reservoir in India

Category	Yield (kg ha^{-1})	Area (ha)	Present Production (t)	Potential Production (t)
Small	49.90	1485557	74129	148556
Medium	12.30	527541	6488	39565
Large	11.43	1140268	13033	57013
	Total :	3,153,366	93,650	245,134

Reservoir Productivity

Factors Effecting Reservoir Productivity

Morphometric factors

The morphological of a reservoir is determined by the depth of the dam and the terrain of the surrounding area. The depth of the tanks determines the reservoir capacity. Because heat and nutrients are mixed better in a shallow lake, it has a higher production (euphotic zone). Because nutrition sinks at the bottom of the reservoir, where organic material accumulated and is unavailable in the photosynthetic zone, a longer reservoir offers lower productivity (Henderson & Welcomme, 1974).

Edaphic factors

The bulk of reservoirs in India have very low productivity, which has an impact on water quality. The alkaline is a little less than 40 mg/l and the pH is much less than 6.0. The pH of the soil is less than 6.5, the accessible nitrogen is even less than 3.0mg/100g, the availability nitrogen is below 25mg/100g, and the organic matter content is less than 0.5 percent. One of the main parameters that regulate the productivity of water bodies is soil pH. A weak productivity reservoir has a pH of less than 6, a medium productivity reservoir has a pH of 6.5-7.5, and a high production reservoir has a pH of more than 7.5 (Ayyappan *et al*., 2011).

Table 6. Fish Species Affected by Dam Construction in India

River basin	Affected species
Indus	*Freshwater prawns, Labeo dero, L. dyocheilus, Mahseers, snow trouts*
Mahanadi	*Tenualosa ilisha, Puntius sarana, Tor tor, T. mosal, Labeo fimbriatus, L. calbasu, Rhinomugil corsula, freshwater prawns*
Cauvery	*Puntius dubius, P. carnaticus, Cirrhinus cirrhosa, C. reba, Labeo kontius, L. fimbriatus,* freshwater prawns
Krishna	*Tenualosa ilisha, Puntius sarana, P. kolus, P. porcellus, P. potail, L. pangusia, L. fimbriatus, L. calbasu, freshwater prawns*

Source : V. V. Sugunan CIFRI,2000

Management of reservoir fisheries

Environment management

The quick speed of industrialization, inadequate environmental management in the catchment, and a range of other issues have all contributed to reservoir deterioration (Sugunan, 1997). Aside from industrial waste, municipal waste from chemical industries, textile factories, heavy engineering facilities, pulp and paper industries, iron and steel industries, and rayon mills is frequently dumped into reservoirs, posing a threat. Stocking; conservation of aquatic habitats, including breeding and spawning housing, and feeding grounds; fishing equipment like gear and effort limitation; mesh rules; closed season; exotic fish regulations are only a few of the stages involved (Anon. 1997).

Stocking

It is critical to stock species that have the potential to breed and become naturalized inside the systems via auto stocking. During this phase, heavy stocking with fast-growing fish on a shorter food supply chain is required, as is the reproductive grounds protection (Lorenzen, 1995). A fishery based on herbivores with the shortened food supply chain is advantageous because they convert primary output more efficiently to fish flesh (Anon. 1998).

Craft and Gear

Coracle is a most common fishing gear used in reservoir. In Gandhisagar reservoir the most popular fishing vessel is a wooden, flat-bottomed canoe that is 2 to 3 meters long. Reservoir fishing does not use mechanized boats to any significant level. The existence of underwater barriers limits use of active fishing gear in reservoirs, leaving passively gear such as simple gill nets as the only option (George, 2002).

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ROLE OF FISHERWOMEN IN FISHERIES SECTOR, COASTAL AREA OF VERAVAL, GUJRAT

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Abstract
This article reports on the results of survey among fisherwomen in Coastal are of veraval gujarat. Their work, earnings and role in decision making by giving different weight age to individual activities. Major women are work in fish processing plant in processing sector like pre processing work dressing, peeling and grading etc. The female fish vendor, despite her vital role in the fishing industry, not only faces various kinds of problems at each stage in her profession, but also has to hold on to the means of livelihood under constant threat of competition from sophisticated sales outlets such as refrigerated booths. The contributions of the fisherwomen penetrate every aspect of post- harvest handling, preservation, processing and marketing of seafood products.

Keywords : Women, Fish vendor, Marketing

Introduction

The fisheries sector occupies a very important place in the socio-economic development of India. Fishing in India in its coastal states, employing over 14million people. The sector has been recognized as a powerful income and employment generator for mural fisher folk. It is good source of cheap and nutritious food. It is instrument for livelihood of large section of economically backward population of the country. Training in better preservation methods improving the hygienic quality of products Improvements to the traditional technology of fish processing Net mending & Preparation, Drying and Marketing.

Role of women in Fish processing industry

Women's role in small scale fisheries major role in seafood processing industry resource management and decision making Women's involvement in fisheries seem to be similar all the world over In the world. importance of women participation in small scale fishery and Improvement in fish handling practices and equipment. Women and young ladies are involve in Grading and sorting of shellfish and finfish. Peeling and cleaning of shellfish and finfish. Weighing of fish and shrimp. Arrangement of fish and shrimp in . And also in Freezing.

Fig. 1. Women in fish marketing and processing industry

Role of women in fish preservation

Value added products is prepared by women at home and in small – scale industries Preparation of value added product like fish / prawn pickle, fish cutlet, fish balls, fish papad , masala dried fish recognizing the important role that women play in guaranteeing household food security and well-being. Developing marketing by providing further support in different areas such as improving women's access to markets and storage of fish. Women are the tradition folk who maintain our traditional methods for the preservation of fish and food. Providing appropriate training, designed to target women in fisheries. It's important to ensure that training is accessible to women so that they can improve their productivity and the quality of their products.

Women in fish marketing and trading

Home to home sale, Licensed market, Unlicensed market / hawking, Auctioning in landing center ,Road side sale. Coastal fishing households include a large but unknown number of women who are engaged in fisheries activities using small capital commitments and simple technology (such as hand lines and canoes) to harvest and catch marine resources Fitriana, R., & Stacey, N. (2012).

Fig. 2 : Transportation

Problem for women in fisheries sector

Social problems and family problems. Illiteracy and lack of technology knowledge specially in women who engaged in marketing activity. Somewhat low income generation and employment generation.

Some improvement required in sector

- Training in the setting up of cooperatives
- building of a sound infrastructure
- provision of financial assistance
- improved organization of raw material supplies
- development of appropriate technology for proper marketing and preservation
- Improve moral value and support

Fig. 3 : Fish vendor

Conclusion

It is important to accelerate the development initiatives for women in fisheries. To achieve gender equity, changes have to be brought in several levels in fisheries and allied activities. The government and its development partners need to re-orient their programs and implement for women effectively. The emergence of modern fish processing industries provided a new avenue of employment to innumerable women. Aquaculture as an industry is of very recent origin and is yet to involve women in any significant manner.

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CROP RESIDUE BURNING (CRB) IN NORTHERN INDIA: POSSIBLE ALTERNATIVE SOLUTION

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The open field burning of rice stubble is a common practice in many states. Recently burning has caused serious air pollution problems in Northern India including NCR region, which results in calls for participation from stakeholders to deal with environmental issue. The air pollutants from rice stubble burning are primarily CO_2, CO, PM_{10}, $PM_{2.5}$ etc. To address this problem certain technologies like Pusa decomposer, baler, happy seeder, incorporating crop residue in soil, use as soil mulch, use media for mushroom cultivation etc. are options to avoid burning. Instead of these options many farmers still practicing stubble burning. Hence question arises why farmers burn rice straw and which Crop Residue Management (CRM) are the most effective for farmers and society at large.

Some of the Crop Residue Management (CRM) practices are as follows:

Pusa Decomposer : Pusa decomposer developed by Indian Agricultural Research Institute (IARI) available both in capsule and liquid form for speedy decomposition of crop stubbles. Four capsules should be mixed with 25 lt. of liquid formulation and should be kept for 10-12 days after adding jaggey and chickpea flour. This 25 lt. liquid preparation is mixed with 500 lt. water and sprinkled on paddy straw over one hectare land (or 10 lit. per acre). It quickens the process. It fastens the process of rice straw decomposition and ultimately converted into manure. It increases fertility status of soil, accumulates soil organic carbon content in the field. It is good for raising wheat, pea and potato sowing within 20-25 days after Conventional Tillage (CT) operations. This technology (Pusa decomposer) is a long term sustainable solution for paddy straw management in conjunction with Conventional Tilling (CT) method. In conservation tillage the general practice is followed for in-situ decomposition is spraying Pusa decomposer followed by rotavator operation for adequate mixing of residue in soil and then a light irrigation to ensure moisture in field. This practice is already proved to be good and cost effective. It costs only Rs. 300 per acre while cost of other operations being the same. The additional advantage of this method is soil health improvement and increase crop yield. So most of the farmers who already used this method is found it is to be viable and ecofriendly option which ensures soil enzyme activities, microbial biomass carbon ©,organic carbon and nitrogen at a higher trend as compared to sample where pusa decomposer not applied. So Pusa decomposer is a very good sustainable solution aggregation with mechanical intervention to address problem of rice stubble burning.

Happy seeder : A Happy Seeder is an agricultural equipment having features of no-till planter, towed behind a tractor that can dig rows directly for sowing without any prior seedbed preparation. It is operated with the PTO (Power Take off) of the tractor and is connected to it with three-point linkage. It consists of a straw managing chopper and a zero drill that makes it possible to sow new crop in the residue of the previous crop**.**

It is one of the most profitable and scalable residue management practice and proved to be 15 to 20% more profitable than residue burning option. This option has the largest potential to reduce the pollution footprint of on-farm activities. It reduces air pollution due to agricultural activities and would reduce greenhouse gas (GHG) emissions per hectare by more than 78%, as compared to other burning options. It can manage rice residue up to the potential of generating 6,000-11,500 Indian rupees more profits per hectare for the average farmer.

Each year approximately 23 Million Tonnes (MT) of rice straw used to burn in states of Punjab, Haryana and Western Uttar Pradesh which is contributing significantly towards air pollution. In Delhi-NCR (National Capital Region) more than half of the air pollution during winter attributed from agricultural fires where air quality level is 20 times more polluted than safe threshold level as defined by World Health Organizations (WHO). Residue burning has impacts on human health, soil health and economy and climate change.

Baler : A baler is a type of farm implement which used to compress a cut and collected crop (such as hay, cotton, flax straw, salt marsh hay, or silage) into compact bales which is easy to handle, transport, and store. Bales are configured to dry and preserve some intrinsic (e.g. the nutritional) value of the plants bundled. Different types of balers are in use. Each type of baler is forming different type of bale – rectangular or cylindrical, bound with twine, strapping, netting, or wire. This implement has reduced a lot of residue burning interventions.

Incorporating crop stubble as soil mulching material: Crop residues are materials left on cultivated land after the crop has been harvested. Accumulation of crop residues after harvesting is considered to be an effective anti-erosion and fertile measure. Crop residue helps to improve soil structure, enhances soil organic matter content, reduce evaporation, and help to fix CO_2 in the soil. Good residue management practices on agricultural lands have many positive impacts on soil quality. Crop residues can be used in biofuel production. Information on residue cover guides polices for promoting beneficial management practices and helps the estimation of soil carbon.

Use of crop straw as industrial raw material : Paddy straw is a major field-based residue that is produced in large amounts in Asia. In fact the total amount equaling 668 t could produce theoretically 187 gallons of bioethanol if the technology were available (Kim and Dale 2004). However, an increasing proportion of this paddy straw undergoes field burning. This waste of energy seems inapt, given the high fuel prices and the great demand for reducing greenhouse gas emissions as well as air pollution.

Because climate change is widely recognised as a threat to development, there is a growing interest in alternate energy applications for field-based residues.

Straw and husk are the two types of rice remnants that offer the most energy potential. Although rice husk technology is well established in many Asian nations, paddy straw is still infrequently employed as a renewable energy source. One of the main reasons for the widespread use of husk

is its accessibility, as it is readily available at rice mills. Paddy straw, on the other hand, is a time-consuming chore to collect and is only available after harvest.

Utilization of agricultural crop residue for mushroom cultivation : Mushroom cultivation is termed as an agricultural waste clean-up and economic crop for farmers. Agricultural wastes are the good source for mushroom cultivation. In India, Bano and Srivastava [14], cultivated the edible mushrooms first using paddy straw as substrate. Subsequently, several researchers showed that mushrooms could be cultivated from a wide variety of lignocellulosic residues of crops such as paddy, wheat, maize, cotton, sugarcane, pulses, oilseeds, other cereals, banana and coconut waste etc. Almost all type of crops waste has been tried for mushroom cultivation and only few of them found to be suitable for commercial mushroom varieties (Table 1). The abundant availability of cereals waste (straw) gained more importance in mushroom cultivation. In addition, cereals straw could be used alone or in combination of with other residues in order to enrich the nutrients required for mushroom growth. Studies have reported that the supplementation of substrates would increase the yield compared to single substrate. This is because these supplements favour quick mycelial impregnation of substrate as well as an earlier primordial initiation with good number of fruiting bodies.

Table 1: Different crop residues used for commercial mushroom cultivation

Commercial mushroom species	Different crop residues	Mushrooms
Pleurotus species (Oyster mushroom)	Banana leaves, Cinnamon leaves, Coconut fiber pith and coir, Coconut husks, Coffee pulp, Corn fiber, Cottonseed hulls, Groundnut shells, Maize straw, Soybean stems & husk, Sunflower stipes, Wheat straw, Paddy straw, Bajara leaves, Jowar leaves, Sugar cane bagasse, Saw dust etc.	
Volvariella species (Paddy straw mushroom)	Barley straw, Coconut coir, Fibre & husks, Cotton wastes, Wheat straw, Paddy straw, Oil palm fibre, Sawdust, Banana leaves, Rice husk etc.	
Calocybe Species (Milky mushroom)	Rice straw, Wheat bran, Sawdust, Coir pith, Paddy straw, Maize stalk, Sunflower stalk, Sesame stalk, Sugarcane bagasse, Cotton waste etc.	

Commercial mushroom species	Different crop residues	Mushrooms
Agaricus Species (Button mushroom)	Paddy straw, Wheat straw, Sawdust, Coir pith, Maize stalk, Banana leaves, Sugarcane bagasse; Groundnut shells, Coconut coir etc.	

(Kyon and Kim, 2004)

Undoubtedly, the lack of proper management of abundant crop residue has an adverse influence on the environment and human health not only in India but also in the world. Agricultural field burning has created many environmental problems, particularly causing a threat to the soil fertility and the emission of toxic gases such as CO_2, CO, SO_2, $PM_{2.5}$ and PM_{10}. Consequently, a variety of alternative approaches should be considered as substitutes for open field burning, e.g., in situ incorporation, mulching, composting, Happy Seeder machines, and bioenergy use. In conclusion this article provides an overall understanding of various options of Crop Residue Management (CRM) which are widely employed, could not only reduce the environmental impacts of crop residue management, but generate additional value for the agricultural sector globally.

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AN OVERVIEW OF INTELLIGENT PACKAGING SYSTEMS: INNOVATIVE TECHNOLOGY FOR THE FOOD INDUSTRY

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Abstract

Packaging innovation is the most recent trend in food science. Packing techniques must be durable and efficient. This necessitates system validation to ensure that the information being given is accurate and that consumers are not disappointed when they choose new technologies over old ones. Food producers, retailers, and consumers must all be in tune with intelligent system on a wide scale. Attitudes must be open to new technology and individuals participating in each step of the food chain must be confident that the new system is safe and reliable for the end consumer. There is a good attitude toward active and intelligent packaging, and there is still a lot of room for interesting innovation. The following are some concepts for active or intelligent packaging that are currently being developed.

Introduction

Intelligent packaging technologies are commonly utilized to inspect specific features of a food product and provide information to the consumer. The intelligent system's goal could be to increase a product's quality. Intelligent packaging can monitor the outside of the package's qualities or accurately determine the quality of the food items within. Direct contact betwixt the food product and the quality marker is required to measure product quality within the package. Finally, an intelligent system should assist the consumer in making decisions by extending shelf life, improving safety, improving quality, providing information and warning of potential concerns. Intelligent packaging is an excellent tool for tracking probable food supply chain abuse. Intelligent packaging may potentially be able to detect tampering and alert the consumer. Labels or seals should be transparent until a package is opened. The label or seal on the packaging will change colour permanently and may even spell out "opened" or "stop" if tampered with. Perhaps intelligent packaging will be able to alert a customer to an occurrence such as package tampering which could save their life.

Intelligent Packaging: Time-Temperature Indicators (TTIs)

The time-temperature indication is an innovative packaging design that opens the way for packaging technology. The TTI is useful because it can inform consumers when foods have been exposed to extreme temperatures. When food is exposed to a temperature higher than that suggested, the meal quality can quickly decline. A TTI can be used as a small self-adhesive label on shipping containers or individual goods, and when the TTI is subjected to abusive conditions, it will undergo an irreversible alteration, such as a colour change. TTIs are especially beneficial with chilled or frozen meals because food quality and safety depend on cold storage during transportation and distribution. TTIs are often used to estimate the shelf life of perishable products as freshness indicators. Nestle is now using a TTI technology known as Time strip in its foodservice goods in the United Kingdom.

Intelligent Packaging: Gas Indicators

Food is difficult to package since it can breathe and modify its environment while inside a container. The interaction of food with its environment can readily affect the contents of a package. The change in the indicator's color due to a chemical or enzymatic reaction. Gas indicators are a helpful tool for monitoring the composition of gases inside a package. The indicators must directly touch the gaseous environment surrounding the packaged food. Indicators can alert you if there is a gas leak in the container, or they can be used to test the efficiency of an oxygen scavenger. The presence or absence of oxygen and carbon dioxide is often indicated using gas indicators. Oxygen in the air can promote oxidative rancidity in foods and undesired color changes and the growth of aerobic bacteria on them. When oxygen is present, oxygen indicators often change colour. Oxygen indicators can also signal a package's faulty sealing. Water vapour, ethanol, and hydrogen sulphide gas indicators are also developed.

Intelligent Packaging: Thermochromic Inks

There are temperature-sensitive inks on the market that can change colour depending on the temperature. Thermochromic inks can indicate whether an item is too hot to handle or too cold to drink. Thermochromic inks are used in the beverage industry. Because the inks used can be damaged by UV light and temperatures above 121°C, customers should not rely solely on the message of the inks when selecting whether to consume a meal.

Microwave Doneness Indicators

Producers of microwave oven-able foods are anxiously anticipating microwave doneness indicators (MDIs). These indicators would identify the readiness of microwave-heated foods and alert consumers when they are safe to eat. The capacity to evenly heat meals in the microwave so that there is a defined stage at which a product can be termed safe to consume is currently the main problem in this field. Foods now heat unevenly, resulting in hot areas across the dish. These hotspots would trigger a doneness indicator. At the same time, temperatures in cooler locations would not have been suitable for cooking. An ideal MDI would be placed on the lid or dome ofthe microwave container so that the consumer's visual indicator for doneness could be seen readily. This might work because when food is heated in the microwave, the space above it heats up and transfers to the cover. The indicator system would be based on link between temperature of the meal and the temperature of the lid. The indicator must not produce a false reading because the device warms up in the microwave. The consumer must be able to see the indicator without opening the microwave. MDIs are not yet commercially available, but their arrival is eagerly awaited.

Radio Frequency Identification (RFID)

Radio frequency identification(RFID) tags are expected to be included in food packages of the future. RFID tags are sophisticated data carriers that can identify and track a product. They are now utilized to track high-value objects and animals. A reader conveys out a radio signal to read data from an RFID tag in a typical setup. The RFID tag has the potential to provide much more than a traditional bar code. RFID unlike bar codes does not require a direct line of sight to be identified by a scanner. This has the best way people check out at grocery stores. Many RFID tags can be scanned simultaneously and at a high pace. RFID tags might also record temperature and relative humidity data, nutritional information, and cooking directions. They might be combined with a timer or a biosensor to convey time and temperature information and microbiological data. The RFID

technology in the food system is still in its infancy. Most food science problems revolve around simple applications such as tracking and identification, which must be perfected before more complicated uses emerge.

Conclusion

Intelligent systems are a unique packaging field that provides new prospects for food safety, quality, and convenience. In the United States, several active and intelligent packaging designs are commercially accessible. According to some experts, the next generation ofpackaging technology will contain nanotechnologies that will allow new chemicals such as novel antimicrobials and gas scavengers to be put in packaging films. The evolution of low-cost electronic gadgets will also push the innovative direction of active and intelligent packaging. Consumer expectations will continue to rise as society progresses. As additional technologies enter the market, the usage of active and intelligent packaging will certainly grow in popularity. Innovative packaging in active and intelligent systems will become more commonplace. Perhaps intelligent packaging will eventually supplant traditional packaging.

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LACTIC ACID BACTERIA AND ITS ROLE IN TRADITIONAL INDIAN FERMENTED FOODS

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Abstract
Lactic acid bacteria are the group of heterogenous gram positive bacteria, that helps mainly in fermentation process. Fermentation is the most important technology in the food industry. Many microbes are involved in this process. The main objective of this article is to focus on the indigenous fermented foods that are explored and unexplored for LAB. Since LAB isolated from fermented foods are becoming globally important for the use as human probiotics, new isolates may pave a way for intense research in the medical application.

Keywords : Bacteria, Dhal, Idli ,Fermentation, Lactic Acid .

Introduction

Fermented foods now a days are becoming an important part of our human diet. It could be made ready either in household or in industries using specific techniques. Fermentation was evolved as a preservation or prevention technique and during lean periods to counter spoilage of food products. It is one of the oldest and most economical methods for producing and preserving foods. Famous Traditional Asian fermented foods consist of a variety of products obtained from cereals (Idli, soy sauce, kishk), vegetables (sauerkraut, pickles, Suan-tsai), milk (yogurt, koumiss, ripened cheeses) and meat (Chinese style sausage). Lactic acid bacteria (LAB) perform an essential role in the preservation and production of wholesome fermented foods. By producing organic acids, they acidify raw material, mainly by lactic acid. Traditional uses of many LAB as fermentation agents for foods are considered to be safe for the general population.

Lactic acid bacterial genera consist of Lactobacillus, Lactococcus, Enterococcus, Streptococcus, Pediococcus, Leuconostoc, Weisiella, etc.. This article explores about the Lactic acid bacteria and their wide varied applications in various categories of Indian Fermented Foods.

Lactic acid bacteria and its metabolism

Lactic acid bacteria (LAB) include a large number of bacterial genera among which the best known are lactobacilli, lactococci, enterococci, streptococci, leuconostoc, and pediococci. At present, it is very difficult to establish a clear demarcation line between beneficial and virulent species, being some problematic traits more linked to strain than to species. However, Lactobacilli and Lactococci are considered GRAS (generally regarded as safe). Commensal LAB living in both gut and other mucosal ecological niches, although fed with abundant nutrients, still have a stressful life and often are compelled to cope with antagonistic host factors as well as with yeast or bacteria sharing the same habitat. These harsh conditions allowed the evolution of interesting metabolic and cross talk features.

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Sugar fermentations

In these bacterial genera, two categories of fermentations are happening namely Homolactic fermentation and the other one is Heterolactic fermentation. In Homolactic fermentation various obligate homolactic LAB like *Pediococci, Lactococci, Streptococci,* and some *Lactobacilli* produces 100 percent lactic acid through EMP pathway. Some Heterolactic fermenters such as *Leuconostoc*, *Oenococcus,* and some *Lactobacillus* species lacks the glycolytic enzyme fructose - 1,6 bisphosphate aldolase due to which hexose sugar metabolism through EMP pathway is not possible. Hence, they follow an alternate pathway called pentose phosphate pathway to produce lactic acid. The Fig.1 describes the metabolism of sugars in a Lactic Acid Bacteria (LAB).

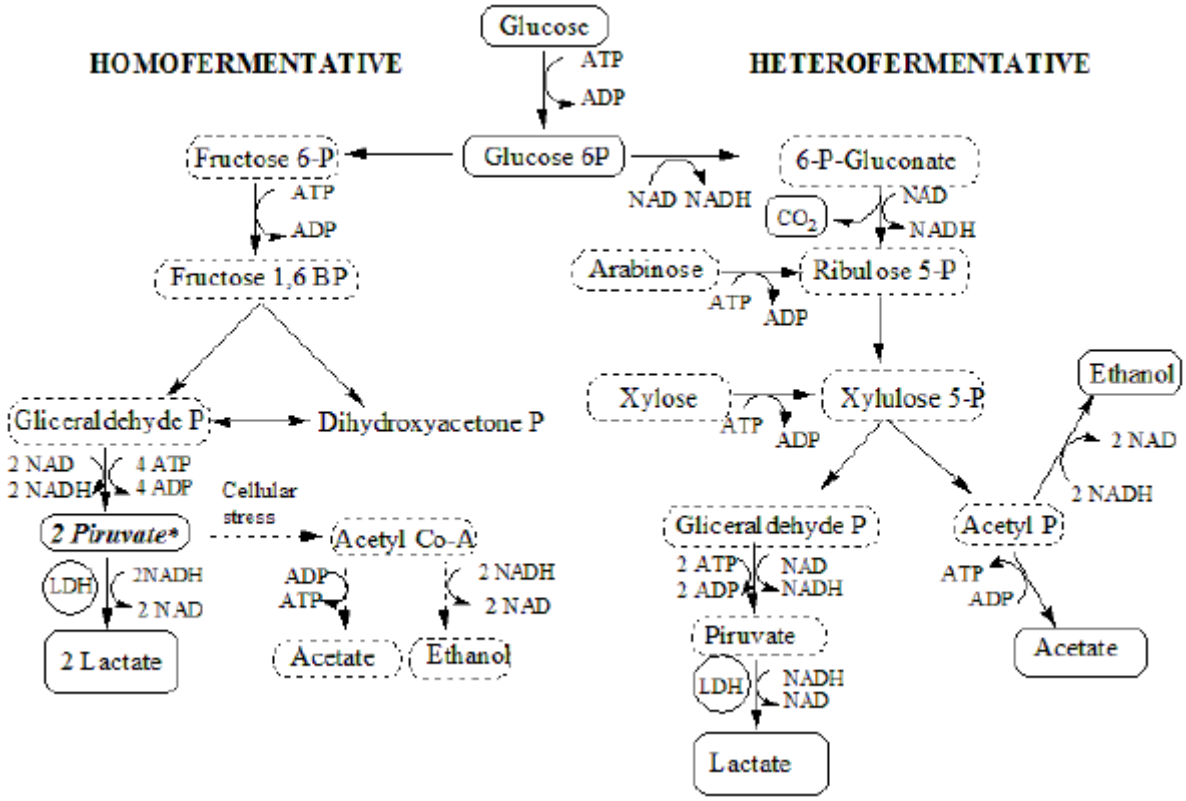

Fig.1 Metabolism of sugars in Lactic acid bacterial (LAB)

Traditional Indian Fermented Foods

Fermented foods are categorized as follows:

1. Cereal-based (with/without pulses) fermented foods,
2. Cereal/pulse and buttermilk-based fermented food,
3. Milk-based fermented foods,
4. Vegetable, unripe fruits-based fermented foods.

Cereal-based (with/without pulses) fermented foods

- Cereal-based fermented foods are considered as staple foods in their respective regions.
- Foods like idli, dosa, dhokla, koozhu, nan, parotta, ambali, pazhaiya soru are widely consumed by the local population.

- Cereals such as rice (Oryza sativum), ragi flour (Eleusine coracana), wheat flour (Triticum spp.), barley flour (Hordeum vulgare), and pulses such as black gram dhal, red gram, green gram dhals are widely used in the preparation.
- In the preparation of fermented foods such as idli, dosa, adai dosa, kallappam, ambali and dhokla, the batter is prepared from the basic ingredients and this batter is left overnight at room temperature for fermentation, occasionally sodium bicarbonate is added to provide anaerobic conditions for the growth of yeast and LAB.
- The fermented batter is prepared into either as steamed cakes (idli) or as pan cakes (dosa, appam) before it gets too soured.
- Koozhu is the Tamil name for porridge made from millet. Finger millet, a traditional South Indian food, is consumed in the fermented form, as koozhu in households.
- Fermented rice or Pazhaiya soru is prepared by adding water to cooked rice and by incubating the mixture overnight, and finally adding buttermilk and salt and directly consumed.
- Microbes isolated from these foods include: Weissella paramesenteroides, Lactobacillus fermentum, L. plantarum, Enterococcus faecalis, Pediococcus acidilactici, P. cerevisiae, L. mesenteroides.

Cereal/pulse and buttermilk-based fermented food

- Buttermilk is an additional source of LAB in this type of fermented foods. W. paramesenteroides isolated from Mor kuzhambhu showed antibacterial activities towards food borne pathogens Salmonella typhi and L. monocytogenes.

Milk-based fermented foods

- Yoghurt is one kind of fermented milk produced by a process known as proto-cooperation. Proto-cooperation is a process that produces yoghurt by mutual stimulation of growth of Lactobacillus Delbrueckii subsp. Bulgaricus and Streptococcus thermophilus. These interactions are known for decades.
- A range of cheese varieties, such as Swiss, Cheddar and Italian-type cheeses are being manufactured using LAB. Lactate formation by Lactose and galactose, quantitatively the most important substrates, by LAB is crucial for cheese production.
- Dahi or curd is most popular and commonly used traditional Indian fermented product. Dahi differs from yogurt in its use of mixed starters of mesophiliclactococci. A principal flavour-inducing metabolite is diacetyl, which is appreciated more by people of South Asian origin compared to the acetaldehyde flavour in yogurt.
- LAB species isolated from fermented milk products include Streptococcus cremoris, S. lactis, S. thermophilus, Lactobacillus bulgaricus, L. acidophilus, L. helveticus, L. cremoris, L. plantarum, L. curvatus, L. fermentum, L. paracasei subsp. pseudoplantarum, L. alimentarius, L. kefir, L. hilgardii, Enterococcus faecium, L. mesenteroides, L. farciminis, L. brevis, L. lactis subsp. cremoris, L. casei subsp. casei and L. bifermentans.

Vegetable, unripe fruits-based fermented foods

- Fermented pickles are very popular and are part of daily diet. Fruits and vegetables are used in pickle formation using lactic acid fermentation, which occurs before the pickling process.

- Using this indigenous technique of bio-preservation, perishable and seasonal leafy vegetables such as radish,cucumbers and young tender bamboo shoots are fermented into edible products.
- Pediococcus pentasaceous, L. cellubiosus, L. plantarum, L. fermentum, L. brevis, L. mesenteroides, L. lactis, E. faecium and P. acidilactici are predominant LAB species found in fermented vegetables.

Conclusion

Indian foods are diversified due to their diversity in Indian culture and foods. There are a lot of benefits from these fermented foods like appetizing, relief from diarrhoea, constipation, stomach pain and gas trouble. Extensive research is needed to analyse the relationship between the LAB and the benefits brought in fermented foods.

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GLUTEN: AN OVERVIEW

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Abstract
Gluten is a plant protein which has vast impact on human nutrition. Its characteristic features determine the properties of flour which is used in producing breads, various baked products, pasta and noodles. However, there has been a controversy whether gluten is beneficial or detrimental to our health. Therefore this article provides an overview on gluten, its composition and its biological role in humans with and without gluten intolerance. Consequently, the article discusses the potential benefits and drawbacks of gluten-free diet and the alternatives that an individual consumes with celiac disease. Therefore, this article provides an overview of gluten and the misconception revolving around it.

Key words : Gluten, Celiac disease, Gluten Intolerance, Gluten free diet (GFD)

Introduction

Think of a Friday night. It's Manchester United versus Chelsea. You are relaxing on your couch with a box of your favourite delicious mouth watering pizza. It's soft and stretchy and you are enjoying it at the fullest. But, while delighting your taste buds with such soft yummy pizza slices, did you ever think what is present in it which is contributing to this softness and stretchiness. The simple answer is gluten.

Gluten is a complex plant protein which is composed of glutenin and gliadin (Biesiekiers, 2017). Its name is derived from a Latin word "gluten" which means "glue". It is named so because of its sticky glue like structure. It is present in many cereal crops such as barley, rye and with the highest amount in wheat which is 60-85% (Žilić, 2013). As gluten has a characteristic sticky nature, it provides fluffiness to the buns, breads, cakes and pastries and it is one of the important components of the bakery industry. Also, the wheat tortillas (*roti*) which most of the Indians consume on daily basis contain a huge amount of gluten. Though gluten is present in mainly wheat derived food and is being consumed for decades, it has come under controversy during the recent times. Question arises whether gluten is beneficial or detrimental to our health.

Effects of gluten on human health

In the recent times, it was rumored that people who consume gluten rich food in large quantities may suffer from coronary ailments. In order to investigate that, a study was conducted in 2017 in a population of 100,000 people with no celiac disease. In the experiment they were given gluten rich diet. On completion of the experiment, it was found that there was no effect of gluten in causing heart ailments.

Moreover, it is expected that gluten may act as a prebiotic to our body. Arabinoxylan is an oligosaccharide which is a prebiotic extracted from the wheat bran and is used to activate the good bacteria (Bifidobacterium) in the human colon. This bacteria helps in keeping the gut healthy and

any changes in its amount leads to several gastro intestinal diseases. So it is always advisable to consume products made from whole wheat flour.

However, according to a study it was found that 1% of the world population that feeds on wheat derived food suffer from celiac disorder which is gluten intolerance (Mahadov and Green, 2011). The gluten intolerance is an immune reaction which ends up damaging the small intestine followed by stomach cramps, diarrhoea and bloating which causes gastrointestinal distress and nutritional deficiencies (Balakireva and Zamyatnin, 2016).

Considering the problem of gluten intolerance, there are certain food materials which can be consumed as a substitute to gluten rich foods.

Sources of gluten free diet

Until now the primary treatment for the gluten intolerance among the population has been the incorporation of gluten free diet in their food habit. But the complete avoidance of wheat, barley and rye products which are the primary source of gluten may lead to other deficiencies viz. deficiency of vitamin B, D, zinc, fibre etc. So to avoid these deficiency problems there are other grain flour available which are manufactured from rice, oats, maize, millets, amaranth, quinoa etc. (Hosseini *et al*., 2018). These flours when consumed would provide an adequate nutrition to the person without triggering the celiac disorders.

But as the days are passing by, many people who are tolerant to gluten and can digest it are adapting the gluten free diet (GFD) as a precautionary measure. So another question arises that whether gluten free diet is a boon or ban.

Gluten free diet (GFD): A boon or ban?

There are many potential benefits and drawbacks of gluten free diet. The primary benefits are reduction in gluten-sensitive irritable bowel syndrome, non-celiac gluten sensitivity and increase in athletic performance. Despite these benefits, the GFD may impose certain health complications such as deficiency of micronutrients, increase in fat content in food, increase in coronary diseases and increased expenditure on gluten free products (Niland and Cash, 2018).

Conclusion

Gluten is a highly complex mixture of proteins and is healthy for individuals. But the negative impact of gluten is that, it can cause serious side effects in people with chronic digestive disorders such as gluten intolerance. Therefore, gluten free diet is clearly beneficial for patients with celiac disease or for people with gluten sensitivity. However the people who are tolerant to gluten must consume it and should not adapt to gluten free diet.

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DELINEATING SOIL HEALTH GOVERNANCE AND FOOD SECURITY DURING THE PANDEMIC

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Abstract
COVID-19 aggravated several soil health threats. The long-term impacts of pandemics on soils include increasing pollution and depletion, affecting human health. Border restrictions and fluctuating demand for agricultural products forced farmers to increase crop yields and sell surplus animals Soils are also endangered by the urge to convert agricultural areas to houses as a result of pandemic-induced changes. Several governance mechanisms are described to better human-soil relations during a pandemic. Preventing land-use change and increasing soil fertility are crucial post-pandemic soil governance aims.

Introduction
In the present scenario more than being a primary source of biomass production soil has emerged as a multifunctional resource. Soils are the cornerstone of the food system and a major supplier of the ecological goods and services that humans depend on to govern, among other things. Soils are also a vital source of the ecological goods and services that humans rely on. The relationships between soil and health are often difficult to disentangle due to the abundance of confounding variables. Nonetheless, increasing scientific knowledge of soil processes and variables affecting human health is allowing for a better understanding of how soil affects our health. Multidisciplinary research involving soil science, agronomy, agricultural sustainability, toxicology, epidemiology, and medical sciences will enable the discovery of new antibiotics, a better understanding of how materials added to food production soil affect health, and the deciphering of the complex relationships between soil and human health. Soil health was adversely affected and faced many ill-effects by COVID-19. Despite considerable support for a "One Health" strategy to reducing the danger of zoonotic pandemics like the COVID-19 pandemic, the intricate interaction between soils and human health is not fully understood (WHO, 2021).

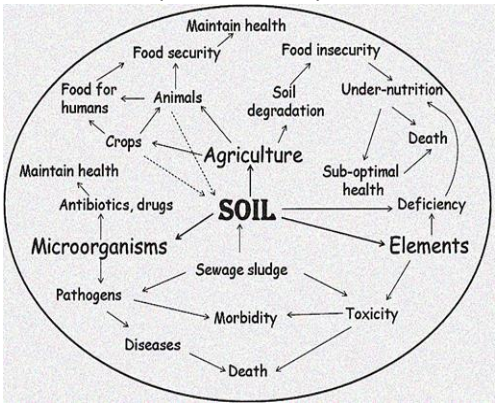

Figure 1. Interactions between soil, environment and human health (Adapted from: Oliver & Gregory, 2014).

The pandemic's impact on soil health and food security

While the COVID-19 pandemic's total economic impact on agriculture may be smaller than on other sectors, sudden border closures and shifts in demand for agricultural goods had direct on-farm repercussions. Numerous farmers faced financial difficulties as they lost access to markets for perishable crops, as well as the manpower and other inputs necessary to operate their agricultural operations. As a result, many farmers are under extreme pressure to do everything it takes to better their financial situation in the near term. Farmers may strive to boost yields by continuous cropping without rehabilitating soils or bringing marginal areas into production. While nutrient-dense, good soils may act as a temporary bank marginal soils will rapidly run out of nutrients. Farmers may be receiving insufficient information to assess the long-term implications of these short-term profits or to seek alternate management approaches. Additionally, some farmers have been unable to get the workforce necessary to carry out plant production and preventative measures against weeds, pests, and disease (FAO, 2020). When combined with restricted availability to agricultural supplies as a result of disruptions to distribution networks, some farmers are suffering more than typical crop loss due to weeds, pests, and disease. Where farmers can afford and get herbicides and pesticides, chemicals may be administered in greater quantities than normal to 'fix' the issue. Where soils are already exhausted, this excessive treatment will have a detrimental effect. Farmers were unable to sow crops due to financial stress caused by the epidemic, this resulted in huge soil loss owing to erosion during the pandemic. As a result, some farmers who were already operating on the edges may also left the business. This fact, along with manpower shortages, resulted in a rise in the average farm size and the adoption of chemical-intensive agricultural practices and monocultures.

Soil fertility preservation for human health and well-being

When soils are healthy, they provide a significant tool for resiliency for the agriculture sector and household food security during a pandemic. Because of this, preventative measures to safeguard soil health in the event of a pandemic should be advocated. Agricultural rotations, crop leftovers, animal and green manures, and other organic wastes all contribute to soil fertility and degradation mitigation. However, organic farming alone is seldom a viable solution to food security concerns due to its typically lower yields when compared to cropping methods that use inorganic fertilizers. Integrated management strategies that include rotation and organic and mineral fertilizers may help to preserve both human and soil health.

Table 1. Soil as a nutrient bank and its role in plant and human health

Elements	Plants	Mammals	RDA or AI/mg	Function in mammals
Primary elements				
Nitrogen(N)	Yes	Yes	105	Essential constituent of DNA, RNA and proteins
Phosphorus(P)	Yes	Yes	700	Essential constituent of bones, cells and energy processes plus other functions
Potassium(K)	Yes	Yes	4700	A systemic electrolyte and essential in regulating ATP with sodium
Secondary elements				
Calcium(Ca)	Yes	Yes	1300	Essential constituent of bones and required

Elements	Plants	Mammals	RDA or AI/mg	Function in mammals
				for synthesis and function of blood cells, and function of muscle, heart and digestive system
Magnesium(Mg)	Yes	Yes	420	Required for bones and processing ATP
Sulphur(S)	Yes	Yes	–	Constituent of aminoacids–diets with sufficient protein contain adequate sulphurs other eisno RDA
Trace elements				
Chlorine(Cl)	Yes	Yes	2300	Pump functions of cells and hydrochloric acid in stomach
Boron(B)	Yes	Yes	–	Has role in some animals in vitamin D activation, but uncertain whether this is a Nutritional effect. Helps to build and maintain bones and is involved in Ca and Mg metabolism
Iron(Fe)	Yes	Yes	18	Required for many proteins and enzymes, particularly hemoglobin in blood
Manganese(Mn)	Yes	Yes	2.3	A cofactor in enzyme reactions
Copper(Cu)	Yes	Yes	0.9	Required component of many redoxenzymes
Zinc(Zn)	Yes	Yes	11	Required component of many enzymes
Nickel(Ni)	Yes	Yes	–	Suggestedroleinsomeanimalsinenzymefunctionandironadsorptionandmetabolisminhumans
Molybdenum(Mo)	Yes	Yes	0.045	Component of several oxidase enzymes
Sodium(Na)	Beneficial	Yes	1500	A systemic electrolyte and essential in regulating ATP with potassium
Selenium(Se)	Beneficial	Yes	0.055	An essential cofactor of antioxidant enzymes
Cobalt(Co)	Beneficial	Yes	–	RequiredinthesynthesisofvitaminB_{12}(cobalamine),whichissynthesisedbybacteria

Conclusion

COVID-19 emphasized the need of treating soils with the same urgency as climate change and biological diversity loss. To prepare for future pandemics, officials must take proactive measures to protect soil health. Existing restrictions aimed at preventing soil contamination and loss cannot be anticipated to be implemented during a pandemic. Regulations may be suspended or not enforced in the event of an emergency or due to mobility difficulties. As a result, healthy, productive soils are required to mitigate the detrimental effects of pandemics on food production and to avoid land conversion. By adopting Land-Degradation Neutral objectives, soil health may be prioritized in the event of a pandemic, hence increasing resilience. Similarly, the FAO's Voluntary Guidelines for Sustainable Soil Management and the use of Integrated Pest and Disease Management techniques

both contribute to soil health promotion. In the long run, landscape planning may assist in identifying acceptable locations for urban and suburban growth, avoiding the unintentional loss of rich agricultural soils.

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EFFECT OF MICRO-PLASTICS ON MARINE ENVIRONMENT

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Abstract
The dispersion of the microplastics in the environment may be ingested by animals and cause them diseases or death. Moreover, when microplastics are dispersed in the ocean, they may also bring with them and distribute microorganisms that cause diseases or cause algal blooms.

Keywords: Microplatics, disease, source

Introduction

Plastics in the ocean have been known to suffocate marine life or cause them diseases. However, smaller plastics are harmful, too. Plastics can be degraded into microplastics of various sizes ranging from 100 nm. They may also come from plastic fibers of polyesters such as those from the clothes we wash (Figure 1). Microplastics can be categorized into those manufactured for their abrasive qualities which are already less than 5 mm (primary); from breakdown of larger plastic items (secondary); and from pre-production pellets (tertiary) [2].

Figure 1. Microplastic samples collected from the sea

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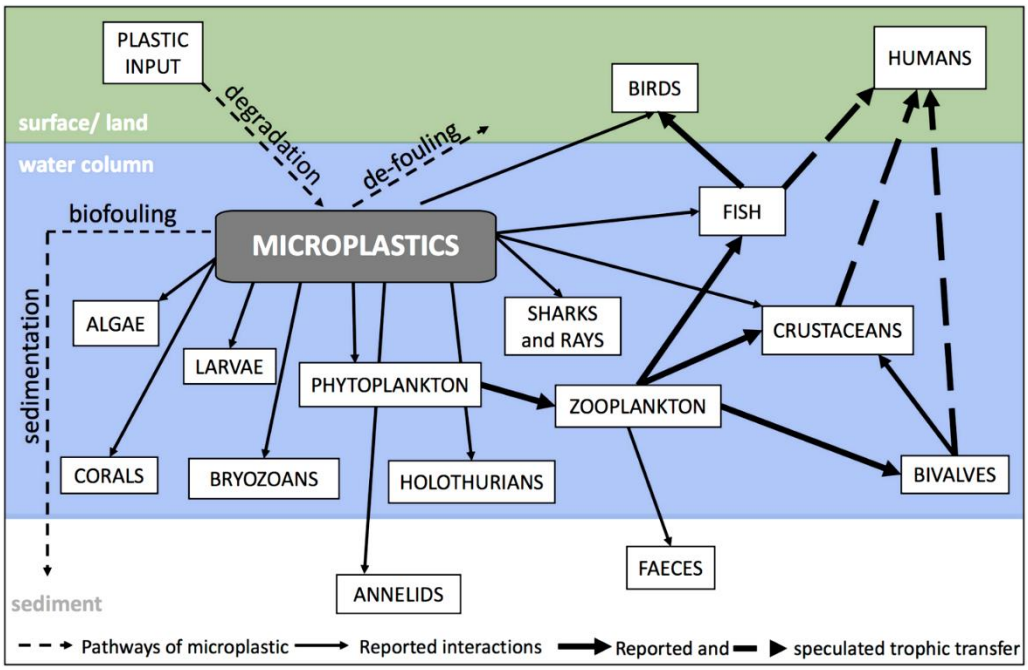

Figure 2. Microplastic interaction with different organisms in the foodweb

Plastic pollution can lead to: 1) bioaccumulation in which toxic chemicals from plastics are accumulated in the tissue of an organism; and 2) biomagnification which refers to the increased concentration of toxic chemicals in animals higher on the food chain [3]. The microplastics are made-up of disease-causing toxins such as polychlorinated biphenyls (PCBs) [4] [5]. When small fish ingests a toxin and the larger fish ingests plenty of these small fishes. The toxin magnifies because the large fish eats plenty of the small fishes to survive. Hence more than one species is harmed by the toxin because it has entered the food chain and humans can be part of that food chain (figure 2). In humans, accumulation of these toxins that cause illnesses such as cancer and kidney problems [6] can lead to early death (Figure 3 and 4). Moreover, it also affects the reproduction and development processes of aquatic organisms [7] thus, leading to changes in population structure.

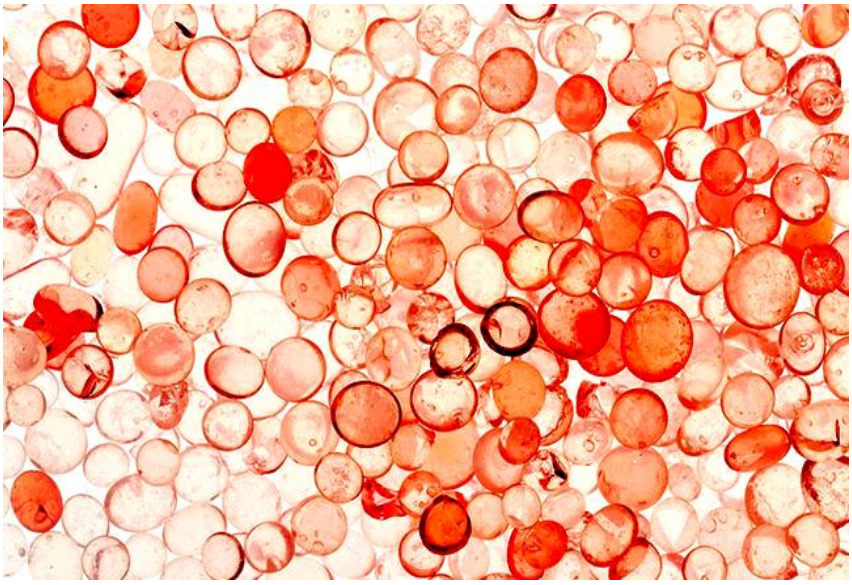

Figure 3. Presence of Microplatics in human blood sample

There are plastic degrading microorganisms that use plastics as a food source [8]. Microplastics, due to their Small sizes, can be dispersed by Ocean waves. Marine microorganisms that degrade these plastics are dispersed too as they hitchhike on the plastic particles [7|. The ecosystem of interacting microbes on plastics is formed and may carry with it pathogens [9] and invasive microbial species [7] into new environments. This may include exotic pathogenic organisms such as *Aeromonas salmonicida* introduced in the North Adriatic [10].

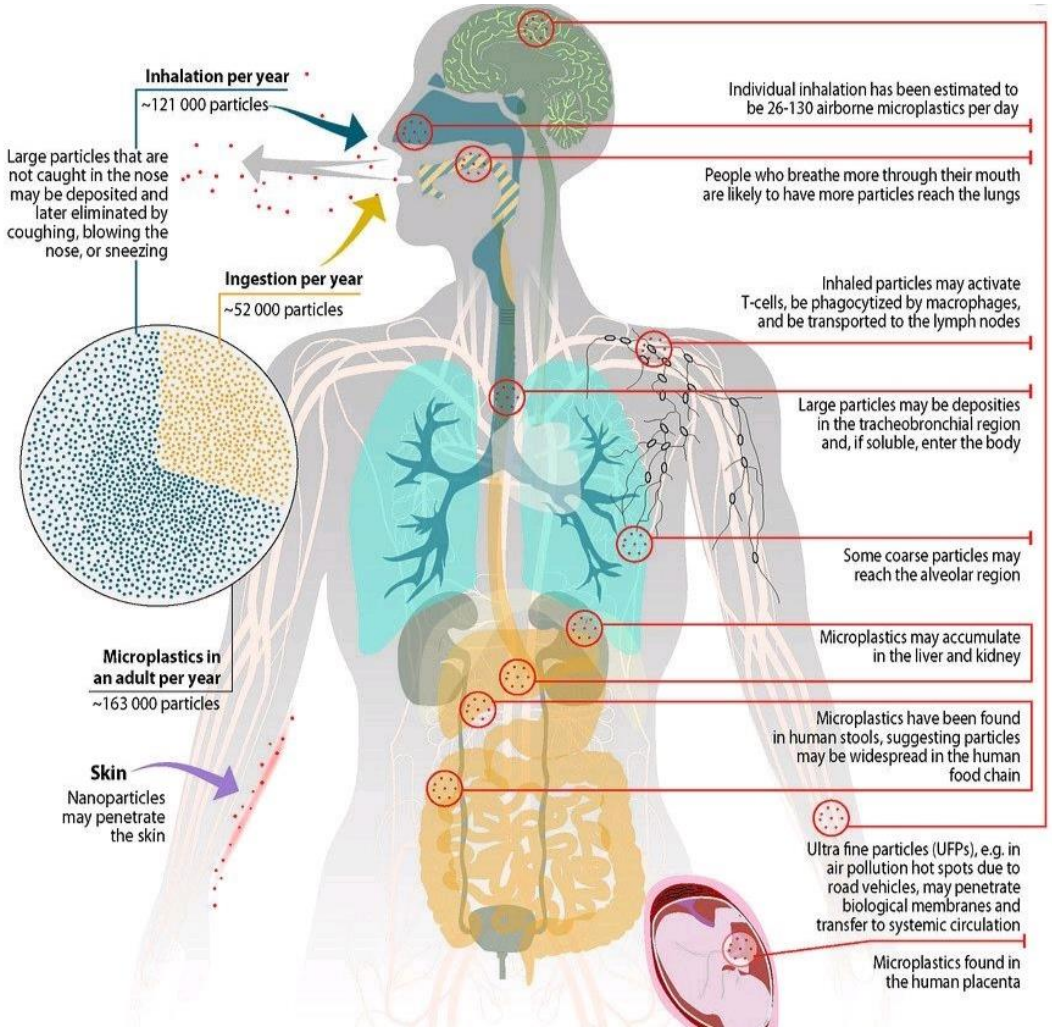

Figure 4. Human exposure to Microplastic and Nanoplastic particles

Conclusion

UNEP focused on three categories of plastic alternatives; natural fibres from plants and animals; biomass-based, compostable, synthetic biopolymers; and re-usable, durable, non-plastic materials. In order to completely eliminate plastics, single-use plastics, further research in plastic alternatives is needed to accomplish this.

Microbead- Free Waters Act 2015 of the United States is one of the most famous legislation that focuses on solving the problem of Microplastics. Stricter guidelines and laws, like this, must be issued, across the world, in order to decrease the risks and dangers associated with plastics and microplastics. Global educational campaigns, raising awareness, international cooperative

programs, and remediation of microplastics, are the several solutions and factors that can contribute in reducing plastic and microplastic pollution.

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Conflict of Interest statement
The authors declare that there are no conflict of interest.

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MARINE PLASTIC POLLUTION IN OUR OCEAN AND MARINE HEALTH

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- Over 300 million tons of plastic are produced every year for use in a wide variety of applications. At least 14 million tons of plastic end up in the ocean every year.
- Eighty percent of the waste at sea comes from the land and mainly from poorly collected and non-recycled household waste.
- Plastic debris degrades very slowly and persists in the marine environment.
- A total of 5,000 billion plastic particles are estimated to float in our oceans.
- Plastic pollution threatens food safety and quality, human health, coastal tourism, and contributes to climate change.

WHAT IS THE ISSUE?

To meet the requirements of its varied uses, plastic is designed to be rot-resistant and to last, but once in the environment, these properties become disadvantages. Depending on the nature of the plastic, its lifespan can range from a few years to several centuries. Under the influence of solar UV radiation, wind, currents and other natural factors, plastic breaks down into small particles called micro plastics.

The majority of debris in the oceans is produced by the fragmentation of macro-waste with the continuous release of fragments that are only of a few millimeters in size (micro plastic). These tiny plastics can be consumed by the different biota including corals, planktons, marine invertebrates, fish and whales and are ultimately transferred along the food chain. Micro plastic pollution is becoming an issue of concern because of its detrimental effect mainly on the marine health and biota.

Fig 1. Plastic debris in ocean

Effect of plastic debris on the health of marine biota:

In the marine environment, a wide range of organisms, from plankton to large vertebrates, such as fish, turtles or whales, interact with plastic waste. Each year, more than 100,000 marine mammals and one million birds are estimated to die trapped in plastic bags or after ingesting floating waste they confuse with prey.

Fig 2.The impacts of plastic on the marine organisms

Micro plastics are more complex, invisible and difficult to treat. Due to their small size, they are loaded with toxins and can be ingested by all filtering organisms, including mussels and oysters, and thus easily enter the food chain. They are the same size as the plankton on which fish and whales feed. Many organisms are grafted on this floating waste: bacteria, algae and crustaceans. Transported by currents, plastics can displace exotic or harmful species thousands of miles, severely disrupting ecosystems. The harmful effect of micro plastics on corals involves retention of plastic fragments in mesenterial tissue which leads to reduction in feeding capability and lowering in energy reserves. Microplastics also adversely affect planktons which are most essential component of the marine habitat.

Plastic waste release caused by COVID-19:

The recent COVID-19 pandemic has led to an increased demand for single-use plastic, intensifying pressure on this already out-of-control problem. Most of the plastic is from medical waste

generated by hospitals that dwarfs the controlling package material. This poses a long lasting problem for the ocean environment and marine health.

How to reduce the amount of plastic waste?

Fig.3 Plastic waste from the COVID-19

Plastics are now considered to be a threat to the marine environment. Nevertheless, as total ocean clearance is not possible, reduction of upstream pollution at the source must be achieved through integrated catchment management, water sanitation and improved waste management (collection and recycling).

Fig 4. COASTAL CLEANUP DAY-2019 organized by
students and staff of College of Fisheries Science, Veraval

Controlling plastic pollution also involves promoting recycling and the circular economy. These measures must be simultaneously accompanied by a change in our consumption behavior, through education and citizen awareness, because the health of the sea and the oceans depends on each of

us. The accumulation of waste in the sea is a global problem that requires comprehensive and coordinated solutions.

Conclusion

The problem of plastic pollution in the marine ecosystem is an issue of concern nowadays because it's deleterious effects on marine biota. Thus immediate actions are required against the unnecessary use of plastics and its products. Need to spread awareness among the general public regarding the harmful effects of microplastics.

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SOIL CARBON SEQUESTRATION: SUSTAINABLE PRACTICES

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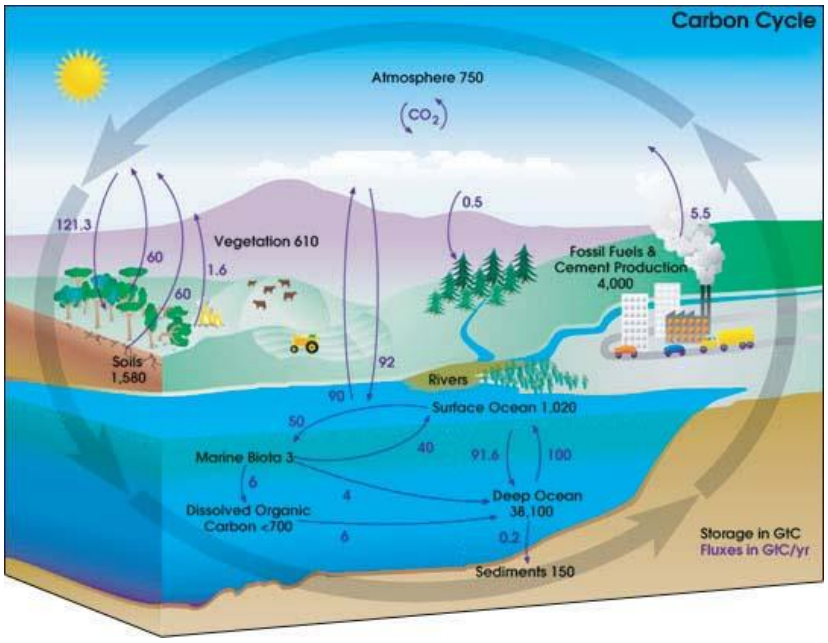
Climate change, due to a substantial increase in atmospheric CO_2 leading to increased temperatures, variation in precipitation and reduction in natural resources, has a more profound impact on agricultural production and certainly on security of food. In India, CO_2 accounts for 7% of total global GHG emissions and agriculture and livestock contribute 18% of gross national emissions. Atmospheric concentrations of carbon dioxide can be lowered either by reducing emissions or by taking carbon dioxide out of the atmosphere and storing in terrestrial, oceanic, or freshwater aquatic ecosystems. The long-term conversion of grassland and forestland to cropland and grazing lands has resulted in losses of soil carbon worldwide but there is a major potential for increasing soil carbon through restoration of degraded soils and widespread adoption of soil conservation practices.

Climate change mitigation can be addressed by adopting agricultural practices that contribute to carbon sequestration and storage, thus establishing a link between agriculture, carbon sequestration and climate change. Carbon sequestration and sustainable development have a direct link with the climate change adaptation and mitigation strategy. Therefore, there is a need to improve soil organic carbon stocks to create an impression towards mitigation and adaptation strategy on climate change, land restoration, improving the environment and accelerating food safety and security.

Carbon Sequestration :
Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. It is one method of reducing the amount of carbon dioxide in the atmosphere with the goal of reducing global climate change. Clean Development Mechanism (CDM) supported carbon sequestration activities under the Kyoto protocol with a focus on afforestation and reforestation, seen as being the most effective and readily measurable means to sequester carbon as biomass both above and below ground. In the post-Kyoto negotiations efforts are being made to give due attention to the huge carbon sequestration potentials in rangelands.

Importance of Carbon Sequestration :
According to the IPCC report (2019) global mean surface temperature has increased by 0.87 C. In the year 2020, it has been reported that the contribution of GHGs by energy use is 73.2%, followed by agriculture; forestry and land use 18.4%. Among, all the greenhouse gases, (CH_4, CO_2, N_2O, CFCs, etc.) CO_2 is the fastest growing. On the other hand, land degradation, which is a driver of climate change through the emission of greenhouse gases and reduction of carbon uptake, can be avoided and reversed by adopting rehabilitation activities like conservation agriculture, reduced tillage, and biochar.

Due to development of agriculture depletion of soil carbon stocks. Agricultural soils are among the planet's largest reservoirs of carbon and hold potential for expanded carbon sequestration, and thus provide a prospective way of mitigating the increasing atmospheric concentration of CO_2. much of the carbon in the atmosphere is absorbed by the soil, which reduces the CO_2 load and maintains atmospheric temperature. Globally, agricultural soils are estimated to potentially sequester 0.4 to 0.8 Pg C per year following recommended management practices on cropland, 0.01 to 0.03 Pg C per year in irrigated soils and from 0.01 to 0.3 Pg C per year in grasslands. It is estimated that soils can sequester around 20 Pg C in 25 years, more than 10 % of the anthropogenic emissions.



Carbon Cycle Image: FAO SOILS PORTAL

Agricultural Practices for Carbon Sequestration

Soil organic carbon is an integral part of soil organic matter and is considered an essence for terrestrial life. It is crucial to keep the soil organic matter at the threshold level for all related processes and practices. Soil organic matter is restored by adopting soil and land use specific best management practices (BMPs). Appropriate land use is beneficial to maintaining threshold level carbon and ecosystem services. Some technical and management methods to improve soil organic carbon.

1) Conservation Agriculture

A farming system that promotes minimum soil disturbance, maintenance of a permanent soil cover, and diversification of plant species. Conservation agriculture is practiced at around 125 mha and in India; it is still below, covering an area of 1.5 mha. The three fundamental principles of conservation agriculture, minimal soil disturbance or reduced tillage, management of surface crop residues, and cyclical crop rotation.

The principle of protecting the soil with managing the top soil to create a permanent organic soil cover can allow for growth of organisms within the soil structure.

No-tillage and minimum tillage practices keep more crop residues on the soil surface and have higher soil carbon concentration, improve soil structure, increase porosity and reduce bulk density.

Minimum soil disturbance which is essential to maintaining minerals within the soil, stopping erosion, and preventing water loss from occurring within the soil. Unlike reduced tillage, conventional tillage depletes SOC stocks by increasing the decomposition and mineralization of organic matter. Crop rotation with legume cover crops increases the rich biodiversity and carbon stock of the soil. Unlike temperate and subtropical regions, tropical regions require the adoption of best management practices, such as conservation agriculture, which is useful for sequestering more carbon in regions with high rainfall and high temperatures. When no-till practices are followed, the producer sees a reduction in production cost for a certain crop.

2) Crop Residue Management

Crop residue is plant material remaining after harvesting, including leaves, stalks, roots. The annual production of crop residues in India is around 500 million tons and if 15% of these crop residues are applied to the soil, it increases the C concentration of the soil and thus carbon sequestration. The benefits of residue recycling, which provides several critical, and mostly irreplaceable environmental services, have been demonstrated by decades of diverse soil, plant science, and agronomic research. Protection against water and wind erosion, enhanced water storage capacity of soils, their enrichment with organic matter, and nutrient recycling are the principal benefits. The application of crop residues to the soil and its gradual decomposition provides sufficient soil organic matter that improves soil biodiversity and overall soil quality.

3) Nutrient Management

Integrated Nutrient Management maintain the soil fertility and of plant nutrient supply at an optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner. INM achieve high productivity as well as soil organic carbon sequestration to cope with climate change. In a long-term experiment with a variable combination of fertilization practices in the cultivated field, it was found that a high soil organic carbon sequestration was recorded for a balanced organic fertilizer. Consequently, the continuous use of fertilizers is necessary to maintain soil fertility and crop productivity. The application of animal manure and compost in the field has proven to be a good practice for saving soil organic carbon.

4) Biochar

Biochar is defined as a fine-grained, porous, carbon-rich material produced during pyrolysis process that is a thermochemical decomposition of biomass with a temperature about 380°C to 1000°C in the absence or limited supply of oxygen. When applied to soil, it has a variety of benefits to an ecosystem by improving soil fertility and accumulating carbon. Around 60% of this biochar organic carbon is of high stability and therefore resists decomposition more-so than plant material that has not been processed into biochar. Biochar coal acts as a carbon-negative process, that is, it captures more CO_2 from the atmosphere and therefore allows long-term carbon sequestration and stores up to 0.55 Pg of CO_2 per year. According to different estimates, between 72 and 127 Mt of crop residues are burned in India. Biochar is an alternative solution that captures a large amount of CO_2 from the atmosphere when added to soil. It reduces methane and NO_2 emissions through the soil microbial degradation process because it is composed of recalcitrant C, resistant to microbial decomposition.

5) Agroforestry

Agroforestry is a land use management system in which trees or shrubs are grown around or among crops or pastureland. This system is believed to have a higher potential to sequester carbon because

of their perceived ability for greater capture and utilization of growth resources than single-species crop or pasture systems. It is considered an important strategy for carbon sequestration by neutralizing anthropogenic emissions, improving the environment, soil quality, agricultural productivity, and promoting food security. Carbon sequestration in agroforestry can be estimated above and below ground. Above carbon sequestration is the total biomass of plant matter and this depends on site selection, species, age and management practices. The subsoil plays an important role in contributing C to the soil depending on the land use system. According to studies, the C stored by the agroforestry system in the soil varies from 30 to 300 Mg C per ha up to 1 m depth.

- **Benefits of soil carbon sequestration**
  - It can be helpful in the reduction of CO_2 emissions.
  - It can reduce the emissions of different GHGs.
  - It can be helpful in the reduction of atmospheric temperatures.
  - It helps in maintaining suitable biotic habitat.
  - It decreases nutrients losses.
  - It can improve soil health and productivity.
  - It can increase water conservation.
  - It can promote and sustain root growth.

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SEAWEED – CLASSIFICATION, SOURCE AND USES

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Introduction

Seaweeds, constituting an important renewable marine resource, grow in the shallow waters of sea wherever suitable substrata are available. In our country, seaweeds are found more abundantly along the southeastern and northwestern parts of the coast, and they are negligible along other parts**.** Agar, alginate and carrageenan are only found from seaweeds. As gelling, stabilising and thickening agents, They are extensively used in various industries related to food, confectionary, textile, pharmaceutical, dairy and paper mostly.

Seaweeds are also called macro-algae that are different from micro-algae (Cyanophyceae), which are microscopic in size, mostly unicellular, and are best known by the blue-green algae that sometimes bloom and contaminate rivers and streams.

Classification of seaweeds

Based on pigmentation, Seaweeds can be classified into three broad groups: brown, red and green. Botanists refer to these broad groups as Phaeophyceae, Rhodophyceae and Chlorophyceae, respectively.

Brown seaweeds are usually large, and range from the giant kelp that is often 20 m long, to thick, leather-like seaweeds from 2-4 m long, to smaller species 30-60 cm long.

Red seaweeds are usually smaller, generally ranging from a few centimetres to about a metre in length; however, red seaweeds are not always red: they are sometimes purple, even brownish red, but they are still classified by botanists as Rhodophyceae because of other characteristics. Green seaweeds are also small, with a similar size range to the red seaweeds.

Fig- Wild harvested seaweed from veraval coast, Gujarat and some seaweed found along veraval coast

Sources of seaweed

Brown seaweeds

Brown seaweeds are more useful and grow in cold waters in both the Northern and Southern Hemispheres. They thrive best in waters up to about 20°C. Brown seaweeds are found in warmer waters, but these are less suitable for alginate production and rarely used as food.

Food sources from brown seaweeds comes mostly from the genera Laminaria, Undaria and Hizikia. Originally, harvests of wild seaweeds were the only source but after development of culture technique, seaweed for food comes mainly from farming rather than natural sources.

Red seaweeds

Red seaweeds are found in cold waters such as Nova Scotia (Canada) and southern Chile; in more temperate waters, such as the coasts of Morocco and Portugal; and in tropical waters, such as Indonesia and the Philippines.

Dulse (Palmaria palmata, formerly Rhodymenia palmata) is another red seaweed. Most of the raw material used for the extraction of agar comes from two genera, Gelidium and Gracilaria.

All Gelidium used for commercial agar extraction comes from natural resources, principally from France, Indonesia, the Republic of Korea, Mexico, Morocco, Portugal and Spain.

The original source of carrageenan was the red seaweed Chondrus crispus (common name: Irish Moss), collected from natural resources in France, Ireland, Portugal, Spain and the east coast provinces of Canada.

Use of seaweed

Seaweed as human food

Fresh, dried and processed seaweeds are utilised for human consumption. The algal carbohydrates are hard to digestible and the food value of the seaweeds depends on the minerals, trace elements, proteins and vitamins present in them. In Japan, Indonesia, China, Philippines and other countries of Indo-Pacific regions, seeweeds such as species of Caulerpa, Codium, Hydroclathrus, Sargassum, Porphyra, Gracilaria, Acanthophora and Laurencia are used as food (Subba Rao, 1965; Levring et. al, 1969; Michanek, 1975 and Chapman and Chapman, 1980). They are eaten as salad, curry, soup or vegetables. Some of the edible seaweeds occurring in different localities along the Indian coast are species of Ulva, Enteromorpha, Chaetomorpha, Caulerpa, Codium, Dictyota, Padina, Colpomenia, Hydroclathrus, Rosenvingea, Chnoospora, Sargassum, Turbinaria, Porphyra. Halymenia, Grateloupia, Gracilaria, Hypnea, Rhodymeina, Centroceras, Acanthophora, and Laurencia. The methods of making different recipes from seaweeds are given in detail by Chennubhotla et. al. (1981). The Making gruel from seaweed Gracilaria edulis is being practiced since decades in the coastal areas of Tamil Nadu.

Fertilizers and soil conditioners

Seaweed meal is dried, milled seaweed, and again it is usually based on the brown seaweeds because they are the most readily available in large quantities. Species of Ascophyllum, Ecklonia and Fucus are the common ones. They are sold as soil additives and function as both fertilizer and soil conditioner. They have a suitable content of nitrogen and potassium, but are much lower in phosphorus than traditional animal manures and the typical N:P:K ratios in chemical fertilizers.

Insoluble carbohydrates found in large amounts from brown seaweeds act as soil conditioners (improve aeration and soil structure, especially in clay soils) and have good moisture retention properties. Their effectiveness as fertilizers is also sometimes attributed to the trace elements they contain, but the actual contribution they make is very small compared to normal plant requirements.

Maerl is a fertilizer derived from red seaweeds that grow with a crust of calcium carbonate on the outside, the calcareous red algae, Phymatolithon calcareum and Lithothamnion corallioides. As a substitute for agricultural lime, they are harvested by dredging or digging and are used to neutralize acid soils.

Animal feed

the availability of seaweed for animals has been increased with the production of seaweed meal: dried seaweed that has been milled to a fine powder.

Norway was among the early producers of seaweed meal, using Ascophyllum nodosum, a seaweed that grows in the eulittoral zone so that it can be cut and collected when exposed at low tide. Laminaria digitata, both Ascophyllum and Laminaria species used by Iceland, and the United Kingdom, Ascophyllum.

Fish feed

A technical grade of alginate is uses as a binder to formed doughy mass from meat waste and dry additives containing extra nutrients as feed must be not disintegrate or dissolve in the water when thrown into the fish pond or cages.

There is also a market for fresh seaweed as a feed for abalone. In Australia, the brown seaweed Macrocystis pyrifera and the red seaweed Gracilaria edulis have been used.

The green seaweed, Ulva lactuca, has been fed to Haliotis tuberculata and H. discus.

Biomass for fuel

In 1974, the American Gas Association decided to look for a renewable source of methane (natural gas) and sponsored a project to produce seaweed on farms in the ocean, harvest it and convert it to methane by a process of anaerobic fermentation. The project was divided into two parts: one the production and harvesting of the seaweed (biomass), the other the conversion of the biomass to energy (methane, that could be burned to produce energy). The "giant kelp" was chosen as a cultured seaweed that grows off the coast of California, Macrocystis pyrifera, because of its high growth rate and ease of harvesting by mechanical means.

Cosmetics

Extract of seaweed is often found on the list of ingredients on cosmetic packages, particularly in face, hand and body creams or lotions.

Integrated aquaculture

Cultivation of Gracilaria started in Taiwan Province of China in the 1960s as a source of raw material for its agar industry. At first cultivation was on ropes in ditches containing fish pond effluents, but by 1967 it was moved into the fish ponds themselves. This had the twofold benefit of the seaweed using the fish waste material as fertilizer and the fish eating the epiphytes, such as Enteromorpha species, that would otherwise become serious pests for the seaweeds.

In Israel, an integrated system has been tried. fish feed by pellet and there effluent turn drained into seaweed cultivation tank (Ulva). Seaweed produced was used by abalone as a feed and there effluent drained into fish tank. The fish and abalone grew well, the ammonia nitrogen in the seaweed effluent was reduced to 10% of total amount fed to the system.

Porphyra species are the source of the human food, nori, and so their use in integrated aquaculture is an attractive economic alternative, particularly because they are very efficient in taking up nutrients. Trials are being run on the east coast of Canada and United States of America to combine Porphyra with salmon farming.

Wastewater treatment

There are two main areas where seaweeds have the potential for use in wastewater treatment. The first is the treatment of sewage and some agricultural wastes to reduce the total nitrogen- and phosphorus-containing compounds before release of these treated waters into rivers or oceans. The second is for the removal of toxic metals from industrial wastewater.

Seaweeds can be used to reduce the nitrogen and phosphorus content of effluents from sewage treatments. Many seaweeds have a preference to take up ammonium as the form of nitrogen for their growth and ammonium is the prevalent form of nitrogen in most domestic and agricultural wastewater. Ability to take up more phosphorus than they require for maximum growth Another important feature of many seaweeds.

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SCOPE AND CULTURAL PROSPECTS OF CRAB FARMING IN INDIA

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Introduction

Mud crab farming on a commercial scale is rapidly expanding in the coastal ponds of Andhra Pradesh, Tamil Nadu, and Kerala. Crab farming has been given a high priority by countries surrounding the Bay of Bengal Regions to improve output for the export market. *Scylla serrata* and *Scylla oceanica* are the most frequent mud crabs; the latter is preferred because it develops to a maximum size of 1.5 kg. Along the east and west coastlines of the nation, there are several potential shallow coastal waterways, lagoons, brackish water lakes, estuaries and intertidal marshy regions. In most commercial fishing regions, indiscriminate fishing of immature crabs is taking place, which can be captured and fattened in ponds. Commercially caught moulted crabs are ideal for fattening in cages and ponds. The Central Marine Fisheries Research Institute has created a feasible technique for seed production, which will encourage private entrepreneurs to produce on a commercial scale in the nation. In many parts of India, high-saline-water-media shrimp ponds have been converted to mud crab farming and such sites provide sufficient opportunities for the production of crab. Wild seed is available throughout the year in the backwater zones of Chilka Lake, the Sunderbans, Kakdip, Namkhana, the Kakinada coast, Dowleswaram, Ra jamundry, Pulicat Lake, Killai backwaters, Muthupet saline swamps, Punnakayal estuarine complex, Colacbel, Vypeen/Neendakara, and Kozhikode for boosting culture activities.

Grow-out Culture

culture and fattening are two different procedures. Fattening refers to the holding of growers or water crabs for a short period to acquire maximum biological attributes to achieve better economic returns. Culture is a grow out process to increase young seed to a marketable size of 500 g. In the fattening technique, the stock is fed vigorously at 15-20 percent of body weight. The growth of the gonads is promoted by cuttlefish wastes and fresh bivalved meat. In tidal locations, brackishwater medium with a concentration of 20-25 ppt is reported to be the best favorable for cultural activities. At 90-110 CW, mud crabs reach maturity. Females of 7-8 cm size with undeveloped gonads are obtained from commercial catches and fattened in dimensional cages built of boxes at a density of 3-4 pieces per square meter. The fattened gravid female is obtained in 3 or 5 weeks, depending on the crab beginning size and environment. In a cage culture method, more than 90% of the fish survive, but in coastal ponds, only 30-40% survive. Mating and copulation should be prevented as crops should be harvested before they breed. Crab fattening is beneficial because of high turnover, cheap operational costs, a high survival rate due to cannibalism control, a short raising time, and strong market demand for the final product.

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Fig. 1. *Scylla serrata*

Feeding

The cultivated crabs must be fed once a day, preferably in the late evening, with trash fish or molluscan (Gastropods/Bivalves) meat as well as butchery waste material at a rate of 5-10% of stocked biomass, based on the measured feeding intensity and size of the crab recorded during regular and periodic sampling of cultivated crabs. In 3-4 weeks, 150-500 gm "water crabs" can attain a final weight of 250-650 gm (Tiwary *et al.,* 2009).

Crab Farming in Ponds

Mud crab farming on a large commercial level is being developed in coastal tidal ponds. Soil mounds with mangroves were maintained in between to serve as a natural shelter. To reduce crab mortality, especially during moulting season, by strong predators. Feeding is composed of low-cost trash fish and gutted wastes from a fish market. Commercial captures yield seeds with a diameter of 3-7 mm CW without any mortality (Marichamy,1996).

Fig. 2. Mud crab farming in pond

The rates of growth, survival and output vary based on the cultural system. Monoculture with a single size stocking, monoculture with variable sizes stocking, polyculture with milkfish and mullets and fattening of gravid female crabs have all been tried, with promising results in the range of 2500-

3500 kg/ha/crop. Selective harvesting of market size crabs (400-500 g) from culture ponds is done according to market needs. The crop is managed as though it was a wild stock. The ponds are manured for the growth of *Lab Lab* and other microalgae well in advance in polyculture-" experiments. *Chanas chanas* is a compatible species that grows nicely together without interfering with each other. Milkfish seed is gathered in intertidal lagoons along the Gulf of Mannar coast in May-June and September-October and stocked at a rate of 5000/ha. It can be observed that the marketing size has been reached after 5-6 months. The rate of growth varies depending on the crab size (12-17 mm/23-75 g each month).

Crab Culture in Wooden Boxes

Inside the drainage channel of the shrimp farm, wooden boxes with four chambers (one crab per chamber) made of planks of wood were kept. Each box was 1m*1m* 0.5m in size. Size of the each chamber was 0.5m*0.5m*0.5m and the space in between 2 planks was 2-3 cm. The boxes are placed in the shrimp farm drainage system and connected with wooden poles to protect them from being moved at high tide. stocking and harvesting were done in a continuous process in the box culture method, the whole yield was not obtained at one time and while crabs more than 100 gms were reared generally, few boxes also were stocked with (less than 100) adult crab (more than 200). After they had grown to a marketable size, they were harvested individually. Adult crabs take about a month and a half to reach a weight of 300-350 gm. There was no set schedule for crab feeding like there was for shrimp. Feeding rates in experimental ponds ranged from 5 to 8% of body weight per day. Feed was delivered according to demand or utilization rate in the box method.

Fig. 3. Crab Culture in Wooden Boxes

Hatchery Management

Temperature and salinity have long been known to impact the incubation of berried females for effective larvae hatching because of the low salinity and low temperature, it may take longer for the larvae to hatch, and they may not be viable. The best results are obtained when the salinity is 31 ppt, oxygen is 5 ppm, the temperature is 28-31°C, and pH is 8.00-8.50. On the 17th or 18th day, the larval stock reaches the megalopa stage. Skeletonema, testraselmis, and chlorella combined

with rotifer and yolk make up the early zoeal larvae feeding. Rotifers (30-40/ml) and artemia Nauplii (1O-15/ml), egg custard, fertilized bivalve eggs, and BMC pellets are preferred by Zoeal III and IV.

The problem of Crab Farming

Crab farming will remain small-scale until hatchery procedures for large-scale larval and seed rearing are examined and improved. Larviculture has problems with low survival and cannibalism. In crab farming, an insufficient quantity of seed at the desired period has been cited as a limiting problem. Since of stock loss due to cannibalism, large-scale operations in coastal ponds have a low survival or recovery rate. Crab fishing has grown in popularity in India in recent years and there are promising prospects for rearing crab in cages and ponds in brackish water areas.

Scope for Progress

In addition to current efforts in farming and seed production, scientific research for seed survey, nursery ground protective measures, environmental study for farming and development of extension through training to popularise culture and fattening are some aspects that call for our attention to promote mud crab culture. The existing technology in farming and seed production suggests that this sector of the mariculture business has room for more investment. With adequate management, the current rate of output may be flexibly targeted to 2.4 tonnes/ha/crop of 5-6 months, with a 60 percent survival rate. Crab farming pays more than shrimp growing, especially in fattening operations.

Conclusions

Crab is becoming a more profitable part of the primary fishery in the Indian coastal region, particularly in the Sundarban region of West Bengal. Due to its large size and good flavour, *Scylla serrata* is in high demand both domestically and internationally. Crabs of various sizes are taken from their natural environment by local crab fishermen and marketed according to size. As a result, only giant crabs get a high price. Smaller ones have a lower market demand and are either sold locally or discarded as an undesired catch. Develop crab cultural practices such that small crabs (seed and juveniles) collected by crab fishermen and shrimp seed collectors can be used. Experiments were carried out in both earthen ponds and wooden boxes.

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WATER MANAGEMENT IN GARLIC CULTIVATION

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Abstract
Garlic is an important cash crop in many regions. However, the yield of the crop is constrained by several factors. Garlic grows well under a wide range of climatic conditions. However, it cannot stand too hot or cold temperature. It requires cool and moist climate during vegetative growth and bulb development stages but warm dry weather during maturity. The objectives of garlic improvement, thus, should be induction of sterility, creation of variability and molecular elucidation of genome for breeding superior cultivars adapted to different agro-climatic environments; and establishment of effective biotic and abiotic stress management and post harvest practices adoptable by resource poor farmers and suitable for sustained ecological well being. In Indian context, the improvement and cultivation of long day type garlic needs to be encouraged to commensurate with world leaders in production. Therefore, this article has been attempted to highlight the possible applications in attaining desired productivity and quality in all situations.

Introduction
India is the second largest producer (1.252 million tons) of Garlic (*Allium sativum* L.) in the world contributes 5% of production and covers 15% of area (FAOSTAT, 2014). Garlic is a second most widely used cultivated allium after onion. Garlic, a native of Southern Europe is one of the important bulb crops grown and used as a spice or condiment throughout India. Gujarat followed by Orissa are the largest producing states. It possesses a high nutritive value, its preparations are administered as a cure against stomach disease, sore eyes and ear ache. It is commonly used in the preparation of various dishes. Allicin, the principle amoebic dysentry and is also having many other medicinal properties. It is grown under a wide range of climatic conditions. However, it cannot stand too hot or too cold weather. It prefers moderate temperature in summer as well as in winter. Short days are very favourable for the formation of bulbs. It can be grown well at elevations of 1000 to 1300 m above MSL. Garlic requires well drained loamy soils, rich in humus, with fairly good content of potash. The crop raised on sandy or loose soil does soils, the bulbs produced are deformed and during harvesting, many bulbs are broken and bruised and so they do not keep well in storage.

Over the years, the area, production and productivity increased from 28000 ha, 76,203 metric tonnes and 3 t/ha, respectively in 1974-75 to 349390 ha, 2,651,837 metric tonnes and 6.4 t/ha, respectively in 2019-20 across the country. Among the different states, Madhya Pradesh is the highest producer (30%) followed by Gujarat (22%) and Uttar Pradesh (14%). The crop has been grown for culinary, medicinal, and religious purposes for several years. It has long been recognized all over the world as a valuable spice for foods and popular remedy for various ailments and physiological disorders. Garlic is grown for its edible bulbs, which are composed of number of cloves. The bulbs can be eaten fresh, cooked in various ways, processed into a dehydrated product, or saved for seed to be planted later.

Propagation

Garlic is propagated by cloves. All the cloves are planted except the long slender once in the centre of the bulb. Bulbs with side growth should be discarded. Healthy cloves or bulbils free from disease and injuries should be used for sowing and about 150 to 200 kg cloves are required to plant one hectare. They are sown by dibbling or furrow planting.

- Dibbling: The field is divided into small plots convenient for irrigation Cloves may be dibbled 5 to 7.5cm deep, keeping their growing ends upwards. They are laced 7.5cm apart from each other in rows of 15cm apart and then they are covered with loose soil. June-July and October-November are the normal planting seasons for garlic.
- Furrow planting: The furrows are made 15 cm with hand how or a cotton drill. In these furrows, cloves are dropped by hand 7.5 to 10 cm apart. They are covered lightly with loose soil and a light irrigation is given.

Soil and fertilizer

The garlic can be cultivated on wide range of soils. However, well drained loamy soils with high organic content are desirable. During last ploughing incorporate 10 t/ha of vermicompost. Application of 100:40:40:50 kg NPKS/ha are recommended for enhancement in yield and quality of garlic. One third of nitrogen and full recommended dose of phosphorus, potassium and sulphur should be applied as basal at the time of planting. Remaining two third of nitrogen should be applied in two equal splits at 30 and 45 days after planting. If drip irrigation is used as method of irrigation then fertigation should be done using water soluble fertilizers and its application in number of splits can reduce leaching and maintain nutrients availability. Normally in drip system 30 kg N is applied as basal at time of planting and remaining in 6-10 equal splits up to 60-70 days after planting .

Planting

The planting of garlic cloves of 8-10 mm size at a spacing of 10-12.5 cm × 7.5 cm in the month of October is recommended for obtaining higher bulb yield. However, for quality bulb production planting at 15 cm × 10 cm spacing is recommended. The planting of garlic is generally recommended from 15th October to 15th November.

Intercultural operations

First interculture is given with hand hoe one month after sowing. Second weeding is given one month after the first (about two and half months from sowing) loosens the soil and helps in the setting of bigger and well filled bulbs. The crop should not be weeding out or hoed at a later stage because this may damage the stem and impair the keeping quality.

Irrigation

First irrigation is given after sowing and then field is irrigated every 10 to 15 days depending upon the soil moisture availability. There should not be any scarcity of moisture in the growing season, otherwise, the development of the bulbs will be affected. The last irrigation should be given 2 to 3 before harvesting for making it easy without damaging the bulbs. In South India hills, they are mostly grown as a rainfed crop.

Water management

Garlic like onion is a shallow (up to 0.6 m) rooted vegetable crop. It is more sensitive to irrigation because of shallow root zone and hence requires more frequent watering compared to other vegetable crops. It is very sensitive to moisture stress particularly during bulb initiation and bulb

development. The crop should be irrigated immediately after planting and subsequently at 7-10 days interval depending upon the soil moisture. Avoid waterlogged conditions at all stages as these lead to development of diseases like basal rot and purple blotch. Optimal yield is achieved when soil water content in crop root zone is maintained near field capacity throughout crop duration. However, irrigation should be stopped 3 weeks prior to harvest to prevent rotting, discoloration of bulb skins and exposure of outer cloves. Among various factors responsible for high garlic yield, the use of appropriate quantity of water and nutrients at proper time in a right amount plays a vital role in enhancing the productivity.

Flood irrigation is widely practiced in India for garlic cultivation, which results in inefficient use of irrigation water due to losses in deep percolation, distribution and evaporation. In micro irrigation systems, water is applied at a low rate at frequent intervals near the plant root zone through lower pressure delivery system. This increases the availability of nutrients near the root zone with reduction in leaching losses. More nutrient availability especially nitrogen near the root zone results in increased diameter and weight of bulb. Drip irrigation has excellent potential for increasing irrigation and crop water use efficiency by eliminating deep percolation and runoff losses and minimizing evaporation losses (Ayars et al., 1999). While furrow irrigation is commonly used to irrigate vegetable crops, the use of drip irrigation by growers is increasing rapidly. In addition to increasing efficiency, drip irrigation has many other advantages over gravity irrigation systems, including improved nutrient management (Evans and Waller, 2007), potential for improved yields and crop quality, restrained weed growth, and the ability to continue field operations while irrigation is in progress (Schwankl and Hanson, 2007; Lamm and Camp, 2007). If subsurface drip irrigation is used, then water and nutrients can be applied directly to the root zone, which allows for more efficient root uptake and reduces potential salt accumulation at the soil surface from surface-applied water; it also encourages deeper root development than does surface drip irrigation, which may increase water extraction from shallow groundwater (Lamm and Camp, 2007; Ayars et al., 2006).

Modern micro-irrigation techniques such as drip and sprinkler irrigation help in saving irrigation water and improve the marketable bulb yield significantly. In case of drip irrigation, seed cloves need to be planted at a spacing of 15 × 10 cm in a broad bed furrow (BBF) of 15 cm height and 120 cm top width with 45 cm furrow. Each BBF should have two drip laterals (16 mm size) at 60 cm distance with inbuilt emitters. The distance between two inbuilt emitters should be around 30-50 cm and the discharge of 4 lph. The approximate investment of Rs. 60000-65000 per acre is required for installation of drip irrigation and Rs. 25000-30000 per acre sprinkler irrigation system.

Method of irrigation	Marketable bulb yield, t/ha	Quantity of water applied, ha-cm	Percentage of water savings over surface irrigation
Drip irrigation	13.2	48.7	38.1
Sprinkler irrigation	12.3	50.0	36.5
Surface irrigation	11.6	78.7	-

(Source: Soil and water resources Annexes)

In case of sprinklers, the distance between two laterals (20 mm size) should be 6 m with a discharge rate of 135 lph. The drip and sprinkler irrigation should be given on alternate days based on daily pan evaporation rate. The operating pressure for given drip system should be around 1 kg/cm^{2}and

for rotary micro sprinkler 1.5 kg/cm^2. The drip irrigation system helps in water, labour and fertilizer saving, and improves bulb yield by 15-25% over flood irrigation system.

Harvesting

Garlic is a crop of 4½ to 5 months duration. When the leaves start turning yellowish or brownish and show signs of drying up, the crop is ready for harvest. The plants are then pulled out or uprooted with a country plough and are tied into small bundles which are then kept in the field or in the shade or 2-3 days for curing and drying so that the bulbs become hard and their keeping quality is improved. The bulbs may be stored by hanging them on bamboo sticks or by keeping them on dry sand on the market, the dried stalks are removed and bulbs are cleaned. Well cured garlic bulbs can be kept for 1 to 1 ½ months in an ordinary well ventilated room. If dust smoke is given to it, the bulbs can be stored for 8 to 10 months. They can also be stored at 320F with 60% R.H. Average yield level is 6 to 8 t/ha.

Plant protection

Thrips cause withering of the leaves. 50 % of loss of yield can be there, if it is not controlled properly. Mostly it is observed in dry weather. Application of methyl demeton 25EC 1 ml/litre will check the incidence. Leaf spot is the most important disease. Spraying Dithane M-45 at fortnightly intervals at 2.5g in one litre of water is recommended. To check seriousness of thrips incidence, keep blue sticky traps at 6-8 per acre. If infiltration observed in field take spray of Fipronil at 30 ml/15 Ltr water or Profenophos at 10 ml or Carbosulfar at 10 ml plus Mancozeb at 25 gm/10 Ltr water by 8-10 days interval.

Advanced varieties of garlic

- Agrifound White (G41)
- Yamuna White (G.1)
- Yamuna White (G50)
- G51, G.282
- Agrifound Parvati (G.313)

Benefits of Eating Garlic

- Heart will remain healthy.
- Get rid of high BP.
- Get rid of abdominal diseases.
- Digestion will be better.
- Relief from toothache.
- Relief from cold and cough in winters.

Conclusion

Supplemental irrigation reasonably increased yield of garlic in silty loam soils. Yield increases with more frequent irrigation up to 7 days interval but at a decreasing rate of increase. Consequently, water productivity decreases with increasing applied water except rainfed condition. It may be concluded that when sufficient irrigation facility is available, irrigation should be applied at an interval of 7 to 10 days to get a profitable yield. The interval may be increased up to 15 days in case of water scarcity.

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WAYS OF DOUBLING FARMER'S INCOME

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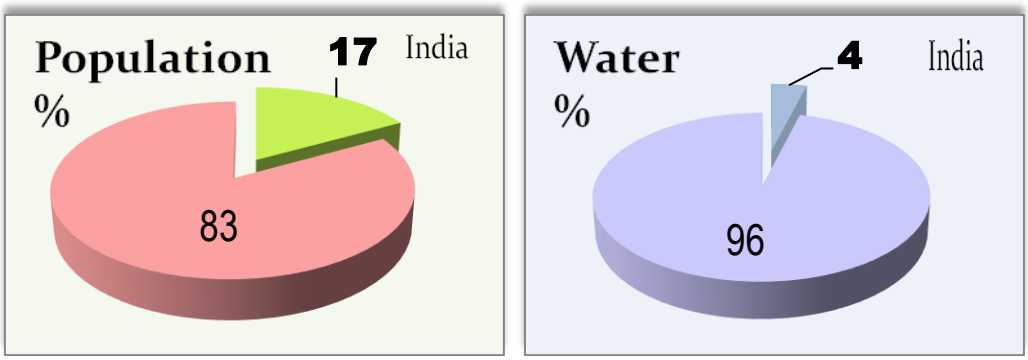
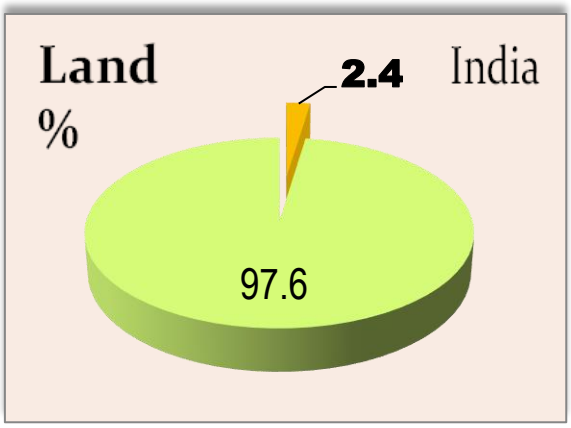
Introduction

All the nations facing problems of poverty, hunger and malnutrition will need to accelerate their agricultural growth for achieving sustainable development goal (SDGs), especially while aiming at no poverty, zero hunger and safe environment for all **(Paroda, 2017).** Income is the most relevant measure to assess farmers' economic well being and sectoral transformation. The crises and distresses plaguing the sector endanger the very livelihoods and welfare of the farmers. Indian Government with the intention giving enough policy thrust on income security, proposed to double the farmers' income by 2022, platinum jubilee year of the Indian independence. The present study analysed the current status of farmers' income across holding size and regions and attempted to decipher the scope and pathways for doubling income through potential drivers. The findings from the National Sample Survey Office **(NSSO)** data indicated that the share of income has increased drastically from 5 per cent to 12 per cent in the case of livestock farming, 45 per cent to 48 per cent in crop production, while that of the wages and non-farm have declined between 2003 and 2013. The challenges faced by the farming community in the coming years have been highlighted for devising relevant pathway and strategies to enhance the income. Yield enhancement followed by cost reduction, fair price realisation and risk adaption has been identified as the potential pathway for doubling income. Farmers' income from crop production, livestock farming, wages and non-farm activities is an outcome of synergy and convergence between technology, extension, institutions and policies to achieve the set target. Indian agriculture needs a relook with a special focus on farm income through productivity/efficiency enhancement coupled with cost reduction, better price realisation and income risk coverage to be on the track of Doubling Farmer's Income. The strategies for doubling the income focusing on IFS, New technologies, Innovations in Extension, diversification / intensification / pest and disease management in vulnerable regions, and cost reducing technologies. Thus, it can be concluded that integrate investment and leadership in science & technology, extension, institutions and policy interventions to doubling farmer's income.

India: strain on system-





- 17% of Global Population
- 4% of Global Water Resources
- 2.4% of Geographical Area
- **Stress on Supply side**
- Soil fatigue
- Ground water depletion
- Plateauing yield
- Climate change
- Post-harvest losses

- **Changed Demand**
  - Economic growth
  - Consumption shifts

Redefining Agricultural Mandate

- Agriculture has the moral responsibility of meeting food and nutritional security in consonance with the agro ecological backdrop.
- It has to generate gainful employment resulting in income gains to make the farmers more economically secure.
- It has to generate raw material that will directly support agro-processing of food and non-food products to support secondary agriculture.
- It has to support agro-processing industry to produce primary and intermediate goods, which will feed the manufacturing sector.
- Agricultural practices need to be on a sustainable basis.

Flagship Schemes

1. Soil Health Management
2. Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)
3. National Food Security Mission (NFSM)
3. e-NAM
4. Pradhan Mantri Fasal Bima Yojana (PMFBY)
6. Rashtriya Krishi Vikas Yojana- (RKVY - RAFTAAR)
7. Mission for Integrated Development of Horticulture (MIDH)

Why Double Farmers' Income

Today, around 138 million Indian farmers' main concern is about declining farm income on the one hand and the increasing cost of inputs on the other. A recent study by the National Institute of Agricultural Economics and Policy Research (NIAP) has shown that around 70% farmers in the country have annual per capita income less than INR 15,000 Paroda *et al.* (2016).

Birthal *et al.* (2017) have further analyzed the situation and found that their geographical distribution is widespread, but mostly concentrated in Uttar Pradesh (27.4%), Bihar (11.4%), West Bengal (9.9%), Odisha (6.3%), Rajasthan (5.8%), Madhya Pradesh (5.3%), Maharashtra (4.9%), Assam (3.9%) and Jharkhand (3.2%). Most of these states lack the required infrastructure for agricultural income growth.

Strategy for Faster Agricultural Growth

- **Improving productivity and production efficiency**
  - *1)Bridging the Yield Gap*
  - *2)Conservation Agriculture*
  - *3)Increasing Nutrient-Use Efficiency*
- **Agricultural diversification - including secondary and specialty agriculture**
  - *1)Innovations in Extension*
  - *2)Attracting Youth to Agriculture*
- **Policy support and linking farmers to market**
  - *1)National Mission on Farmer First*
  - *2)Increasing Funding Support*
  - *3)Linking Farmers to Market*

Seven Sources of Income Growth

DFI Committee identified Seven Sources of Income Growth:

I. Improvement in crop productivity
II. Improvement in livestock productivity
III. Resource use efficiency or savings in cost of production
IV. Increase in cropping intensity
V. Diversification towards high value crops
VI. Improvement in real prices received by farmers
VII. Contract farming

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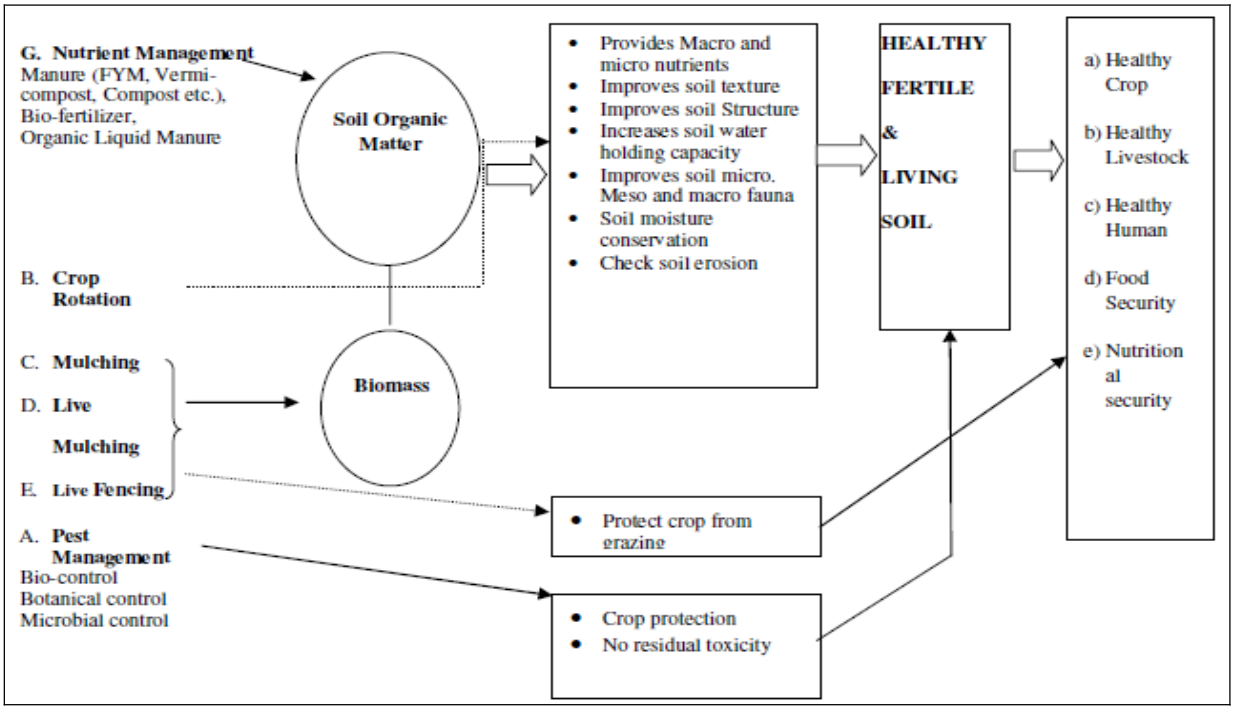
Integration of different of organic practices for sustainability of soil health



Naresh *et al*., 2018

Value-Added Agriculture?

- **Adding Value –** Process of changing or transforming a product from its original state to a more valuable state
  Value-Added Foods
- Local, organic, vine-ripened, or specialty crops
- "Gourmet" foods
  - Jams, jellies, preserves
  - Pickled vegetables
  - Hot sauces, salsas, tapenades
  - Herbed oils and vinegars
- Must consider regulatory, safety and labeling issues

Strategies for resource management

GOVERNMENT'S INITIATIVES

- Organic farming for sustainable agriculture:
- Organic matter content declined – from 1.26% (1980s) to 0.68% (2010-2011)
- Compost from farm waste using *Pleurotus*
- Vermicomposting of agricultural waste thro' demo cum training
- Bio-Fertilizer Production Units(15 BFPUs) – capacity 3850 MT – Produce and distribute 3 strains viz., *Azospirillum, Rhizobium and Phosphobacteria*
- Liquid biofertilizers – 5 BFPUs strengthened – capacity 2.5 lakh litres per annum.
- Blue Green Algae & Azolla produced and distributed to farmers
- Green manure crop seeds procured and distributed to the farmers at a subsidy of 50%.

- Enrichment of Soil Fertility through Trash Mulching in Sugarcane (2013-14) - 5000 Ha – Allocation Rs.1.01 crore

Efficiency of Water Use

Government's Initiatives

a. System of Rice Intensification (SRI
b. Sustainable Sugarcane Initiatives
c. Trash Mulching

Improved Implements and Agricultural Practices for Inclusive Growth in Income of Farmers in Dryland

- CRIDA Bullock Drawn Planters
- CRIDA Tractor Drawn Planters for timely sowing
- CRIDA Paired Row cum BBF Planter
- CRIDA Paired Row cum BBF Planter
- In situ water conservation
- Improved Machinery for Crop Residue Management

Contract Farming

In Punjab Pepsi, Punjab Agro Industries Corporation (PAIC) and Punjab Agricultural University (PAU) Partnership in Profile

The advantages of contract farming-

- Farmer gets exposure to world class agro technology Planting materials/healthy disease free nursery Crop monitoring technical advice free at his doorstep Agricultural implements.
- The farmer obtains an assured up front price & market outlet for his produce .
- Focus shifts from prices to returns per acre - driven by productivity increases .
- The private sector gets requisite quality material regularly at predetermined prices .
- Promotes long term planning and investments
- Web based scheme benefits tracking system

Strategies for improving farmer's income –

- Big focus on irrigation with large budgets and integrated policies , with the aim of "per drop, more crop".
- Provision of quality seeds and nutrients based on soil health of each field.
- Large investments in agricultural infrastructures such as warehousing and cold chains to prevent post-harvest crop losses.
- Promotion of value addition through food processing .
- Creation of a national farm market and removing distortions.
- Introduction of new crop insurance schemes to mitigate risks at affordable cost like PMFBY (Pradhan Mantri Fasal Bima Yojana).
- Promotion of ancillary activities poultry, beekeeping and fisheries .
- Other strategies that can be adopted are :-
  1) Strengthening organic food programs.
  2) Promotion of Integrated Farming System.
  3) Integrating all central and state subsidies Constraints in sugarcane mechanization

4) Considering that substantial yield gaps exist in major crops and across all regions, we have to leverage technology, adopt precision farming and ensure that farmers get correct and timely crop advisory and market information.
5) 5) To simplify, every variety of a crop has a genetic yield potential which can be achieved if a proper agronomic package is adopted.
6) There are several ideas being tried to put agricultural extension on digital medium, but a wellcoordinated approach harmonising the efforts of traditional institutions is the need of the hour.
7) 7) Likewise, irrigation efficiency too has to be addressed. The focus should be on "more crop per drop."

Principles of Strategy

- Production not a Challenge – productivity is.
- De-risk Agriculture
- Monetise the Output
- Address structural issues

Conclusions

i. Doubling real incomes of farmers by 2022 is a formidable task but it can be possible only through the proper implementation of the appropriate strategies.
ii. Public R&D institutions should be supported to develop capacity in areas of technologies such as biotechnology which appear to have great potential.
iii. Farming is a skilled profession and hence, people could be skilled and motivated through various skill development programmes of the government..
iv. Lucrative avenues can be created for those who want to leave agriculture and incentives and skills those who want to enter/continue this occupation.
v. Awareness about opportunities available for commercialisation and diversification, better technologies, facilities, markets, insurance, climate change, government policies, etc. must be created among the farmers.
vi. Higher price realisation by farmers need to be achieved through various price realisation market reforms like e-NAM and various provisions of APMC Act.
vii. Promotion of initiatives like soil health card, ICT-based agricultural extension, formation of FPO's, Integrated Farming System.
viii. Concerted and well-coordinated efforts are required to be made between the Centre and the States.

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MANAGEMENT OF INSECTS ATTACKING MANGO AND CITRUS

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Introduction

There are numerous insect pests attacking mango and citrus and over 175 species of insect have been reported damaging these trees but the major pests hinder the production and declining the yield. Major pests of these trees in the Bundelkhand region of Uttar Pradesh have been listed below. It is almost necessary to manage these pests otherwise there is a heavy fruit drop and the trees may remain without fruit.

Insect Pest of Mango

Mango hopper

It is one of the most serious pests of mango and prevalent throughout the country causing heavy damage to mango crop. Though hopper population occurs throughout the year in the orchards but occasionally it rises it population during January to April on flowering flush. Closely spaced crops where shade are more prevalent having higher humidity encourage the multiplication of the hopper. The nymph and adult pierce and suck the cell sap from tender parts resulting in vigourity reduction which leads to shedding of buds, flowers and even the young fruits. The secretion of honey dew act as a medium for the attraction of the fungus. Sooty mould development takes place giving blackish appearance. For managing the mango hopper, avoid dense planting, maintain cleanliness, prune infested shoots. Neem formulated sprays can be follow up as the hopper population appears (Azadirachtin 3000 ppm @2 ml/l). Spraying of imidacloprid (0.005%, 0.3ml/l) during early stages of panicle formation is effective. The second spray of thiamethoxam (0.005%, i.e., 0.2 g/l) or acephate (1.5 g/l) should be applied after setting of fruit. Orchardists are advised not to spray if > 50 % flowering has already occured because it will affect the activity of pollinator resulting in low fruit set.

Mango leaf webber

In Northern India, mango leaf webber is an important pest. Timely and proper management of this insect is important to save the mango for the coming year. The moth oviposits on leaves hatching in a week. The larvae scrap the epidermal surface of the leaves and then start webbing thereby feeding on entire leaves. Densely planted orchards have higher infestation rates than the normal spaced and canopy managed orchards. For managing the pest, pruned the infested shoots and burn them. Remove the webbed leaves. Spray of lambdacyhalothrin 5 EC (2 ml / lit of water) managed the pest.

Mealy bug

The gravid female oviposits in the soil in an egg sac. Mealy bugs can be seen on leaves, flowers, branches, fruits and fruit stalk. Nymph and adult suck the cell sap from leaves and inflorescence part leading to dryness and flower drop. The secretion of honey dew from their body leads to sooty mould development. Management can be adopted by removal the weeds that harbour mealy bugs. Ploughing, flooding and raking of soil exposes the eggs to sunlight and also the exposed eggs will be predate by natural enemies. Banding the tree trunk by polythene sheets of 400 gauge thickness 30

cm above the ground level and just below the branching junction avoids the climbing of the mealy bug. Application of 5% NSKE/ *Beauveria bassiana* (2g/L) near the tree trunk reduce the pest population.

Stem borer

The adult oviposits in the cracks and crevices of the bark. This pest on other fruits too. The grubs of stem borer make irregular tunnel by feeding inside the stem resulting in interruption in transportation of water and nutrient. Terminal shoots dry up in early stage and in severe case, wilting of entire branches or tree occur. To minimize the infestation of the borer, destroy the infested branches. Alternate hosts should be removed in and around the orchards. Plug the holes of the tree trunk after cleaning and insert cotton wool soaked in emulsion of DDVP or petrol /kerosene and plaster the hole with mud mixing with fungicides.

Insect Pest of Citrus

Fruit fly

Fruit fly is among the serious pests attacking different horticultural crops and is being considered as the most destructive pest. The gravid female lay their eggs beneath the fruit epidermis and maggots upon hatching feed on the fruit flesh. Oozing of liquid from the fruits, fruit rot and infestation spreads rapidly. Ultimately the quality and taste of fruits deteriorates. For managing this insect, collect the infected fruits and destroy it. Raking of the soil frequently under the trees or ploughing the infested fields after the crop is harvested is recommended as it can help in killing the pupae. Monocrotophos or nuvacron, 1-1.5 ml/l, profenofos 0.05 % or fenthion 0.1 % at intervals of 15 days commencing from flowering may be useful in minimizing the fly.

Citrus butterfly

The mature larvae are yellowish green having horn like structure on the dorsal abdomen. The early stage of larva resembles bird droppings. The young larvae feed on upper surface of the leaf lamina from margin to midrib. The grown-up larvae feed on matured leaves causing defoliation of the entire plant. For managing the damage by the insect, hand picking and removal of different stages of the pest and application of entomogenous fungus, *Bacillus thuringiensis* 1 g /L or neem seed extract 3% or quinalphos 25EC @ 2.0 l in 1500-2000 litre of water per ha can be followed.

Leaf miner

The female leaf miner oviposits singly on the underside of leaves. The larvae mines the underside of leaf. In severe infestations, the insect attacks both the surfaces and occasionally fruit. White irregular lines having silvery appearance has been observed on leaf surface. Spraying neem oil on regular basis is one of the best organic methods against leaf miner pest.

Citrus psyllids

The female psyllids lay their eggs singly on the under surface of soft young leaves. The psyllids suck the cell sap from tender leaves, which later curl up, dry and fall off. For managing the pests, timely pruning the affected trees and dried shoots is important. The following insecticides *viz*., NSKE 5 %, neem oil 10l, dimethoate 30 EC 3.0 L, imidacloprid 200 SL 250 ml in 1500-2000 L water per ha can be applied during March and again in September.

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BROWN MANURNG: NEW APPROACH TOWARDS INM

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Introduction

Climate change is impacting all farming zones, Producers also desperately trying too optimize best usage of rains that does fall. Topsoil & farming are being harmed in the same way, as cropping intensifies to satisfy global food demands and profit margins shrink, resulting in diminishing soil structure and, in some instances, reduced soils co2 emissions (Chan *et. al*., 2003). Fuel, herbicide, fumigants, and fertilizing expenses are growing while plant revenue are expanding slowly, resulting in lower profitability valuations but also Poor reverts per unit of inputs. By eliminating marginal secondary and micronutrient deficiencies, boosting the productivity of applied nutrients, and preserving favorable physical conditions in the soil, the dual use of organic fertilizers and chemical fertilizer helps in retaining yield stability. India has a large amount of bio-waste that may be processed into composts & manures and utilized in agriculture fields. However, a massive volume of biowaste is not being effectively and scientifically turned into composts and is being lost via diverse sources. Furthermore, transporting limited bulky organic manures is expensive. In contrast to break crops, Brown manuring plants' usage to interrupt insects lifecycle as well as enhance nourishment seems to be widely established, since there have been no recent comprehensive evaluations (Roper *et. al.,* 2012).

Brown Manuring

Brown farming was initially established in the Lock hart area of North-South Wales, Australia, in 1996. Mr. Goodens would be the 1st person to undertake brown manuring. This approach was to use against the weedkiller ryegrass population in Australia for winter crops. They sowed a cover crop with the intention of incorporating it into the soil before weed seedlings sprouted. This practice has aided in the rotation of chemical classes, the preservation of ground cover, the prevention of weed seedlings, the addition of useful nitrogen from pulse nitrogen fixation, and the provision of agronomic benefits including increased soil reliability & water - holding capacity to the farm's cropping system. Brown farming is a strategy that involves cultivating green manuring crops such as dhaincha, sesbania, sunhemp, and others like an inter-cropping / Mixed-cropping & destroying it with herbicides used for manuring during post-emergence. Carbon farming, or BM, are basically "No-Till" variation about GM in which a herbicides is used as volatilize this same crops before to blooming rather than cultivating. Cutting brown manure entails producing a grain legume crop with limited fertilizer and pesticide inputs in order to maximize dry matter production before the principal weed species develop viable seed. According to the brown manuring technique, Sesbania or other green manure crops are cultivated in standing crops and killed using the post-emergence herbicide for manuring where the plant residues are left standing inside this fields alongside the major crops before being incorporating / In-Situ ploughed till the residual

decomposition into topsoil, with the goal of adding OM besides ragweed's control via its shadow impact (Tanwar *et. al.,* 2010).

Crops used during brown manuring include

- Among the non-leguminous plants are wild indigo, niger, and others.
- Leguminous crops include lentil, dhaincha, sun hemp, mung, and cowpea.

Crops Which Permit Brown Manuring

1. RICE 2. PEARL MILLET 3. MAIZE 4. SUGARCANE

Brown manuring in rice is the process of cultivating *Sesbania spp.* & paddy togetherness, & After roughly 25 Days of co-culture, when *Sesbania bispinosa* plants overtake the paddy varieties in height, a weedicide 2,4-dichlorophenoxy acetic acid may be applied to kill the *Sesbania grandiflora L.* plant. *Sesbania grandiflora L.* plant may turn Brown & die within 4-5 Days of Spraying; leaves will fall to the ground, forming mulch and aiding in weed smothering. Because it's such a selective herbicides, it only kills Sesbania plants yet not rice plants. This is known as the down knocking affect.

Sesbania is a living cover that provides weed hindrance (during the pre-killing stage) and afterwards as a dead residue mulch provides stimulation via the addition of organic matter (at post-killing period). Because brown manure crops are planted between the lines of the main crop, the planting density in the fields was high, resulting in little free area for weed to spread, resulting in a low weed population. During BM, knocking downs *Sesbania grandiflora L.* with 2,4-dichlorophenoxy acetic acid accelerates degradation & released nutrients found in *Sesbania grandiflora L.* when comparing too In-Situ assimilation. *Sesbania grandiflora L.* might contribute carbon & nitrogen to the earthensoil, facilitating appropriable microbiological activity. Furthermore, after the breakdown of *Sesbania grandiflora L.*, some Natural Acid and Allelochemicals were produced, it may have a depressing impact on the weeds seed company. Brown manuring treatment improves soil fertility and reduces weed competition, resulting in increased crop yield.

Facts about Brown Manuring

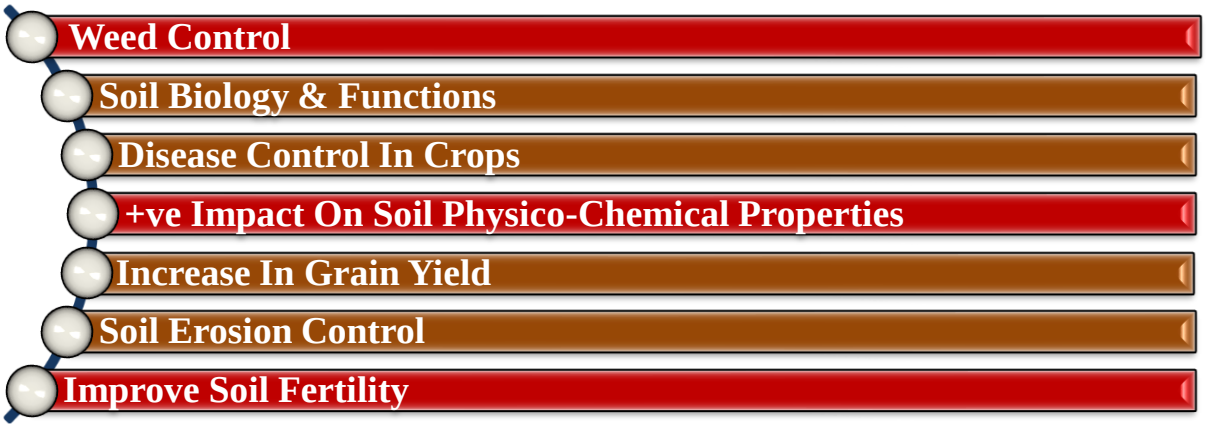
- Herbicides are employed to destroy the manure crops & weed in this no-till type of green manuring.
- The plants have been kept standing to protect the lighter soil from erosion.
- During the practice, moisture will be preserved, and chemical desiccation will occur.

Qualities of an Ideal Brown Manure Crops

Growers can enhance to control the weeds & fixation of N while reducing expense and risk by using crops species who are most suitable to brown manuring. The following are the most important factors to consider while choosing brown manuring crops:

- Plant seeds should be readily available and reasonably priced.
- It should be simple to cultivate and grow vigorously
- It should produce a lot of dry matter in a short amount of time
- It should be competitive with target weeds
- It should have a lot of ground cover to decrease wind erosion and retain moisture
- This will not conflict with the primary crop

Advantages of Brown Manuring



Conclusion

Given the rising expense of pesticides and fertilizers, brown manuring might be seen as an alternative approach to increased crop yield and productivity, hence improving farmer revenue. Brown manuring is a practice that involves returning plant debris to the agroecosystem in order to restore fertility of the soil & nutrient availability while also taking into account the soil's physical and biochemical properties as well as the Agricultural economy. Also it helps to preserve groundwater, decrease grass-weeds & viral-diseases issues, and offset greenhouse gas emissions. Brown manuring may be utilized as a beneficial strategy for increased crop output and therefore benefit for farmers since it is environment friendly and significantly reduces weed but also provides nutrients to the soil. It should therefore be extensively promoted by extension organizations in order to reap the advantages for the nation's agricultural community.

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Interests in Conflict

There are no conflicts of interest declared by the authors.

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