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BIOFORTIFICATION: A WAY OF REDUCING MALNUTRITION

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Abstract

"Malnutrition and lack of micronutrients are affecting the growth of poor children. Looking at this, it has been decided to fortify the rice given to the poor via different government schemes such as the public distribution system (PDS) and mid-day meal (MDM) will be fortified by 2024."- said PM Narendra Modi. Every second woman in India is anaemic, and every third child is stunted, according to WHO reports, making undernutrition one of the country's major problems. According to a recent study by NFHS-5, things had gotten worse than they had in the previous study by NFHS-4, necessitating the need for rapid action. The government just started using the +F logo on packaging and labelling.

Micronutrient Malnutrition : Micronutrient malnutrition, a sneaky kind of hunger, affects billions of people in resource-poor families in developing nations. Deficits in iron, iodine, zinc, and vitamin A are their main problems.

Global Status of Malnutrition:

1. Two billion people suffers from malnutrition worldwide
2. 795 million people are undernourished world-wide.
3. 155 million stunted children who are less than 5 years.
4. Malnutrition contributes to 11% loss in GDP in Asia and Africa.

Deficiency Symptoms:

Iron (Fe):

a. Anaemia: Infants, children, adolescent and especially pregnant women.
b. Severe Anaemia: Women death occurred during childbirth.
c. Impairs mental development and learning capacity during childhood and adolescent stage.
d. Reduce the ability to do physical work in adults.

Zinc (Zn):

a. Growth retardant: Delayed sexual and bone maturation, diarrhoea, impaired appetite.
b. Increased susceptibility: Infectious mediated via defects in the immune system.
c. Severe form of Zn deficiency: Short stature, hypogonadism, impaired immune function, skin disorders, cognitive dysfunction and anorexia.

Vitamin A:

a. Night blindness
b. Keratomalacia
c. Growth retardation and reproductive disorders
d. Easily exposed to measles, diarrhoea, and respiratory disease.

Concept of Biofortification : The production of nutrient-enhanced food crops with greater bioavailability for the human population using contemporary biotechnology techniques, traditional plant breeding, and agronomic approaches is known as "biofortification" or "biological fortification." Typically, it refers to the process of creating foods with higher nutritional content. The food's flavour, aroma, or texture are not changed. It is a cost-effective strategy and/or practical method that doesn't need people to alter their eating routines or patterns.

What is +F logo?

The Food Safety and Standards Authority of India (FSSAI), which created the "+F" logo for fortified foods, states that food fortification is necessary to fight the long-term effects of malnutrition and deficiencies. Consumers will be able to tell which products are nutrient-dense thanks to the recently introduced blue sign +F on packets of common foods like oil, milk, double-fortified salt, wheat flour, and rice. To control the provisions relating to fortified foods, FSSAI introduced the Food Safety and Standards (Fortification of Foods) Regulations, 2018, on August 2.

FORTIFIED
SAMPOORNA POSHAN
SWASTH JEEVAN

The following are some of the key elements of the regulations:

- It outlines the specifications for incorporating micronutrients into food to strengthen it. Producers of the fortified food must submit a quality assurance undertaking.
- Packaging and labelling must include information about food fortification, the +F logo, and the slogan "Sampoorna Poshan Swasth Jeevan."
- Additionally, it is important to adhere to the Food Safety and Standards (Packaging and Labelling) Regulations.

Need of +F logo

Food packages with the blue +F symbol will be instantly recognisable and make it easier for consumers to determine which goods are nutrient-rich. Additionally, it guarantees that the proper amount of micronutrients has been added, making these foods safe for eating. Since nutrients are added to the commonly ingested staple foods. As a result, this is a fantastic way to enhance the health of a significant portion of the population.

Importance of Biofortification

- **Selective addition of nutrition:** The process of biofortification makes it possible to incorporate particular nutrients into a given crop through genetic engineering or selective breeding.
- **Reduces need for overspending on food:** In underdeveloped countries, where the majority of people cannot afford to spend more money on nourishing food, biofortification is a lifeline.
- **Enhances human productivity:** Human productivity is significantly decreased when sufficient nutrients are lacking. Effective nutrition provision can considerably increase productivity.

How Biofortified Crops Improve Food and Nutrition Security?

1**. Better agronomic characters:** Greater yield, resistance to pests, tolerance to stresses which improve food security.

2. Higher nutritional concentration: More iron, zinc, beta- carotene and/or tryptophan and lysine which improve nutritional security.

Demonstrated Impact of Bio-Fortified Crops:

1. Iron-biofortified rice: Increased by 20% storage iron in non-anaemic women of reproductive age (Philippines).

2. β-carotene-biofortified sweet potato: Reduced by 37% pre-schooler's with vitamin A deficiency and improved by 10% storage vitamin A in school-age children (South Africa).

3. Lysine- and tryptophan-biofortified maize (QPM): Improved children's growth by 9-12% (8 studies in Latin America and Africa).

4. Zinc-biofortified wheat: Improved zinc absorption by 33% in women of reproductive age (Mexico).

Biofortified Varieties

- **Rice:** CR Dhan 310 (protein rich variety), DRR Dhan 45 (zinc rich variety)
- **Wheat:** WB 02 (zinc & iron rich variety), HPBW 01 (iron & zinc rich variety)
- **Maize:** Pusa Vivek QPM9 Improved (provitamin-A, lysine rich hybrid), Pusa HM4 Improved (lysine & tryptophan rich hybrid), Pusa HM8 Improved (lysine & tryptophan rich hybrid), Pusa HM9 Improved (lysine & tryptophan rich hybrid)
- **Pearl millet:** HHB 299 (iron & zinc rich hybrid), AHB 1200 (iron rich hybrid)
- **Lentil:** Pusa Ageti Masoor (iron rich variety)
- **Mustard:** Pusa Mustard 30 (low erucic acid variety), Pusa Double Zero Mustard 31 (low erucic acid & low glucosinolate variety)
- **Cauliflower:** Pusa Beta Kesari 1 (β-carotene rich variety)
- **Sweet Potato:** Bhu Sona (β-carotene rich variety), Bhu Krishna (anthocyanin rich variety)
- **Pomegranate:** Solapur Lal (iron, zinc & vitamin-C rich variety)

Standards for Fortification?

Under the Ministry's guidelines, 10g of FRK must be blended with 1 kg of regular rice. According to FSSAI norms 1 kg of fortified rice will contain: 28-42 mg Iron, 10-15 mg Zinc, 75-125 microgram Folic Acid, 500-750 microgram Vitamin A, 1-1.5 microgram Vitamin B1, 0.75-1.25 microgram Vitamin B12.

Prerequisite for Biofortification

1. There is enough genetic diversity available within the species' gene pool.

2. A fair amount of phenotypic stability across different edaphic habitats and temperate regions.

3. Plant breeding through selective breeding is used to create crop types that are biofortified.

Conclusion

Future predictions indicate that vitamin and mineral deficiency will become increasingly harmful, and biofortification is emerging as a viable remedy. The current nutritional issues connected to micronutrients are addressed via biofortification. The most economical and environmentally friendly way of biofortification to address micronutrient shortages is plant breeding. Given a low-cost, straightforward, and crop-based approach, the biofortification technology has tremendous promise for tackling the problem of micronutrient deficiencies in the developing countries. Farmers can multiply seeds over years at almost little marginal cost, and it only requires a one-time investment. With the introduction of various biofortified crop varieties that are assisting in overcoming micronutrient deficiencies in the target populations, there has been significant

advancement in this area. With further planned study and sensible legislation, biofortification may experience significant success in the years to come.

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INNOVATIVE POSTHARVEST MANAGEMENT TECHNOLOGIES : EFFECTUAL DRIVER OF AGRICULTURAL SUSTAINABILITY

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Summary
Innovative postharvest management technologies are imperative to ending global rural poverty and food problems. In the postharvest subsector, the dire economic and food security consequence of postharvest losses have led the Nigerian Stored Products Research Institute to develop innovative technologies that improve income, food security and standard of living of farm households without depleting the resources available to future generations. These eco-friendly and climate change compliant technologies include NSPRIDUST^{TM}, Parabolic shaped solar dryer, Evaporative cooling system, and NSPRI Solar cold storage system.

Introduction
Sustainability in agriculture revolves around the need to develop technologies and practices that are accessible, effective, and lead to improvements in food productivity within the limits of available natural, physical and social resources (Morelli, 2011). Ultimately, sustainability in agriculture aims at promoting farming practices and methods that are economically viable, profitable, good for communities, and improves the quality of life of farm families without compromising the ability of future generations to achieve same (Mensah and Enu-Kwesi, 2018). Though there is no agreed universal path to agricultural sustainability, even so, it is imperative to recognise that most sustainable agriculture systems require a high level of farmer skills and management to function optimally. Interestingly, while contemporary agriculture as it were produces considerable output within a given time, it comes with a number of problems that require sustainable agriculture fixing; foremost amongst these is how to systematically handle commodities after harvest and ensuring that harvested products reach the consumer.

Agriculture intensification schemes in most developing countries of the world, especially in sub-Saharan Africa and Nigeria in particular are aimed at improving income, food security and standard of living of farm households. Nevertheless, enhanced production devoid of matching boost in postharvest management skills and use of traditional postharvest technologies for processing may worsen postharvest losses in all of its facets. What's more, postharvest losses in sub-Saharan Africa (SSA) are in the region of 30% (James & Zikankuba, 2017) and translates to 1.3 billion metric tons of food that does not reach the consumer (Ambuko, 2017). This loss, based on an assumed daily caloric intake of 2,500 per person, represents sufficient food to feed over a billion people. Categorically, the Food and Agriculture Organization of the United Nations (FAO) (2011) estimated that the value of postharvest losses in grains alone in SSA is a whooping USD 4 billion per year. In view of the dire economic and food security consequence of postharvest losses painted above, postharvest management technologies and practices become unavoidable.

Postharvest management is a system of handling, processing, storing, and transporting commodities after harvest. The significance of postharvest management is that it has the potential to meet food need of a rising population by reducing losses (a significant shrink in postharvest loss can lessen food insecurity) and making more food obtainable from raw commodities through proper processing. It strengthens the action chain that produce, transport, and process food and all other related products that give sustenance to the ever growing world population and emphasizes focus on preserving quality, and safety of the commodities. Besides, a well-managed postharvest system will result in better quality, higher value for commodities and products, and improved income. Simply put, if agriculture is to be used for uplifting people out of poverty, then, creative and effective postharvest management technologies that are eco-friendly and climate change compliant must complement sustainable agricultural production activities.

Postharvest management can be a difficult task for smallholder farmers and handlers, and artisanal processors for the reason that they work with limited resources, unskilled manpower, and insufficient financing etcetera. Mismanagement and limited capacity for postharvest handling and processing undermines profitability, predisposes produce and processed products to contamination among others. For example, untoward postharvest management practices have led to about 33% of food produced globally going to waste (Terzo, 2020). By the same token, poor quality products occasioned by ineffectual postharvest mismanagement have led to loss of income and subsequently difficulty in maintaining a decent quality of living for farmers, handlers, and processors alike.

Dearth of creative postharvest management skills as well as technologies such as temperature control to maintain cold chain and limited value addition skills have been the bane of increased income and food security among rural farmers, handlers and processors of fruits and vegetables in underdeveloped countries. However, the massive improvement in standard of living in Asia as a consequence of The Green Revolution is an indication that utilization of effective postharvest management methods is a sine qua non requirement for agricultural transformation and poverty reduction, both core components of the concept of agricultural sustainability. Standing on this premise, some creative, simple, low cost postharvest management approaches and technologies by Nigerian Stored Products Research Institute (NSPRI), a foremost postharvest research institute in the West African sub region in recent times to spur increased productivity in the postharvest subsector that are sustainable include:

NSPRIDUST^{TM} : This is a grain protectant sourced from diatomaceous earth. It is mainly employed as control against insect pests' attacks and may be applied to grains as powder or used in form of slurries for surface treatment in silos and warehouses. The product grazes and absorbs lipids from the thin waxy protective outer layer covering the surfaces of insects causing loss of body fluid and eventual death within hours or days. It kills most stored grains insects, suppressing their ability to multiply. NSPRIDUST^{TM} is devoid of mammalian toxicity in contrast to synthetic pesticides.

Parabolic shaped solar dryer : This is a parabolic-shaped multi-crop dryer used for drying agricultural produce under hygienic conditions. It is made of transparent acrylic polythene materials which are able to generate solar heat. The dryer has two pneumatic aspirators to suck away moisture from the dryer, two solar power fans to circulate heat evenly in the chamber, and an insulated floor built with polyurethane material to check heat loss. The dryer is capable of drying most grains, roots and tubers, fruits and vegetables, small sized low fat fish etc.

Evaporative cooling system : This is a humidity chamber used for the short term extension of shelf-life of fresh fruits and vegetables soon after harvest. It reduces the temperature and increases

relative humidity which is essential for maintaining the freshness of the commodity. There are majorly two variants: metal-in-wall and wall-in-wall. Depending on the variant, the space between the first wall/metal and the wall/metal is filled with river – bed sand. The sand is kept moist by watering intermittently depending on the prevailing weather condition.

NSPRI Solar cold storage system : This is a solar-powered technology for continuous off-grid storage and preservation of fruits and vegetables and other perishable foods. It is an integrated system whose workings may be upgraded through the attachment of unconnected components. It is made of insulating panels that retains low temperature. High capacity batteries linked to an inverter are used to store energy from solar panels fixed on the roof-top of the cold room which in turn feeds the refrigerating unit. It extends the freshness of harvested produce within the region of 2 to 21 days.

Figure 1: NSPRIDUST™

Figure 2: Parabolic shaped solar dryer

Figure 3: Evaporative cooling system

Figure 4a: Solar cold storage system

Figure 4b: Solar cold storage system (roof)

Conclusion

The Nigerian Stored Products Research Institute contributes to efforts aimed at achieving effectual agricultural sustainability by deploying creative innovative postharvest management technologies such as NSPRIDUST™, Parabolic shaped solar dryer, Evaporative cooling system, and NSPRI Solar cold storage system. These technologies are effective, economically viable, and engender food security within the confines of existing resources and do not preclude the capacity of future generations to achieve same.

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CRISPR/CAS - NOVEL GENOME EDITING TOOL

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What is CRISPR/Cas?

A rapidly evolving genome editing tool Clustered Regularly Interspaced Short Palindromic Repeats associated Cas9 system derived from the bacterial immune system which helps bacteria in protecting themselves from invading foreign DNA like bacteriophage. It is a reasonable, easy, convenient, and quickly adopted genome editing tool transforming into revolutionary model. Many different organisms and tissues are precisely edited and modified by this technique. Cas9 gene sequences for non-coding RNA element called crRNA (CRISPR RNA) & sequences for trans-encoded CRISPR RNA (tracrRNA) combinedly present at CRISPR loci. The two RNA sequences crRNA & tracrRNA dorms complex called guide RNA, which governs the specificity of the breakage of the target sequence in the nucleic acid along with Protosapcer Adjacent Motif (PAM) a 5' NGG sequence. Within the protospacer region the breakage occurs in double stranded target DNA and Cas9 protein is an endonuclease which causes double stranded breaks (DSBs) at the site, when targeted by a guide RNA.

Mechanism

- The fundamental step in altering an organism's genome is selective targeting of a particular DNA sequence.
- The interaction of two biological microtubules, the Cas9 protein and the guide RNA interacts in complex that has a high selectivity for identifying targets sequences.
- In both the natural & artificial CRISPR/Cas systems the Cas9 protein is in charge of finding and cleaving the target DNA as shown in Fig.1.

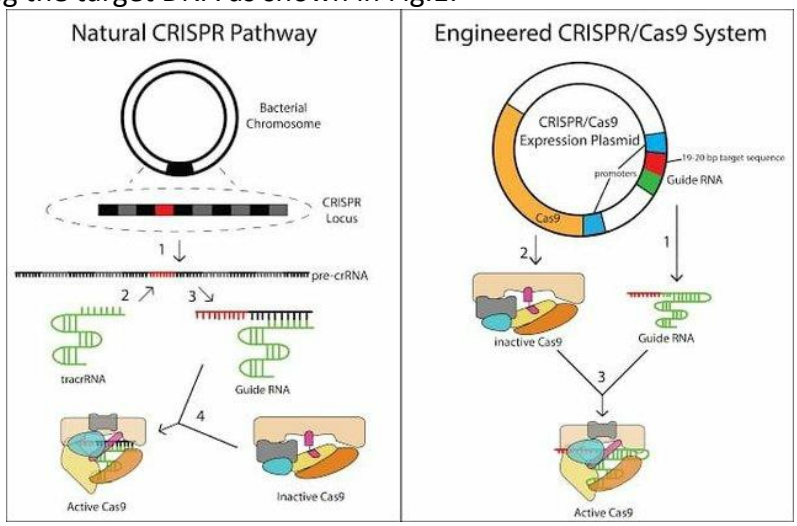

Fig.1

- Six domains REC I, REC II, Bridge Helix, PAN interacting, HNH & Ruvc present in the Cas9 protein.
- The REC I domain is the largest and is in charge of binding guide RNA.
- The PAM interacting domain confers PAM specificity & as a result, it is in charge of initiating binding to target DNA.
- The cleavage of single strand DNA is done by nuclease domain i.e. HNH & 2 Ruvc domains.
- In the absence of guide RNA, the Cas9 protein remains inactive.
- Guide RNA in engineered CRISPR system is made of a single strand of RNA that forms a T shaped with one tetra loop & two or three stem loops.
- The guide RNA is manipulated to have 5' end that is complimentary to the target DNA sequence.
- This engineered guide RNA binds to Cas9 protein as shown in Fig.2. causes a conformational change in the protein and this conformational change causes the inactive protein into active form.

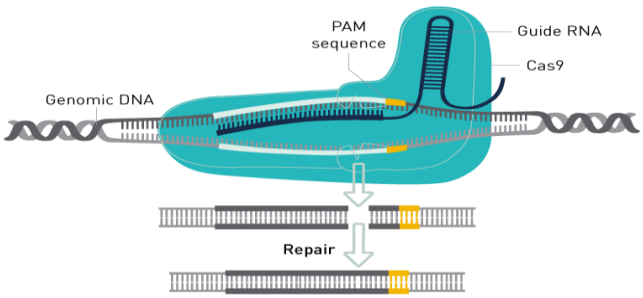

Fig.2

- The conformational change mechanism is not fully understood, it is believe that steric interactions or weak protein side chain binding & RNA bases could causes the change.
- When the Cas9 protein is activated, it looks for binding with sequence for the target DNA that matches its protospacer adjacent motif (PAM) pattern.

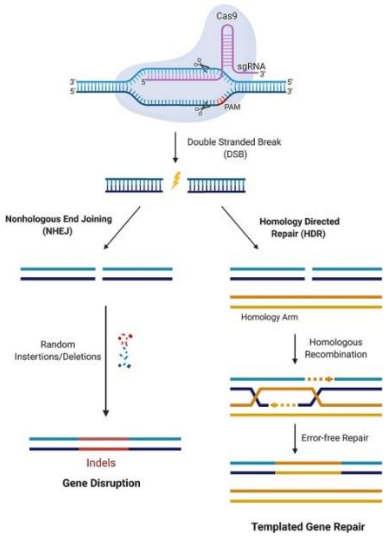

Fig.3

- PAM is two or three-base sequence that is located with nucleotide downstream of the guide RNA region.
- When the Cas9 protein discovers a potential target sequence with the appropriate PAM, the protein will immediately melt the bases and pair them upstream of the PAM on the guide RNA's complementary regions.
- If the complementary and targeted regions correctly pair, the Ruvc & HNH nuclease domains will cut the target DNA after the third nucleotide base upstream of the PAM.

Pros & Cons

Pros -

- To meet the widespread food insecurity by increasing yield & crop quality can be achieved through genome editing tool.
- It is tolerant against yield loose caused by pathogen and other abiotic stress & herbicide resistant crop varieties can be developed by gene insertion and replacement.
- Using CRISPR/Cas mediated gene knockout huge progress has been made to produce male sterile lines & High throughput plant mutant libraries can be generated.
- Novel breakthrough application is in base editing, trans gene free genome editing, multiplex genome editing using CRISPR.

Cons –

- The modification is unnatural and ethical dilemma arises by such practices.
- Sometimes smallest changes made at the minor level may lead to unexpected results.
- Genetically modified plants will have a detrimental effect on our genetic diversity.
- A well-known fact about such techniques they are costly so they are called as Rich people's tool.

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ENVIRONMENTAL EXTERNALITIES OF AGRICULTURE SECTOR

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Introduction

Agriculture sector plays a significant role in the Indian economy by providing subsistence to more than half of the population. This sector is vital to rural livelihoods, employment, and national food security. While India is rising in various other sectors, such as IT, service sectors, etc., India remains primarily a farming society. Agricultural productivity has increased significantly over the last few decades. This rise is due to the adoption in India of modern farming techniques involving improved irrigation, high-yielding varieties, agrochemicals, and the mechanization of farms. The high-yielding varieties are more demanding because their use has increased the need for inputs like irrigation, pesticides, and fertilizers. Pressures on the agro-ecosystems are continuously rising because of the chemical overload. The very agro-inputs responsible for increasing agricultural production increasingly show signs of threats to the community's climate, health, and socio-economic well-being. Furthermore, in many parts of the country, monoculture, continuous cultivation of improved varieties, and excessive application of agrochemicals have resulted in high incidences of insect pests and diseases.

Externalities arise when certain actions of an individual have unintended external (indirect) effects on another individual. There are two kinds of externalities, i.e., positive and negative externalities. The former arises when an individual's behavior creates a beneficial outcome for society or other entities. When an individual or a group act in a way that harms others, this is known as a negative externality. A technological spillover is a beneficial externality that happens when the invention of a product benefits the business and enters the pool of technical expertise within society, which helps society as a whole.

Positive externalities of the agriculture sector:

1. **Land Saving due to Recycling of Crop Residues as Animal Feed:** In mixed farming systems, livestock production saves land by using or recycling crop by-products, viz., dry and processed forage as animal feed. Unless the by-product feeds were replaced by feed grains or cultivated green fodder, that would need vast additional land to generate so much feed and fodder. Land conservation is a beneficial impact on the environment.
2. **Land Saving due to Dung as a Substitute for Fire-wood in Domestic Fuel:** Another way to save the land from livestock production is by providing dung as domestic fuel. Around 37 percent (235 Mt) of the total wet dung produced (635 Mt) is domestic fuel. As fresh dung consists of about 80 percent moisture, the total dry dung cake production was estimated to be 47 Mt. At a replacement rate of 3.54 in terms of thermal energy, if this amount of dung cake were to be replaced by fuelwood, India would require 13 Mt of fuelwood in addition to whatever quantity is produced otherwise. To produce this large amount of fuel wood, about 1.62 Mha of land will have to be constantly put to cultivate fuelwood plants with 4.5 years of gestation lag (Dikshit and Birthal, 2013).

3. **Saving of Chemical Fertilizers due to Use of Dung as Manure:** After meeting its demand as food, the remaining dung is used as manure to fertilize crops, showing the savings in using chemical fertilizers. Around 76 Mt of dung (based on the dry matter) is used as manure. The total availability of soil nutrients from manure was 1.22 Mt comprising 0.54 Mt of N, 0.14 Mt of P, and 0.54 Mt of K; it adored about 6 percent of the total nutrients used in the country in 2007 (Dikshit and Birthal, 2013).
4. **Saving of Fossil Fuel due to Use of Animal Energy in Agriculture:** To estimate the contribution of animals to saving fossil fuel, we need (i) the substitution or substitution rate between working animals and tractors and (ii) the fossil fuel (diesel) needed per tractor per year for replacement animals' work. It is a purely engineering rate of substitution between working animals and tractors. A bullock is rated at 0.4-0.5 HP (horsepower). As a result, a 35 HP tractor should be able to replace at least 70 bullocks (Dikshit and Birthal, 2010).

Negative Externalities:

1. **Degradation by land-use conversion:** There are four types of native (pre-agricultural) lands: prairies (step), wetland, forest, and arid lands (desert). We need to be converted to use these lands. The practices of conversion include slash burning accompanied by ploughing (prairie, forest), drainage (wetlands), and irrigation (arid lands). The transformation through the conversion phase generates pollution and pollutant loads which are usually many orders of magnitude higher than the original native land's background loads. The most dangerous activity is deforestation. Eighty percent of tropical deforestation is caused by non-traditional, shifting cultivation, i.e., small fanners clear and burn a few hectares of land a year, mainly for food production. Deforested land has lost much of the topsoil, and no return to the forest has been returned. In addition to soil loss, the conversion of native land to agriculture changes soil chemistry, leading to significant chemical loss. For example, conversion of prairies into arable land and drainage of wetlands triggered nitrification of large amounts of organic nitrogen stored in the native soils and released large quantities of nitrate into groundwater and subsequently into the base surface flow.
2. **Increased erosion and soil loss:** Except for arid lands, soil loss from fields by erosion is at least an order of magnitude higher than the normal loads. The critical source of diffuse contamination is soil erosion, and sediment is also the most visible pollutant. The environmental impacts of excessive erosion and sedimentation caused by agriculture can be listed as follows-
    - Excessive sediment loading on receiving waters includes deterioration or destruction of aquatic habitats. Excessive deposition of sediments in slow-moving reaches and impoundments blankets the bottom fauna, "paves" the bottom of the streams, and destroys fish spawning areas. Sediment can destroy spawning areas and food sources and harm fish and other aquatic wildlife.
    - Excessive sedimentation triggers a rapid depletion of reservoir storage ability and an accumulation of deposits that hinder everyday biological life. In many parts of the world, reservoirs constructed on sediment-laden streams were filled in just a few years, even before the reservoir's entire purpose was achieved.
    - Sediment-borne nutrients will promote algal growth and thus speed the eutrophication process. The soil and suspended water adsorb phosphates and, to a lesser degree, ammonia from fertilizer applications and waste discharges.

- Sediment - especially its fine fractions - is a primary carrier of other pollutants such as organic components, metals, ammonium ions, phosphates, and many organic toxic compounds. For example, persistent organochlorine compounds, such as aldrin and dieldrin pesticides, have low water solubility but are readily adsorbed by suspended sediment.

3. **Chemical pollution by fertilizers and pesticides:** Streams and lakes in agricultural areas that were reasonably clean now suffer from excessive algal growth and eutrophication caused by nutrient discharges from fields and animal operations. The unreasonable application of agricultural chemicals caused the most severe water quality changes. Groundwater previously safe for drinking is now unsuitable for human consumption due to a high nitrate content and contamination by organic chemicals, many of which are carcinogenic.
   Pollutants exist in soils in two phases: (1) as a part of paniculate soil matter and (b) dissolved in the pure water of the soil. More than 99 percent of most pollutants (except nitrate) are stored in paniculate form. Less than 1 percent is dissolved; however, the dissolved fraction is essential because it represents the fraction that is bioavailable to organisms. The pollutants associated with particulates can be moved by erosion. Dissolved contaminants can be leached by diffusion and move with water either into surface or groundwater runoff.
5. **Pollution from animal operations:** Animal pollution may be divided into that from pastures and concentrated animal operations (feedlots). Dairy farming for meat differs from cattle grazing, where cattle are spread in pastures. Milking of dairy farms demands that the cows be gathered daily in a concentrated area for milking. Though small (typically less than one hectare), these barnyards produce very high pollution loads. Phosphorus production by one dairy cow or heifer is 18 kg/year. Of that amount, a significant portion may reach the receiving water bodies (Dikshit and Birthal, 2010).
4. In the past several studies quantified that methane was emitted from livestock production. These studies have shown wide variations, ranging from 8.5 Mt to 10.5 Mt, depending on the methods and data used and the year for which the gas emission was estimated (Lerner *et al*., 1988, Singh *et al*., 2012). The Indian Climate Change Assessment Network reports that the agricultural sector released 334 Mt of CO_2 in 2007, of which livestock accounted for about 63%.

Conclusion

There are solid and complex linkages between policies and practices in land use, economic incentives, land degradation, and water quality impairment. In solving agricultural pollution problems, it is essential to differentiate between the root causes of pollution and its symptoms. For example, eutrophication is a symptom of anthropogenically enhanced input of nutrients from agricultural lands. Still, the root cause is poor land management practice that may reflect economic subsidies for fertilizers, failure to internalize the external cost of pollution, and lack of enforceable pollution control laws. Since overburdening receiving waters with waste fertilizers and pesticides from agriculture usually results in a diminished use or even loss of the water resource for other beneficial services, society must balance its needs. Agricultural production models or policies are urgently required which internalize the external costs of pesticide use and environmental degradation and encourage the conservation of natural capital in production processes and markets. The first step is to raise awareness within the farming community of the economic costs of pesticide use.

Generally, externality can be overcome by the following economic/legislative instruments:

- ✓ Government intervention, e.g., by imposing limits or bans on using certain lands for agricultural purposes, or on use of fertilizers and pesticides as well as mandatory and enforced water quality standards; and

- ✓ Using economic instruments such as fees for pollution discharges or subsidies, e.g., implementing Best Management Practices.

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A BEST SOLUTIONS TO THE PLASTIC WASTE PROBLEM: EXTENDED PRODUCER RESPONSIBILITY

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Introduction

Recently, the Union Environment Ministry has come out with a draft notification for regulation of Extended Producer Responsibility (EPR) under Plastic Waste Management rules 2016. The draft specifies the quantity of waste that will have to be managed by producers, importers and brand owners who generate plastic packaging waste in India. Earlier, the Ministry had notified the Plastic Waste Management Amendment Rules, 2021. These rules prohibit specific single-use plastic items which have "low utility and high littering potential" by 2022.

What is Extended Producer Responsibility (EPR)?

According to the OECD definition, Extended Producer Responsibility (EPR) is "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle".

Extended Producer's Responsibility (EPR) is a concept under which producers are given a significant responsibility– financial and/or physical – for the treatment or disposal of products post-consumption. It is a mixture of environmental, economic, and social factors.

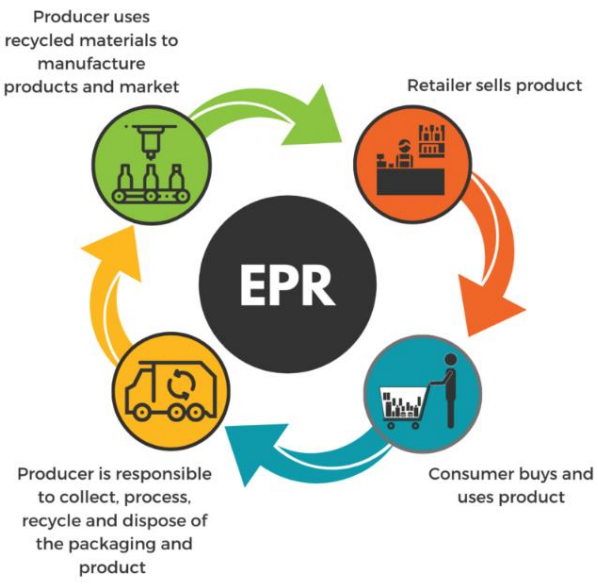


Figure 1. Extended Producer Responsibility (EPR)

The origins of EPR: It all started with Thomas Lindhqvist in 1990 at Sweden's Lund University, when he introduced the EPR concept in a report to the Swedish Ministry of the Environment.

Objectives of EPR are:

1. Integration of environmental costs
2. Improved waste management
3. Reduction of disposal
4. Reduction of a burden on municipalities
5. Design of environmentally sound products

Benefits of the EPR

1. EPR causes producers to change packaging design and selection, leading to increased recyclability and/or less packaging use.
2. It promotes the principle of "polluter pays" by holding the producer accountable for the entire lifecycle of the product.
3. It provides additional funds for recycling programs, resulting in higher recycling rates.
4. It improves recycling program efficiency, leading to less cost, which provides a benefit to society.
5. It results in a fairer system of waste management in which individual consumers pay the cost of their own consumption, rather than general taxpayers.
6. It decreases the environmental impact from a product and its packaging.

Figure 2. Benefits of the Extended Producer Responsibility (EPR)

Disadvantages

1. It is speculated that such laws could increase the cost of electronics because producers would add recycling costs into the initial price tag.
2. There are concerns that manufacturers may use recall programs to pull second-hand electronics off the reuse market, by shredding rather than reusing or repairing goods that come in for recycling.
3. Fees are set in place to help incentivize recycling, but this may deter the use of manufacturing with better materials for different electronic products.

Key Points of Extended Producer Responsibility (EPR):

1. It mandates producers of plastic packaging material to collect all of their produce by 2024 and ensure that a minimum percentage of it be recycled as well as used in subsequent supply.
2. Producers of plastic will be obliged to declare to the government, via a centralised website, how much plastic they produce annually.
3. Makers and users of plastic packaging can collect certificates, called EPR certificate and trade in them.
4. Entities that do not meet their targets or do not purchase enough credits to meet their annual target must pay a fine.
5. Were they to meet their targets within three years, they stand to get a 40% refund. Beyond that, however, the money will be forfeited.
6. Funds collected in this way will be put in an escrow account and can be used in collection and recycling/end of life disposal of uncollected and non-recycled/ non-end of life disposal of plastic packaging waste on which the environmental compensation is levied.
7. From July 2022, the manufacture of a range of plastic products will be banned. The list includes: Earbuds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks etc.

Categories Covered under Plastic Packaging draft

Category I: Rigid plastic packaging

They are plastic products that do not give easily when squeezed. Many are large, bulky items like lawn chairs, buckets, toddler toys etc.

Category II: Flexible plastic

It includes packaging of single layer or multilayer (more than one layer with different types of plastic), plastic sheets and covers made of plastic sheet, carry bags (including carry bags made of compostable plastics), plastic sachet or pouches.

Category III: Multi-layered plastic packaging

They are the plastics which have at least one layer of plastic and at least one layer of material other than plastic.

Targets: Companies will have to collect at least

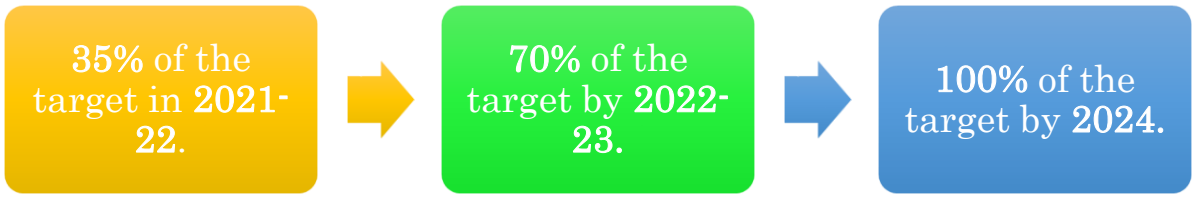
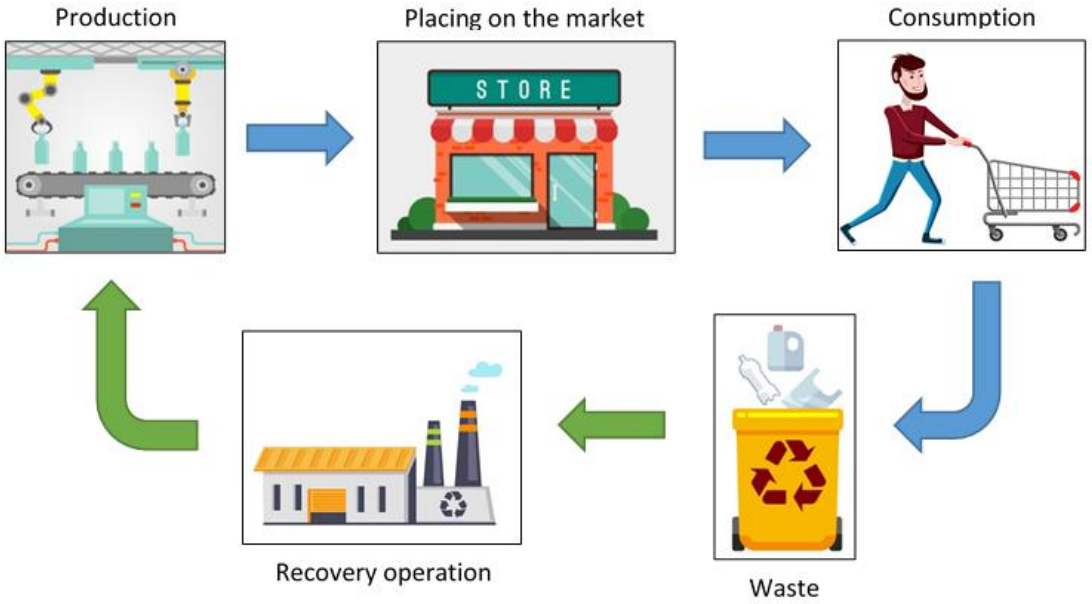


Figure 4. Targets for Plastic manufacturing companies

In 2024, a minimum 50% of their rigid plastic will have to be recycled as will 30% of their category 2 and 3 plastic.



Suggestions for effective management, Plastic packaging can be grouped into three categories:

1. **Recyclable and effectively handled by the informal sector: G**overnment could support and strengthen the informal recycling chain by bridging gaps in adequate physical spaces, infrastructure, etc.
2. **Technologically recyclable but not economically viable to recycle:** Market value secondary plastics can be increased by increasing the demand for and use of recycled plastics in packaging, thus creating the value to accommodate the current costs of recycling.
3. **Technologically challenging to recycle (or non-recyclable): E**nd-of-life processing technologies should be closely evaluated, based not only on their health and environmental impacts, but also on the implications for continued production of low-quality and multi-layered plastics.

Other suggestions

1. Undertake **research/feasibility studies** including on the benefits and opportunities of establishing an EPR scheme.
2. It includes investigating examples of well-established EPR schemes in other countries;
3. **End-of-life processing technologies should be closely evaluated**, based not only on their health and environmental impacts, but also on the implications for continued production of low-quality and multi-layered plastics.

4. Government should support the **necessary waste collection infrastructure** and **development of markets for recycled material**.

Conclusion

EPR mechanisms for packaging emerged in the late 1980s and have since been implemented in most European Union member states as well as in some other countries.

- The fee serves for the collection and further handling of the packaging waste.
- Ensuring the collection, sorting, recycling or energy recovery of packaging waste remains in the responsibility of the obliged companies.
- EPR involves producers in the management and financing of packaging waste.
- Gives them the opportunity to assume responsibility for their waste.

The government should redo the consultation process for the draft guidelines and involve informal workers. The scope of plastics covered by the guidelines could be altered to exclude those plastics which are already efficiently recycled and to include other plastic and multi-material items.

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HYBRID SEED PRODUCTION IN CARROT (DAUCUS CAROTA)

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Abstract

In Brazil, the production of organic carrots has increased in the last five years. In organic farming systems, seeds should only be obtained from organic sources. In this experiment, different GA3 solution concentrations were used to soak carrot cuttings (roots) for different times before being planted for seed production. Improved vegetable varieties with additional attributes besides yield may be more likely to be accepted by farmers. These studies include selecting carrot populations more suitable for organic production systems, identifying the most appropriate seed harvest times, and developing physical and alternative chemical root and seed treatments. Seed Quality Use of seed peeling and organic compounds to improve.

Introduction

Organic carrot production has gradually increased in Brazil over the last decade. Organic production requires seeds that are obtained only from organically produced seeds. Seed borne disease control is more difficult because carrots are a biennial crop for seed production, as organic production systems do not allow the use of chemicals. It can be used to control pathogens. The current work provides preliminary information on the results of organic carrot seed production obtained with embrapa vegetables. Carrots are biennials and naturally flower after the roots have vernalized. Carrot seeds vary greatly in maturity as a result of the mother plant's umbel formation. Many plant species are induced to flower under non-inducing conditions by gibberellin (GA) application. Vegetables play an important role in food security and economic viability and are well suited to the common cereal-based agricultural system prevailing in different parts of our country. Over 60 varieties of vegetables are grown in subtropical and temperate agricultural climates.

Climatic Requirement

Seed germination and root growth are strongly influenced by soil temperature. The optimal temperature range for carrot seed germination is 7.2-23.9 °C. The Oriental carrot species is well adapted to the climatic conditions of the Indian plains and can be grown either during storage or in field conditions, anytime during root development or after maturity, in tropical but moderately cold conditions 4–6 Sow freely for a week. Seed formation, vocalization and flower development do not occur until these plants are subsequently exposed to temperatures between 12.2 and 21.1 °C.High temperatures reduce carrot germination. Seeds germinated better at 20°C than at 35 or 36°C. For this reason, seeds of European carrot varieties are produced only in the hills of India, where winters are harsh.

Soil Requirement

Carrots grow in all types of soil, but deep, well-drained, loose, loamy soil works best. Carrot seedlings will germinate poorly if the clay soil becomes crusted. In acidic soils with pH (5-5.3) carrots

failed and increasing the pH to 6.3 further improved yield. Gupta and Chipman (1976) reported that maximum root and top yields were observed at soil pH values of 6.6 and 7.1.

Field inspection

The development of the mobile inspection platform was triggered by the disclosure of the needs of managers and inspectors regarding on-site inspections. In our field studies, it was clear that mobile devices could outperform paper-based approaches. MIPs can organize and structure inspection information, making information processing a "one-step" process, and providing inspectors with supporting information to better assess your infrastructure. A normalized test form provides a standard protocol of testing that provides a higher inspection.

Floral Biology

Carrots have compound umbels. The first flowering takes place in the royal umbel or primary umbel. The umbel that closes the branches of the main shoot is called the secondary umbel or secondary umbel. The third and his fourth Ambel can be similarly deployed. Primary, secondary and other umbels usually bloom at a distance of 8-12 days from each other. Single umbel flowering is complete in 7 to 9 days, with the peripheral umbel opening first, followed by the inner umbel.

Hybrid Seed Production of Carrot

Isolation Distance

Carrots are commonly cross-pollinated by insects, including bees. Good quality and easily accessible sources of nectar attract many insects. Cultivated carrots hybridize very well with wild carrots and should be taken into account when choosing a site for seed production. Wild carrot pollen seed contamination is a major cause of genetic degradation in seed lines. Seed fields must be at least 1000m for basic seed production and 800m for certified

seed production from other varieties and fields of the same variety that do not meet the varietal purity requirements of certification.

Preparation of Land:

Carrots need deep, well-drained, loose soil to grow, so a thorough comminution of the soil is essential. The field should be prepared into a fine-grained crumb by repeated plowing, plowing, and subsequent leveling.

Source of Seed:

Breeder/founder seeds must be obtained from a source approved by a seed certification body.

Seed rate:

Roots produced from 2.5-3.5 kg of seed per hectare are sufficient to transplant 3-4 hectares for seed production in the second year.

Sowing of Seed:

Ridge seeds are preferred over flax seeds for better root development. It takes 8-10 days for seeds to germinate. The field should be irrigated immediately after sowing to keep the furrows moist until the seeds germinate and to ensure even germination thereafter. When the plant height reaches 5 to 6 cm, it is thinned out at intervals of 6 to 7 cm. Selecting Roots to Transplant: Thorough research and selection of the right plant for the variety is essential to producing good seed. Roots are selected based on top characteristics (small to heavy), short or heavy, skin color, root shape and size, flesh color, core color and size being the most important characteristics. is considered. The core should be the same color as the pulp and be as small as possible. Both early and late ballast should be removed. All diseased forks and hairy roots should be removed.

Planting of selected roots:

After selection, prune the tops of the roots, prune the tops, and then return to a well-prepared field with 75 cm row-to-row spacing and 22.5-30 cm plant-to-plant spacing. After transplanting, compact the soil and pat around the roots. Water immediately after planting.

Fertilizer and manure:

20 tons of fully rotted FYM, 250-300 kg superphosphate and 100-150 kg potassium salt per ha should be applied to the soil as a base dose before sowing. After hoeing and soiling, top-fertilize with 25-300 kg ammonium sulfate per hectare.

Intercultural operation:

It should be weeded with one hand in March, then weeded, weeded, and mulched again 30 days later.

Insect and Disease control:

There are still not many serious pests or carrot diseases in India. Among insects, weevils, leafhoppers and carrot rust flies are important. These can be controlled by spraying with rogor 30 EC, 0.05% solution.

Harvesting of roots:

In October-November, when the roots are fully developed and mature, the crop is uprooted.

Storage of stecklings:

Cuttings should be stored at a temperature of 0°C and a relative humidity of 90-95%.

Conclusion

The present study was conducted to evaluate the effects of different concentrations of gibberellic acid treatment on germination and seedling growth behavior and was examined in Tithonia rotundifolia Blake. The results of the study clearly showed that the application of 500 ppm GA3 for 96 hours maximized the rate of seed germination and growth.

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IMPACT OF DESTRUCTIVE FISHING PRACTICES ON MARINE ECOSYSTEM- SHORT NOTES

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Background

Among all of the fishing practices some fishing method are regarded as the destructive fishing these practices result in serious damage to aquatic the organisms and their habitat. In some cases, these fishing practice used would result in implementation of the major impact over the natural environment which would be irreversible. These practices are mostly not allowed (illegal/ unregulated fishing). Where they are often inadequately enforced. The destructive fishing practices primarily denotes the bottom trawling activity which causing serious threat to the bottom flora and fauna especially in the shallow water regions the coral reefs, sea grass, etc… are also being affected. as well as practices such as shark finning, blast fishing, poison fishing, muro-ami, and push netting. These latter practices are not significant within the fishing zones of most developed nations, being generally outlawed. Add at last in discussion.

History

The term "destructive fishing practices" (DFP's) is well known since 1980's. There is no clear or broadly accepted definition of the phrase exists. The Outcomes and Implementation Statements of the World Summit on Sustainable Development, held in Johannesburg in 2002, contains a commitment to phasing out destructive fishing practices in the marine environment. All nations countries attended and participated in submitting the supported statement. Many nations had made commitments to end destructive fishing practices much earlier. During the year 1999, 124 nations explicitly gave their support to the FAO Code of Conduct for Responsible Fisheries 1995 through the Rome Declaration on Responsible Fisheries. The list of these nations includes most of the major fishing nations of the world. However, while the Code of Conduct contains a commitment to end destructive fishing practices, the Code contains no timelines. In this short article we will elaborate about the destructive fishing practice that was being carried out on world.

List of destructive fishing methods

1. Blast fishing

Blast fishing in other words is referred as "dynamite fishing" which is done cheaply in easier manner with dynamite or homemade bombs with help of the locally available materials. In this method fishes are killed by the exposure to the sudden shock due to the blast and then fishes are skimmed from the surface region or from the benthic region. This kind of explosive fishing method indirectly damaging or having major impact over the large numbers of fishes and other marine organisms such as marine mammals. It also damages the physical structure of ocean water bodies in which these explosions are causing harm to the coral reef's environment and fishes which depend on the coral reef habitat. Blast fishing is also illegal in many waterways around the world and it is banned in the countries such as USA.

(*Source: Reef keeping)*

Commercial dynamite or homemade bombs are constructed using a glass bottle with layers of powdered potassium nitrate (KNO_3) and pebbles or ammonium nitrate (NH_4NO_3) and kerosene also often employed. These own made blasting devices, may explode prematurely without warning due to poor handling and have been known to injure or kill the person using it, or innocent bystanders who are involved in the fishing activity (McClellan and Bruno, 2018).

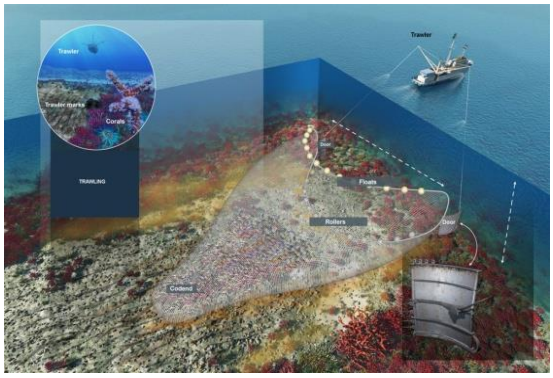
Underwater shock waves produced by the explosion may stun the fish and cause their swim bladders to rupture. This rupturing causes an abrupt of the level of buoyancy in which the fishes will lose its ability to float on the surface on another hand they will sink to the bottom of the seafloor. The explosions indiscriminately kill large numbers of fish and other marine organisms in the vicinity and can damage or destroy the physical environment, including extensive damage to coral reefs along with that the diversity of the marine environment will be reduced even in some cases the food chain may be collapsed. (Explosions In The Cretan Sea: The scourge of illegal fishing) (Lewis, 1996). Researchers believe that destructive fishing practices like blast fishing are one of the biggest threats to the coral reef ecosystems. The damaged coral reefs from blast fishing lead to instant declines in fish species wealth and loss in total catch of fish that is being harvested. (Raymundo et al., 2007).

2. Bottom trawling

Bottom trawling is one of the activity in which a fishing net is dragged dragging (towing a trawl net through by the fishing boat) along the sea floor. It is also referred to as "dragging". The scientific community divides bottom trawling into benthic trawling and demersal trawling. Benthic trawling in the sense it is towing of trawl net at the deep bottom of the ocean floor and demersal trawling is towing a net just above the benthic zone in which the water will be shallow. Bottom trawling targets both bottom-living fish (demersal fishes) and semi-pelagic species such as cod, rock fish, shrimp, squid, etc.

Bottom fishing has operated for over a century. In some areas they are heavily fished such as the North Sea and Grand Banks in which the fish species occurring in that fishing ground was comparatively low when compared with other nearby fishing grounds. While overfishing has long been recognised as causing major ecological changes to the fish community on the Grand Banks, concern has been raised more recently about the damage which benthic trawling inflicts upon seabed communities. A species of particular concern is the slow growing, deep water coral *Lophelia pertusa* as this coral species is regarded as the home to various group of deep sea organism's community, but this coral was easily damaged by the activity of bottom trawling fishing gear. On 17

November 2004, the United Nations General Assembly urged nations to consider temporary bans on high seas bottom trawling.



(Reference:- oceana)

Global catch from bottom trawling has been estimated at over 30 million tonnes per year, an amount larger than any other fishing method. (Watson and Tidd, 2018). Concerns about the environmental impacts of bottom trawling have led to changes in gear design, such as the addition of turtle excluder devices (TED) which is used to reduce the turtle that are caught during the fishing activity also in some areas bycatch reducing device (BRD) are being used which is to reduce or release of the juvenile fishes that are caught, and limitations on locations where bottom trawling is allowed, such as marine protected areas. Moreover, a 2021 estimated that bottom trawling contributed between 600 and 1500 million tons of carbon dioxide a year by disturbing carbon dioxide in the sea floor these kind of emissions approximately equivalent to those of Germany, or the aviation industry. International attempts to limit bottom trawling have been ineffective. Bottom trawling over vulnerable habitat will continue within the Exclusive Fishing Zones of most nations until governments finding the location which area was under fished or which area is over fished then further the location of vulnerable habitats, un explored areas will be found further the steps will be taken to exclude all bottom trawling activities from those damaged areas.

3. Cyanide fishing

Cyanide fishing is a method of collecting live fish mainly for use in aquariums, which involves spraying a sodium cyanide mixture into the desired fish's habitat in order to stun the fish. The practice hurts not only the target population, but also many other marine organisms, including coral and thus coral reef communities. The World Resources Institute (WRI) determined that approximately 20% of the live fish traded on the Philippine market in 1996 were caught using cyanide; assuming this is reflective of southeast Asian practice as a whole, environmental engineer David Dzombak estimates that 12,000 to 14,000 short tons (10,710 to 12,500 long tons; 10,890 to 12,700 metric tons) of live food fish are caught each year using this method (Dzombak et al., 2005).

Reference: (NOAA)

Colourful, particularly eccentric, costly aquarium trade fishes and rare coral reef fish are packed into plastic bags; up to two thirds of these fish die during transport due to the toxin residue in fish body. Some estimates suggest 70% to 90% of aquarium fish exported from the Philippines are caught with cyanide. (Wabritz, 2003) (Barber and Pratt, 1998) (McManus et al., 1997).

Recent studies have shown that the combination of cyanide use and stress of post capture handling results in mortality of up to 75% of the organisms within less than 48 hours of capture. With such high mortality numbers, a greater number of fish must be caught in order to offset post catch death.

Many fishing and diving areas across the whole of South East Asia, already severely damaged from the impact of dynamite fishing, have been ruined or totally lost through cyanide fishing. Cyanide concentration slows photosynthesis in zooxanthellae, which results in coral reefs losing colour; it also eliminates one of their major food sources. (Dzombak et al., 2006) Even at very low doses, cyanide results in higher mortality levels among coral groups.

4. Muro-ami

Muro-ami is a destructive artisanal or traditional fishing method employed on coral reefs in Southeast Asia. An encircling net is used with pounding devices, such as large stones fitted on ropes that are pounded onto the coral reefs. They can also consist of large heavy blocks of cement suspended above the sea by a crane fitted to the vessel. The pounding devices are repeatedly lowered into the area encircled by the net, smashing the coral into small fragments in order to scare the fish out of their coral refuges. The "crushing" effect on the coral heads has been described as having long-lasting and practically totally destructive effects.

Reference :- (insta blog)

5. Fish Poison

It is an old practice of fishing method which shows good output of catch in rock pools and small, semi-enclosed areas. By tradition, chemical compounds from the bark or roots of a some locally available plants (e.g. Mahua oil cake, Derris root powder) are made and mixed along with the water with required quantity. This chemical compounds will affect the fish respiration and causes suffocating effects and resulting in the mass mortality of the fishes on the water surface, further they will be collected by scoop net. In some situations, these poisons are unselective, the corals and many other benthic organisms may face the side effects or in some case it will leads to mass mortality of flora and fauna. Moreover, fishes caught by poisoning will heave impact on the human health while consuming the particular poisoned fish.

6.Harpoon fishing

Harpoon gun is a rudimentary gun made from wood with sharpened metal rod, and a mask consisting of window glass with metal and rubber. This Harpoon is more popular among the young

fishermen compared to the elderly fishermen since it is mainly used by snorkelers and in some places scuba divers, to catch slow moving fish species around coral reefs and even sharks are fished for their fins for shark fin soup production. But Harpoon usage is restricted to shallow reef areas and seagrass beds. The usage of this fishing method around coral reefs has the potential to rapidly deplete local stocks of certain species of larger fish e.g. parrotfish and triggerfish, and this may result in a vivid change in species diversity.

7. Small sized gears

The use of small mesh size of fishing gear is common among the fisherman communities in which they can catch all of the fish species such as sardine, mackerel, prawn, etc… that is occurring in that particular targeted fishing ground. The undersize nets are indiscriminate and have a high effectiveness in catching juveniles.

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IMPACTS OF INTRODUCTION OF EXOTIC SPECIES ON THE BIODIVERSITY

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Exotic organisms are non-native animals and fishes introduced into new habitats where they do not belong and are worldwide agents of habitat alteration and degradation. Free from predators, parasites, pathogens, and competitors that have kept their numbers in check, species introduced into new habitats often overrun their new home and crowd out native species. In the presence of enough food and a favourable environment, their numbers will increase. Once established, they rarely can be eliminated. The gradual but insidious replacement of native biota's by non-indigenous species is leading to 'biotic homogenization', which results in global erosion of regional distinctiveness and loss of native species. Species are also introduced unintentionally through the aquarium trade, ships ballast, on ships' hulls, in packing material, and even on fishing gear.

Fig. 1 Exotic species
(Reference:- Wikipedia image)

INTRODUCTION OF EXOTIC AQUATIC ORGANISMS IN INDIA

Since more than a century ago, exotic aquatic species have been introduced into India. Apart from India, the majority of Asian nations have been actively involved in the transport of fish from one country to another. According to some estimates, India is home to more than 350 exotic species, the majority of which are fish used as decorations in aquariums. The introduction of alien species is considered with concern around the world because to the high danger of disease introduction, disruptive effects on aquatic communities and the environment, genetic degeneration of host stocks, and other factors. Exotic fish species have been introduced to India with varying degrees of success and failure documented. In Indian waters, species including the rainbow trout, silver carp, grass carp, and common carp have established themselves successfully and are making substantial contributions in terms of production and value. The introduction of the exotic Chinese carps and

the large Indian carps led to the development of a high-yielding carp polyculture method known as Composite Fish Culture, which revolutionised the nation's freshwater aquaculture. The silver carp has also adapted very well to the habitat of the reservoir, and it contributes significantly to the high output in the Gobindsagar reservoir in Himachal Pradesh. *Tilapia mossambicus*, a species of tilapia, has also had negative effects. It is an undesirable species for Indian waters due to its prolific spawning in open waterways, competition for food with young carp, and lower customer preference.

Interactions Between Native and Exotic Species

Introduced organisms can change trophic relationships in at least three different ways, taking into account the direct interactions between introduced and endemic species. The number of prey available to local predators may considerably rise as a result of their presence. For instance, in Russia; a number of fish that were unintentionally introduced alongside Ctenopharyngodon idella caused a drop in native species with the same feeding schedule due to their better growth and fertility. Similar effects have been observed with native species that, in some regions of the USA, cannot compete with invasive tilapia. However, it has also been demonstrated that other causes, including as the impact of human activities and significant shifts in hydrographic parameters throughout time, have significantly contributed to the reduction of native species. The advent of new fishing methods and eutrophication have both made substantial contributions to the global fall in fish populations.

It has been suggested that *Lepomis gibbosus* and *Gambusia affinis* consume the eggs of other species. Through stunting by the introduced species, the quality of the fish stock in the habitat can also deteriorate. Fish species including *Carassius auratus, Lepomis cyanellus, L. gibbosus, L. macrochirus, Oreochromis mossambicus, O. niloticus, Tilapia rendalli*, etc. have been documented to have stunted populations as a result of importation. Stunted populations can overtake the existing ones and, under severe circumstances, may even result in an oxygen crisis.

Impact on Environment

The environmental implications of the naturalised introduction of fish are relatively less severe than the direct effects of predation and competition. The effects may spread across numerous trophic levels. Aquatic food chains are quite intricate, especially in tropical regions. To be able to predict the effects of introducing exotic fish on the ecology, certain attempts were made to modernise how they functioned. The most well-known effect is the cascade effect on trophic levels, which holds that a population's biomass results from equilibrium between predation and readily available trophic resources (bottom-up control) (top-down control). In a traditional food chain, declining fish corresponds to an increase in piscivorous biomass when applied to lakes in North America and several European countries, this idea has produced positive outcomes. It enabled the linkage of various trophic levels, which supported the idea of importing predatory fishes to counteract Lake Eutrophication. This type of management, also known as bio-manipulation, entails introducing a predatory fish, which, through cascading trophic interactions, results in a decrease in phytoplankton abundance by eliminating fish that feed on zooplanktivore in order to increase phytoplankton grazing by herbivore zooplankton.

The aquatic food chain is also managed using bio-manipulation to increase fishery productivity. As a result of *Lates niloticus*'s introduction to Lake Victoria in Africa, the native cichlid populations that fed on invertebrates crashed, which increased the population of several insects. This species, which normally inhabits estuaries, is acclimated to moderate salinity, but it has unexpectedly spread to several countries' saltwater atolls.

Alteration of Habitat

The habitat of native animals may be negatively impacted by the introduction of exotic aquatic creatures. The displacement of aquatic vegetation can be caused by herbivorous fish eating plant material, digging up macrophytes for food or nesting places, and organic enrichment, which raises turbidity and inhibits light penetration and photosynthesis. Because of its propensity to dig around at the bottom, the common carp (*Cyprinus carpio*) has a reputation for muddying the water. This inhibits the growth of macrophytes, disrupts benthic animals, and speeds up eutrophication through the faster phosphate recycling.

In India, species of the genus Schizothorax have vanished from waters where carp had been introduced, along with the fisheries based on them, changing the composition and abundance of the native fish fauna. In many parts of the world, *Ctenopharyngodon idella* has been introduced with the goal of eradicating emergent and submerged vegetation. It normally does this job well, but by choosing to prey on more delicate species, it may encourage the growth of tougher vegetation.

Genetic Deterioration

Release of fish into the wild can have genetic impacts as well. Direct impacts include those that operate on a species by initiating changes in gene flow, through hybridization and introgression. Indirect effects are primarily those caused by inadequate number of spawners, either through release of a small number of individuals, or in the indigenous species through ecological processes such as competition, predation, new diseases or parasites. Such genetic effects may lead to a loss of locally adapted populations and genetic diversity. Domestication, which involves changes in the quantity, variety or combination of alleles, produces effects similar to the loss of within-population diversity in nature, except that in nature the loss of diversity by genetic drift is random in character whereas diversity lost due to domestication is related directly to specific characters. Moreover, the effect of drift on genetic diversity is inversely proportional to effective population size, whereas through domestication, genetic diversity is lost in relation to the genetic nature of the trait and selection intensity. For that reason, if domestication allows improvement in culture, it can also entail a decrease in performances in the wild, as domesticated fish frequently show weaker results than wild ones. Fishes have a greater potential for successful hybridization without sterility than either mammals or birds, and this may lead to complex introgression when domesticated fishes meet the wild stocks. Exotics may thus interbreed with either native congeners or with other aliens. Under the pressures exerted through introduction, normal behaviour patterns may be abandoned and hybrids arise from species or genera that do not normally interbreed.

Introduction Of Parasites, Pathogens, And Diseases

Even fish that are not intended for release might import parasites, disease-causing agents, and pathogens. With eels, Anguilla spp., intended for human consumption rather than for stocking into natural waters, nematode parasites of the species Anguillicola were introduced into Europe. Following the arrival of rainbow trout from Western North America, furonculosis occurred in both Europe and South America. Following a common carp migration from the former Yugoslavia in the 1930s, infectious dropsy of cyprinids spread quickly throughout Western Europe. More recently, uncontrolled shipments of the North American fathead minnow spread the red mouth disease-causing *Yersinia ruckeri* to regions of Northern Europe.

Additionally, it is believed that the introduction of foreign species is to responsible for the deadly disease that has spread throughout the shrimp industry, particularly the White Spot Syndrome Virus (WSSV). Recently, disease outbreaks have killed large numbers of cultivated penaeid shrimps all

across the world, but particularly in Asian nations. High mortality rates and serious damage to the shrimp culture business have been brought on by the WSSV illness in China, Thailand, Japan, Taiwan, Indonesia, and India. According to some experts, the white spot disease virus is thought to have entered India covertly through seed that was imported from Southeast Asian nations, where the infection had already been multiplied (Shankar and Mohan, 1998).

Socio-Economic Impact

The effects of introduction may affect socioeconomic variables either directly or indirectly in addition to biological and ecological aspects. This might happen if a native fish that is extremely valued is replaced by an unwanted invasive species. Both North America and Europe (Lake Constance) witnessed this circumstance (Laurentian Great Lakes). Local economies that depend on raising fish in captivity for human consumption are extremely vulnerable financially. If there are negative effects, most notably the emergence of novel diseases or the genetic degradation of cultured brood stocks, the introduction of exotic species could have devastating socio-economical results. Aquaculturists must take precautions to reduce the risks involved since they rely heavily on introducing new stock into existing populations to exchange genetic material. In this context, the fishing industry cannot underestimate the catastrophic effects of the white spot disease, which has caused high mortality in the two native species of India, *P. mondon* and *P. indicus*. Due to the significant financial losses and social effects that resulted, many farmers had difficulty finding work and food at the time.

Effects Of Introduction Of Exotic Aquatic Species

Harmful Effects

- Because they have such a high chance of surviving, non-native species have gained the negative reputation of "invader species." An animal that is not native to the area may do better than one that is, not just because it lacks natural enemies there, but also because it develops more speedily or under less ideal circumstances. Native animals now face greater competition for resources as a result.
- Exotic plants typically crowd out other plants for sunlight and nutrients, reduce the density of native plants, and endanger animals that depend on native vegetation. Exotic plant overgrowth causes rotting and excessive oxygen depletion, which kills fish.
- Exotic animals typically eat native species' food sources, leaving an inadequate supply. They take up safe or beneficial habitat, leaving local species with less space to live. They occasionally act as food for local species, but because they are deficient in key essential nutrients, the native young often perish. In addition, high transportation and navigation expenses, decreased food availability for subsistence fishing, decreased commercial fishing, decreased sport fishing, and decreased water quality or supply are other disadvantages associated with invasive species for humans.

Beneficial Effects

The following have been listed as advantages of introducing alien aquatic organisms, among other things:

- Improvements in aquaculture production (rapid growth, high survival rate, and high dress weight); high market value; foreign exchange earnings; improved food security for the underprivileged as production of exotic species is consumed locally, primarily by the underprivileged; improvement in farmer income and employment opportunities.

- Offers opportunity to develop hybrids that may have higher growth compared to the local fish.
- Mechanism to stop invasive species from interbreeding; can be used to recycle trash and local resources; can be used to control weeds and some vectors; some species cannot reproduce or survive in the wild, such as introduced Artemia; used as live food.
- Enables the formation of domestic brood stocks; makes stock enhancement simple; and makes some attractive species valuable aesthetically and socially.

Role of Government of India For Introduction of Exotic Aquatic Organisms Into Indian Waters

Exotic aquatic organism introduction into Indian waters has been a topic of intense debate and concern. A National Committee on the Introduction of Exotic Aquatic Organisms into Indian Waters exists under the Ministry of Agriculture, DAHD & F, and is chaired by Joint Secretary (Fisheries). Nearly all of the ICAR Fisheries Institutes, as well as a few experts, make up its membership. The National Committee typically decides or advises the best course of action to be taken in this regard by the Ministry after weighing the advantages and disadvantages of the applications given by various agencies, organisations, companies, or individuals for the import of live aquatic species. The proposals are evaluated and either accepted or denied based on the committee's decision.

To decrease the chances connected with the release or escape of foreign species, scientists have turned to the administration of sterility using a variety of ways. For both fin fish and shellfish, the generation of triploid stock has been used the most frequently. However, it is the only technique currently in use for shellfish. This approach has been successfully used to create triploid hybrids of Atlantic salmon (*Salmo salar*) and Arctic Char (*S. trutta*), as well as Rainbow trout (*O. mykiss*) and Coho salmon (*O.kisutch*) species. Such genetic study is very important and shows a lot of promise for triploid fish and sterile fish production and trade.

Conclusion

The research of the ecological, biological, and genetic impacts of the introduction of exotic species in several nations, including India, clearly demonstrates the detrimental effects on some species. Additionally to having a direct impact on ecobiological effects, it has been shown that some fish have even gone extinct as a result of genetic instability and heterozygosity loss brought on by hybridization between alien and native species, among other factors. Therefore, it is essential to only think about any introductions after completing studies at the proper institutes and receiving approval from NBFGR and the Committee for the introduction of exotic fishes.

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MANGOSTEEN CULTIVATION

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Mangosteen (*Garcinia mangostana* L.) is considered one of the tastiest fruits of the world. It is a tropical fruit that is easily accepted by consumers in western markets due to its distinctive taste. It was originated in the Malay Archipelago. Its commercial orchards have been established in Indonesiaand Sri Lanka. In addition, it is also grown in limited areas in Australia, Cuba, Honduras, the Dominican, Jamaica and Panama. Mangosteen, a tropical evergreen fruit tree, is often regarded as thequeen of tropical fruits due to its juicy and delicate pulp and appealing taste. Malaysia is the largest producer of mangosteen, followed by Indonesia, Mexico and China (FAO, 2020). Kerala is the major mangosteen producer (1000 tonnes) state in India followed by Tamil Nadu with an estimated 200 tonnes of mangosteen being produced in Pollachi, Upper Palani Hills and Coonoor. Karnataka comes at number three. It produces about 100 tonnes mangosteen per year.

Nutrients and uses

This fruit is sometimes referred to as the "queen of fruits" due to its nutritive value and the presence of certain compounds that provide a variety of benefits. The primary active constituents of themangosteen fruit are called xanthones which have many benefits, including anti-oxidant properties, anti-allergic and anti-convulsants. People in the Philippines make a decoction of mangosteen leaves, bark and rind which is also beneficial for lowering body temperature and treating dysentery, diarrhoea and urinary disorders. Its rind contains 7-15% tannins and is used to tan leather and darkenfabrics. It is also used as an ingredient in soaps, shampoos and conditioners. The fruit is mainly eatenfresh and can be canned, frozen or processed into jam sweetened preserves, syrups and candies,

Table 1. Nutrients in Mangosteen Fruit (edible portion per 100 g)

Nutrients	Quantity	Nutrients	Quantity
Protein	0.6 g	Calcium	7.0 mg
Fat	1.0 g	Potassium	45.0 mg
Carbohydrate	5.6 g	Iron	1.0 mg
Fiber	5.1 g	Magnesium	13.0 mg
Ascorbic Acid	4.2 mg	Manganese	4.21 mg
Niacin	0.3 mg	Phosphorus	13.0 mg
Riboflavin	0.03 mg	Sodium	7.0 mg
Thiamine	0.03 mg	Moisture	79.7 g
Ash	0.1 g	Energy	34.0 calorie

Origin, history and distribution

In 2000, the area planted in mangosteen in the Philippines was estimated at 1,354 hectares (DA-AMAS, 2004). Important producing areas are in the Sulu Archipelago and several provinces of Mindanao, namely Zamboanga del Norte, Davao del Norte, Misamis Occidental, Davao City and Agusan del Sur.

Climate and soil

Mangosteen cannot tolerate hot dry winds and frost. Climatically, it is grown in tropical humid and high rainfall areas. It requires optimum temperature 25-35◦C and relative humidity (more than 80%). Mangosteen is grown in areas with an altitude of less than 500 meters above sea level. It can be cultivated at high altitude but its growth rate is slow. The tree is adapted to heavy and well-distributed rainfall of 1,200 mm or more without prolonged dry periods. However, the plant needs a short dry time of 15-30 days to flower. Mangosteen prefers deep, fertile, well-drained and slightly acidic, loamy soil, rich in organic matter. Limestone, sandy alluvial or sandy soils with low water content are not suitable for its cultivation. The plants grow well in soil with a pH of 5.5--6.8.

Propagation Seed propagation

In India mangosteen is usually propagated through seeds. Most of the trees grown in India are basically seedling plants. The germination percentage of mangosteen seeds is very low (2 to 3 weeks). Seeds of more than 1 gm should be selected for good germination. Newly extracted seeds should be sown immediately to obtain a high percentage of germination. Sowing is usually done in the seed bed. The seed bed can be of wood or cement and is filled with a mixture of sand and soil in the ratio of 3:1. Seeds are sown at a distance of 2-3 cm at 5-10 mm depth. Seeds germinate in 30 daysafter sowing. Sprouted seeds are transferred to polythene bags. Plants should be watered regularly. Plants are ready in 24-36 months and young plants require more care.

Vegetative propagation

Cleft grafting method is widely used for vegetative propagation of mangosteen. A healthy active shoot is taken as a seedling from the selected mother plant and then it is grafted into a healthy rootstock. A two-year-old rootstock is chosen. These are obtained from selected plants about 30-35 cm in height, healthy rootstock and generally producing continuous fruit. These rootsocks are selected from those plants which are propagated from seedlings and which are about 2 years of age. The diameter (1.6-2.0 cm) of the rootstocks should be same the size of the scion shoots so that the cambium tissues of both are closely matched. Plants are ready in 10-12 months after grafting.

Varieties

The seed of mangosteen is apomictic and hence the seed has the same properties as the parent plant in the grown plant. For this reason it can be propagated from seed or asexually through cuttings. The National Seed Industry Council (NSIC) of Philippines has registered two varieties of mangosteen as UPLB Sweet of Los Baos, Laguna and Roxas Purple of Kailuan, Laguna. The germplasm (sixteen accessions) of mangosteen is being evaluated at CHES-Chetalli. The results showed wide variations for yield and fruit characteristics. The yield varied from 2.5 kg to 24 kg per plant. Various phonological stages in mangosteen are also being studied.

Field preparation and planting

Planting mangosteen in a relatively new area requires careful selection of varieties. Clearing of new land can be done by removing large plants along with their roots. 2-3 tillage is sufficient to get desired soil. A higher rate of organic matter in the soil is recommended. Mangosteen is plantedat a distance of 6 to 12 meters depending on its growth habit. For planting saplings, pits of 1 cubic meter size are dug during April-May and filled with field manure and soil (1:1 ratio) before planting. Planting is done in June-July or sometimes in September. Planting in the field can be done anytime of the year if water source is available. However, the best time for planting is early in the rainy season. Shade should be provided to the newly planted plants. Shade is maintained for 1-2 years

and is gradually reduced to allow for full sun exposure. Slow growth weakens the plant. Coconut husks or hay can be used to conserve moisture during dry periods. Intercropping with short duration crop like banana to provide shade to mangosteen seedlings. Mangosteen trees go through a juvenile stage that can last anywhere between 12 to 20 years, although good maintenance can result in fruiting in 5-7 years after planting.

Training and pruning

The plants do not require any pruning other than removing broken or dead branches. Mangosteen plants that are about 8 years of age or older are cut from smaller internal branches and older, unproductive branches to encourage fruiting.

Irrigation management

Irrigation systems are recommended to supply water during the dry months. The root system lacks root hairs and the plant requires a constant and abundant supply of water to the soil. In adult plants, after a dry period of at least one month, irrigation or heavy rains may induce the plant to flower. It can flower twice a year or sporadically and incorrectly. Regular watering is required during fruit growth and development. Inadequate amountof water can slow down fruit development.

Nutrient management

The vegetative growth of plants is accelerated by the use of nitrogenous fertilizers. Fertilizer is given in a ring around the base at the edge of the canopy. Fertilizer can also be given as a foliar spray, it can be used alone or mixed with pesticide ingredients. The following rates of application for mangosteen are shown in Table 3.

Table 3. Recommended Dosage of Fertilizer for Mangosteen

Tree Age (Years)	Commercial Fertilizer (Tree/Year (in Kg)		
	45-0-0	14-14-14	0-0-60
1	0.22	0.35	-
2	0.44	0.70	-
3	0.56	1.40	-
4	-	2.80	-
5	-	3.60	-
6	-	4.20	0.30
7	-	5.70	0.30
8	-	7.10	0.30
9 and above	-	8.50	0.50

The fertilizer rate increases as the size of the tree increases. According to the soil analysis, necessary changes should be made as and when required. Mangosteen growth can be enhanced with appropriate nutrition and manipulated through nutrient fertilization of sulfur and calcium to initiate flowering with subsequent fruit development. Foliar spraying of fertilizers should be done along with regular NPK fertilizers for off-season and higher production. Simultaneously a foliar spray of 19 ppm (1:55 concentration) or 30 ppm (1:35 concentration) of SQL (sulfur-quick lime) formulation should be done (Saldivar, 1996).

Flowering, pollination and fruit set

Mangosteen seedling begins flowering after 8 to 10 years whereas grafted plants start bearing fruit probably in 5-6 years depending on the climate and cultivation methods. In South Indian conditions,

mangosteen flowers in the month of February to March. Flowering time may vary according to height. Late flowering has been observed at higher elevations than in warm coastal areas. Mangosteen flower has 4 sepals in two pairs, which do not fall till ripe. The flower is made up of 4 petals whose edges are pale green and red. It contains a lot of pollen and the ovary consistsof 4-8 chambers with 4-8 stigmas. The average day of full bloom of the flower was 24-25 days. The mangosteen flower is a terminal flower, which means the flower appears at the tip of a tree branch. The number of flowers on each branch varies. Up to three flowers may appear at the tip of a branch in a season. The fruits ripen in the month of June to August. It takes about 4 months (115- 120 days) for the fruit to ripen. Fruits are spherical in shape; immature fruits are green in color and turn dark brown when ripe. Mangosteen fruit is formed without fertilization(parthenocarpy). Despite this, there is variation in the characteristics of the fruit.

Plant protection

In India, Mangosteen has not seen much outbreak of pests and diseases. Some of the pests and diseases are described below.

Pests and their management

1. **Thrips :** These insects prefer to eat tender, young plant tissue such as flower buds, unopened flowers and unopened leaves. To control them, dimethoate should be sprayed two to three times at weekly intervals.
2. **Tussock Caterpillar (Eupterote fabia) :** The larvae of this insect eat young leaves. Malathion or Fenvalerate should be sprayed to control them.
3. **Mites :** These pests attack the surface of the fruit and distort the fruit with small bites. Due to this, fruits become unattractive. Spraying of Profenephos or Acrezid should be done to control them.
4. **Mealy bugs :** These pests attack new growth and fruits. Carbaryl or dimethoate should be sprayed to control them.

Diseases and their management

1. **Sooty Mold :** This disease affects young leaves. Improving air and sunlight penetration by pruning branches reduces infestations. Common fungicide should be sprayed to control them.
2. **Anthracnose :** This disease affects the leaves. Spraying of common fungicide controls the disease.

Disorders and their managementGummosis

A major disorder called gummosis is found in mangosteen. It is manifested by the shedding of latex in the form of yellow spots on the fruit surfaces or the skin. Latex release can be caused by physical damage, sucking insects, strong winds, and rough harvesting. This disorder can occur in fruits exposed to strong sunlight.

Maturity, Harvesting and Yield

The fruit becomes reddish-purple when ripe and the skin has no latex; the pulp is easily separated from the peel and the soluble solids content ranges from 17 to 20%. Fruits ripen in 110-120 days after flowering. Not all fruits mature at the same time. Harvesting should be done every second or third day as per maturity depending on market demand. The fruits are plucked by hand. Harvesting is done in the morning or afternoon. Under favorable conditions, trees begin to bear fruit 6-8 years after planting. Yield varies from tree to tree and season to season. Trees exhibit alternate bearing habit.

The yield increases from an average of 10-20 fruits per tree after the 5th year to over 1,000 fruits

per tree after the 15th year. It can produce 100 to 500-600 or more fruits per plant. In places with good soil, 200-800 fruits per tree can be produced and in some places up to 2,000 fruits per tree were found.

Post harvest management

Harvesting and handling before the fruit reaches the packing house can result in various injuries to the fruits. Such injury should be minimized in subsequent handling, to avoid further damage and loss in quality. The fruits are taken to the packing house for preparation of the fruits before they are taken to the local market. The fruits are graded according to quality and size before packing. The grades are small (16-18 fruits/kg), medium (12-14 fruits/kg), large (8-10 fruits/kg). Selected fruits are packed in wooden crates or cartons. Mangosteen fruits can be stored for up to 8 weeks at 8-10^{o}C.

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STRATEGIES TO IMPROVE MOTHER-KID BONDING OF GOAT FOR KID SURVIVABILITY

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Abstract
Goats have a wide spectrum of maternal behavior and are frequently referred to as "hiders" when they are young. The survival and growth of newborn kids are dependent on the development of a maternal attachment at an early age. Mother often separate themselves from other group mates few hours before parturition, it facilitates to form a deep attachment with the newborn kids. Within half an hour or immediately after delivery, healthy kids stand up, seek out teats, and suckle. As a result, strong and exclusive maternal attachment is established between the doe and kids. Establishment of initial bonding between mother-kid occurs during sensitive period, since this stage is restricted to early learning of sensory cues which is transferred naturally with the mother. Olfactory signals are the most promising way for mother to recognize their own newborns. Several extrinsic factors affecting mother-kid bond includes nutrition, human interference and other external stimuli. However, some management strategies could initiate strong mother-kid relationship process and ensures the viability of newborn kids.

Keywords : Bonding, Mother-kid, Parturition and Sensory cues

Introduction

Domestic livestock species such as cattle, buffalo, goat, sheep and pig require good maternal care to ensure that offspring are survived. Mother is usually the main caretaker of the young at early neonatal life. The main difference between domestic ungulates (cattle, buffalo, goats and sheep) and altricial laboratory species (rat, house mouse and rabbit) is that their young are immobile and helpless at birth; in contrast, mothers in domestic ungulates give birth to precocious newborns capable of a high degree of independent activity from birth, which help in formation of mother-young bond. It is common for sheep and goats that not to build nests for their newborn young, unlike the other domestic ungulate species (e.g., sow). During the first postpartum hours of intense mother-kid care at the birth site, the doe leaves her kid for several hours, while the young hide and wait for her return for nursing. The physiological control of maternal care and mother-young bonding depends on the facilitation of learning by physiological changes occurring at parturition (Romeyer et al., 1994). Understanding of physiological and environment control on mother-kid bonding will help developing management strategies for improving this bond.

Importance of mother-kid bonding

In most domestic animals, parental care is mainly performed by mother. A strong mother-offspring bond is a key to the survival and growth of mammalian young one. Parental care in goats is largely performed by mother, who provides food (milk), warmth, shelter, and protection from predators and conspecifics. Goats rarely provide indiscriminate care to their offspring. Preferential care of an own kid is often predicted on the dam's capacity to distinguish between its own and alien kids. The same applies to young kids' recognition of their mothers.

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Figure 1. Maternal care of Black Bengal goat (A: Licking and sniffing of kids after birth; B: Post-partum successful suckling)

Figure 1 depicts the maternal care of kids after birth followed by the suckling of colostrum with successful mother-kid bond. When a proper mother-kid bond is developed the mother goat is always able to recognize her young quickly and reject any alien kids that attempt to suck from them (Poindron et al., 2003). This discrimination in goats is established within 2–4 hours after birth. Although selective nursing of kids relies on olfactory recognition, however, mothers can also identify their kids from a distance using visual and auditory cues (Mandal et al., 2022; Poindron et al., 2003; Nowak et al., 1997). The development of a good mother-kid bond after birth will enable the kid's early colostrum intake. Besides supplying energy, colostrum contains immunoglobulins, especially in ungulates, which provide passive immunity (Das et al., 2022). Consequently, it will provide protection against numerous diseases of kids in the early phase of life. Therefore, early access to the udder is vital for the proper development of the mother-kid bond and survival of the neonate. This developed bond forms the base of future suckling and nursing to young that determines growth, development and future performance of kids.

How does the mother-kid bonding develop?

The most critical step during sensitive period is the successful development of mother-kid bond following parturition. The sensitive period is few hours prior and subsequent to kidding. Figure 2 depicts that prepartum success relies on the female's ability to choose an appropriate birth place that minimizes the risk of predators, disturbances, and misidentification of kids. This promotes postpartum success and initiates the development of the mother-kid bond. Most preparturient goats show a strong tendency to isolate themselves from the flocks (Yılmaz et al., 2012; Ramírez et al., 1995). This isolation-seeking behaviour of preparturient goats enables natural selection of birthplace and promotes the mother to express maternal behaviour. "Isolation seeking" refers to the behavior of hiding and separating from disturbances (arising from different threats), so the female can give birth in a calm place, where she can then nurse and develops bond with her newborn young.

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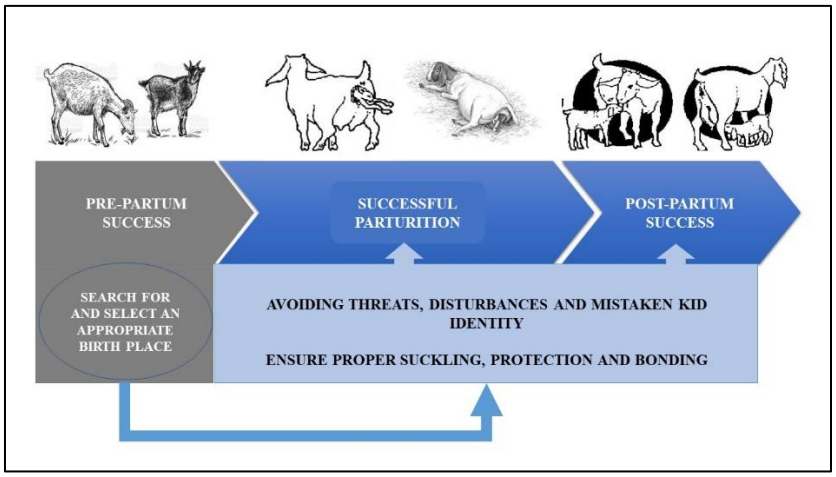

Figure 2. Development process of mother-kid bond in goats

The period when the bond is established is known as the "sensitive period," since it is a limited stage that is dependent on early acquisition of sensory cues (sight, touch, smell, and hearing) transmitted naturally with the mother or the environment during the newborn phase. The bond established at birth, which is dependent on a learning process is known as "imprinting". It allows the identification of the mother and important for the newborn survival. Immediately after delivery of the fetus, mother goats are highly attracted to the smell and taste of amniotic fluids, and lick the fluids that are coated over the kids' bodies. Licking of kids just after birth helps in drying up and stimulating the kids for suckling. This also transfers attraction and recognition to their newborn and develops selective bond with her kids. The most selective way for mothers to recognize their own newborns is through olfactory cues.

Factors affecting mother-kid bond development and survivability of kids'

The development of mother-kid bonding during the sensitive period is affected by the both maternal and infant factors (figure 3). The mortality of kids is always highest in the first few days after birth because of the difficulties in transitioning from a totally protected intrauterine life to an unpredictable extra-uterine life. The birth process itself is the first critical stage. Dystocia is one of the leading causes of perinatal kid mortality occurs due to trauma and fetal hypoxia. In such cases dam failed to exhibit maternal behavior due to stress and pain, thus hampering the development process of mother-kid bonding post-partum. After delivery, the newborn's survival will be primarily determined by the quality of interactions with the mother.

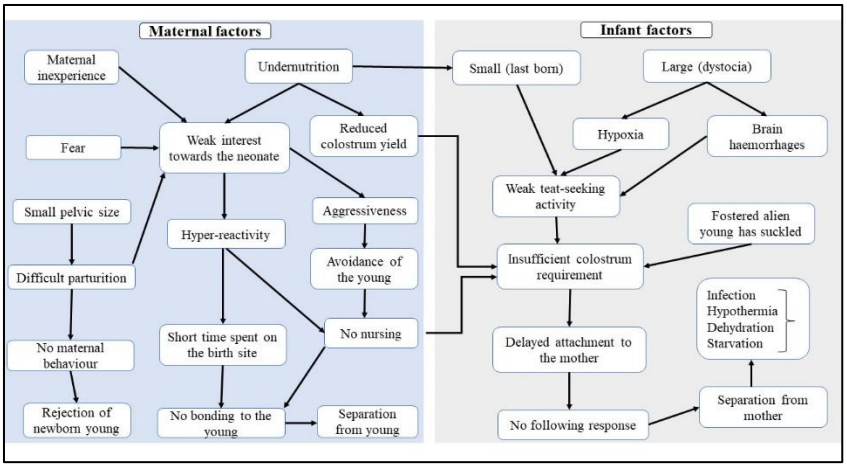

Figure 3. Factors responsible for failure of mother-kid bonding and kids' survivability

Mothers with inexperience have been identified as a possible cause of mortality in their kids. Neonatal rejection is most common in primiparous goats, and it may lead to starvation and mortality of kid. Does with little experience either show temporary delay in maternal care or display behavioural disturbances. It can delay neonate's access to the udder. These circumstances can reduce the chances of survival of kids, especially under adverse climate conditions.

Undernutrition during gestation leads to depressed maternal behavior of goats and high neonatal mortality of kids. However, poor bonding between mother and kid as well as perinatal kid loss may be strongly related to low birth weight of kid and mis-mothering as a result of undernutrition in the dam during pregnancy. A low level of maternal nutrition during pregnancy decreases the formation of mammary secretary tissue mass, which has an impact on the lactation period, resulting in less colostrum and milk for the offspring, which affects growth and the kids' survival.

Management strategies to improve mother-kid bonding for kid survival

Although the mother-kid bond development process is a completely natural process; however, there are few strategies which can help mother-kid bond development process and improve kid survivability.

a) Provide proper nutrition during pregnancy

Proper nutrition during pregnancy is important for mother-kid bond development and survival of kid at birth. Pregnant does ration must be supplemented with available green fodder @ 5-7 kg / head / day. The pregnant doe should be fed concentrate mixture @300-500g (16% DCP and 77% TDN) supplemented with adequate minerals and vitamins. The grain allowance should be lowered as kidding time approaches but good quality dry roughage should be offered free choice. It is usually preferable to feed lightly on the day of parturition, but allow drinking plenty of clean and cool water. After parturition, gradually increase the concentrate mixture to sustain milk production. Good nutrition of the mothers during pregnancy reduces the chances of birth difficulty, poor mother-kid bonding and the birth of weak kids and thereby improves the chances of kid survivability.

b) Facilitate for natural selection of birth place

The parturient doe should be free for natural selection of birth place. Isolation of does from the rest of her conspecifics may be good to the establishment of early bond with their offspring. Natural selection of birth place promotes mothers to express good maternal behavior and habitat choices that increase the chances of their newborn's survival. This isolation aids in decreasing interference of newborns by other mothers or predators, both of which are detrimental for development of bond. Therefore, establishment of a mother-young relationship requires complete isolation from other goats. This behavior may promote mutual identification and quick access to the udder upon delivery. Therefore, isolation helps increasing the likelihood of young survival through proper development of the mother-young bond.

c) Housing management and provision of maternity pens

Pregnant does should be kept in separate kidding shed (maternity pens). The dimension of the shed shall be 1.5m(l)×1.2m(w)×3.0m(h), a manger for feed and a bucket for keeping water shall be provided. Floor of the shed should be non-slippery. Provide clean fresh straw for bedding. In cold climates some warming device, like a room heater or heat lamp or electric bulb shall be fixed, so that newborns are protected from cold stress during winter. Parturition in the isolated maternity pens keeps doe undisturbed from other adult female. It helps to create specific bond with kids, which will increase the survivability of newborns.

d) Early feeding of colostrum

Early feeding of colostrum is utmost important for survivability of kids. Early development of mother-kid bond facilitates early access to colostrum. The energy reserves of newborn kids are very limited. Colostrum, besides providing energy, contains immunoglobulins, which ensure passive immunity to the kids. Thus, early access to the udder is vital for survival of the neonate. Ingestion of colostrum at an early age triggers mechanisms that can also facilitate the establishment of mother-kid bond. Therefore, it is advised to feed colostrum within 30 minutes after the birth of kids.

e) Human assistance

Occasionally, human assistance is also required to initiate the mother-kid bond development process and increase the kid's survivability rate. During dystocia, the doe strained and failed to give birth and in such cases, human assistance become of paramount importance. This assistance could initiate early delivery of fetus and facilitate survivability. It also facilitates creation of early bonding between mother and newborn kid. It is evident that some primiparous does immediately after parturition, abandon newborn kids and resist licking due to nervousness and fear. In such cases, human interference is inevitable to bring the doe close to newborn kids and assist her in licking. This will help to dry up the amniotic fluid and further accept to suckle up the teats.

Conclusion

The success of bonding depends on the female's ability to identify an appropriate birth site that will ensure calm parturition and provide ideal conditions for postpartum expression of maternal behaviors by eliminating predators, disturbances, and mistaken identity of offspring. The primary function of a mother-kid relationship is to provide nutrition, protection, and guidance to the offspring. Maternal care and suckling are essential to the development of the mother-kid bond and survivability of newborn kids. Hence, strong and exclusive bond between mother and kid will be an added advantage in terms of kid survivability, growth and future productivity.

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SUSTAINABILITY IN FARMING SYSTEM

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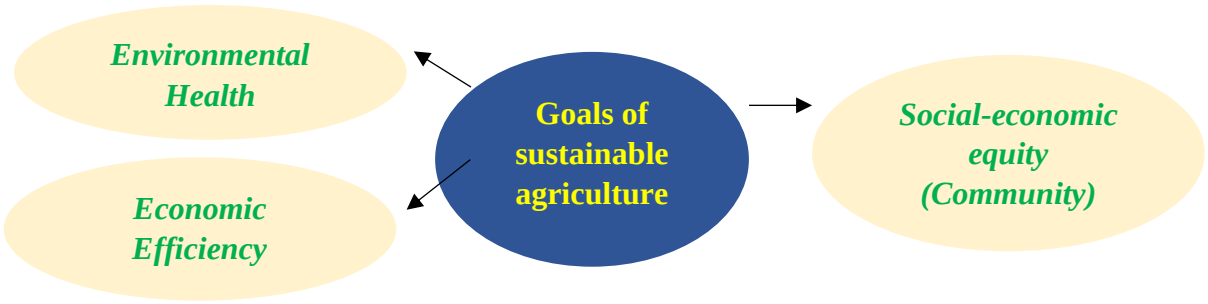
Sustainable Agriculture

The concept of sustainable agriculture set out by Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR). Sustainable Agriculture is the successful management of resources for agriculture to satisfy the changing human needs, while maintaining or enhancing the quality of environment and conserving natural resources. Sustainable Agriculture is a farm system that mimics as closely as possible the complexity of a healthy and natural ecosystem.



Main goals of sustainable agriculture

Sustainable Farming Systems

Farming system that are capable of maintaining their productivity and usefulness to society indefinitely. Such systems must be resource-conserving, socially supportive, commercially competitive, and environmentally sound.

Basic features of sustainable farming systems

- The need to maintain or improve soil quality and fertility. This is often attained by increasing the organic matter content of the soil, and by minimizing losses from soil erosion.
- Production programs are designed to improve the efficiency of resource utilization. This will result in the most cost-effective use of water, fertilizers, and pesticides.
- An attempt is made to improve internal nutrient cycles on the farm, which will reduce the dependence on external fertilizers.
- Efforts are made to improve biological diversity on the farm. This will result in improved natural suppression of pests, and may also help to improve internal nutrient cycling within the farm.
- Farm management and marketing programs are designed to minimize overhead costs and to increase returns, often by following alternative marketing schemes.

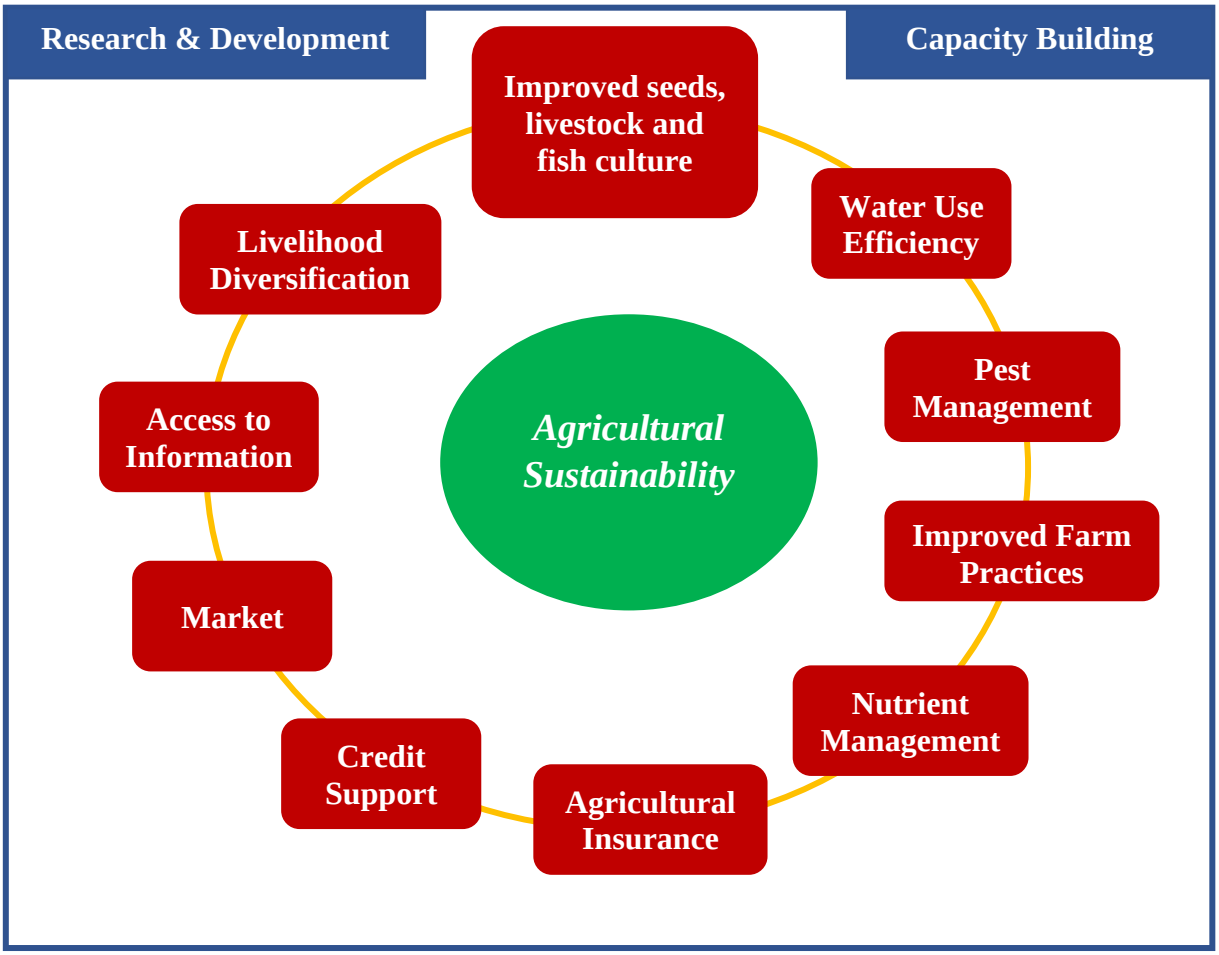
Sustainable farming practices:

- Crop rotations that mitigate weeds, disease, insect and other pest problems; provide alternative sources of soil nitrogen; reduce soil erosion; and reduce risk of water contamination by agricultural chemicals
- Pest control strategies that are not harmful to natural systems, farmers, their neighbours, or consumers. This includes integrated pest management techniques that reduce the need

for pesticides by practices such as scouting, use of resistant cultivars, timing of planting, and biological pest controls

- Increased mechanical/biological weed control; more soil and water conservation practices; and strategic use of animal and green manures
- Use of natural or synthetic inputs in a way that poses no significant hazard to man, animals, or the environment.

Key dimensions of agricultural sustainability - National Mission for Sustainable Agriculture (NMSA 2010)



Three-dimensional concept of agricultural sustainability

1) Ecological: The core concerns are to reduce negative environmental and health externalities, to enhance and use local ecosystem resources, and preserve biodiversity. More recent concerns include broader recognition for positive environmental externalities from agriculture.

2) Economic: Economic perspectives on agricultural sustainability seek to assign value to ecological assets, and also to include a longer time frame in economic analysis. They also highlight subsidies that promote the depletion of resources or unfair competition with other production systems.

3) Social and political: There are many concerns about the equity of technological change. At the local level, agricultural sustainability is associated with farmer participation, group action and promotion of local institutions, culture and farming communities. At the higher level, the concern is for enabling policies that target poverty reduction.

Indicators of agricultural sustainability:

Indicators of sustainability help us to identify, quantify and evaluate the effect of agriculture.

1) Policy Relevance:

Indicators should address the issues of primary concern toa country and receive the highest priority. In some cases, policy makers may already share concern about an aspect of sustainability and be ready to use indicator information for addressing issue.

2) Predictability:

To allow a forward-looking perspective that can promote planning and decisions on issues before they become too severe. Anticipatory decision making is at least as important to sustainable agriculture as is recognitions of existing problem.

3) Measurability:

To allow planner and analyst the means to assess how the indicator was derived, either qualitatively or quantitatively and decide how it can best be applied in the planning and decision-making process.

Key policy issues affecting agricultural sustainability

- Input subsidies encourage excessive use
- Minimum support prices for cereals discourage diversification
- Electricity or fuel subsidies encourage groundwater depletion
- Subsidized milk or dairy imports discourage local production
- Fuel or machinery subsidies discourage conservation tillage
- Insecure property rights mean no incentive for long term investments.

Policy and practice for agricultural sustainability

1) The characteristics of the natural resource base and farming systems of the poor
2) Farmers' awareness and assessment of the importance of environmental degradation
3) The availability of sustainable production technologies and their suitability for the poor
4) Farmers' capacity to mobilize investment resources through their own assets and networks
5) Economic incentives for conservation management or investment
6) Security of tenure and rights of access to resources by the poor

The level of institutional capacity within communities to support adaptive responses by the poor

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USE OF BIOCHAR: A NEW STEP TOWARDS SUSTAINABLE AGRICULTURE

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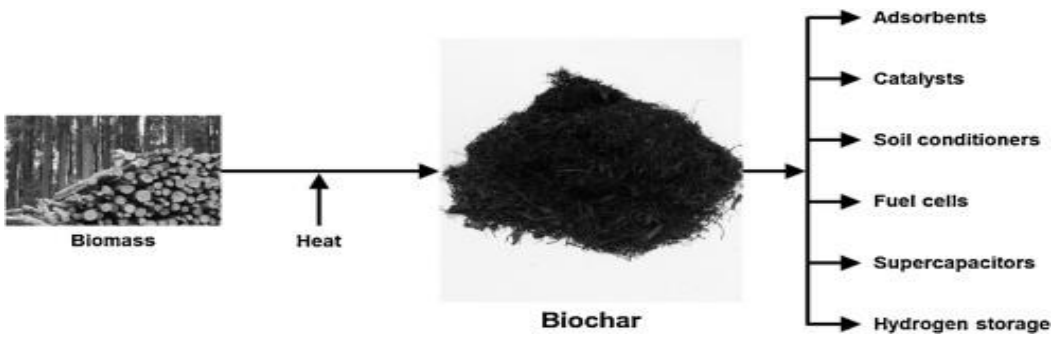
Introduction

Biochar is a substance that resembles charcoal that is made from plant materials such as grass, agricultural waste, and forest wastes that degrade at high temperatures, frequently during the creation of renewable energy. The procedure transforms the plant material's physical and chemical qualities into biochar, a highly porous, stable, carbon-rich substance. According to recent study, it may be utilized in agriculture and horticulture as a soil conditioner and an amendment for container substrates, and it may enhance a number of the physical, chemical, and biological characteristics of soil and substrate.

The creation of biochar—a carbon-rich solid obtained from the pyrolysis of biomass—and its storage in soils as a technique of reducing climate change by sequestering carbon while both supplying energy and boosting crop yields have been proposed.

What is Biochar?

1. The term "biochar" refers to a material rich in carbon formed during the pyrolysis process, which is the thermo chemical degradation of biomass at a temperature of roughly ≤700°C with little or no presence of oxygen.
2. It is a burnt byproduct of biomass pyrolysis made from biological wastes, crop residues, animal manure, poultry manure, or any other kind of organic waste material.
3. The chemical breakdown of a substance at high temperatures without oxygen is known as pyrolysis (Lehman *et al*., 2003).
4. The use of biochar in agriculture has been pushed as a win-win situation since it improves soil quality, increases agricultural sustainability, and reduces greenhouse gas (GHG) emissions.



Characteristics of Biochar

1. Similar in appearance to charcoal made by natural burning, biochar is a fine-grained, porous substance. It is created through the oxygen-restricted burning of biomass (IBI-International Biochar Initiatives).

2. Biochar acts as a net extraction of atmospheric carbon dioxide stored in highly recalcitrant soil carbon stocks by forming a carbon-negative recalcitrant soil carbon pool when used as a soil supplement.

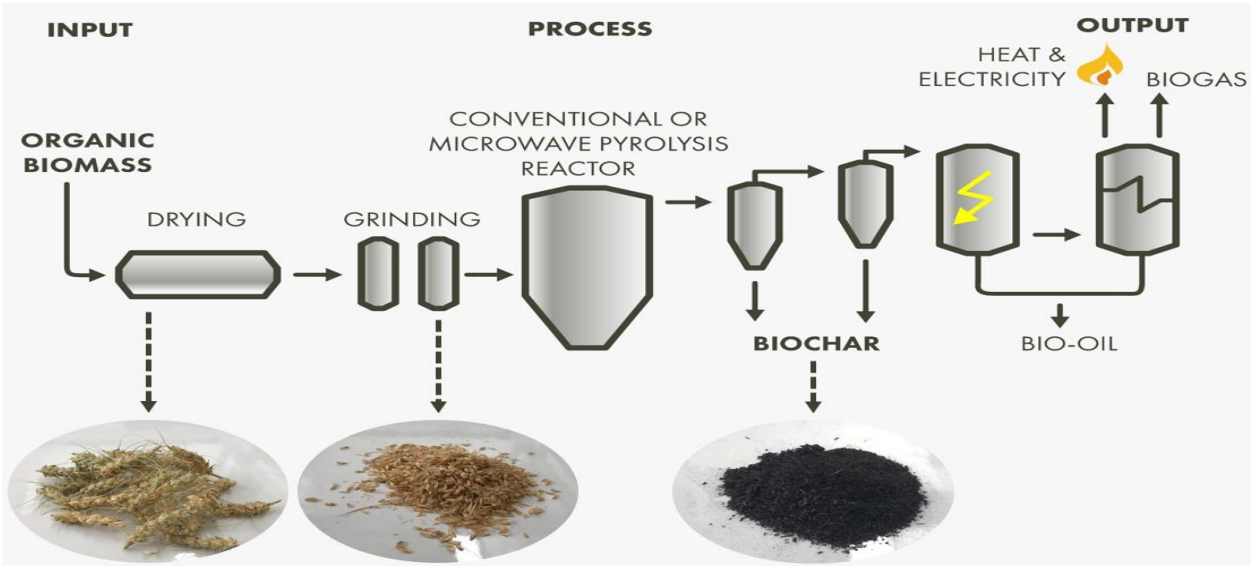
Biochar as a Soil Amendment

One potential benefit of adding biochar to soil or a container substrate is that it can change the physical and chemical characteristics of the soil by:

1. Increasing the Cation Exchange Capacity (CEC)
2. Increasing surface area
3. Increasing pH
4. Increasing the availability of plant nutrients
5. Increasing the ability to hold water.

Climate Smart Benefits of Biochar

1. Increasing soil fertility will encourage plant development, which will increase CO_2 consumption in a positive feedback cycle.
2. The use of biochar can lessen the requirement for chemical fertilizers, which will cut greenhouse gas emissions from the fertilizer industry.
3. Two powerful greenhouse gases from agricultural soils, nitrous oxide (N_2O) and methane (CH_4), can be reduced by biochar.
4. Increased soil microbial activity can lead to more carbon being stored in the soil via biochar.
5. In order to replace carbon-positive energy from fossil fuels, biochar manufacturing produces thermal energy, bio-oils, and gas synthesis.



Other Benefits

1. Biochar can boost a material's ability to hold more water, which prevents leaching of nutrients and water.
2. By enhancing fertilizer use effectiveness, decreasing fertilizer costs, and preventing the need for the enforcement of water-quality rules for nonpoint source pollution, minimizing nitrogen losses through leaching can increase grower profits and sustainability.
3. Biochar can also reduce irrigation needs and enable production to increase on scarce water resources by improving water retention.

4. When the aforementioned advantages are combined, the root-zone habitat of plants and the microbial community around them are altered. This frequently results in increased microbial population and activity and can also boost crop yields.

Demerits

1. With the state of technology today, it is not economically feasible and cannot be widely adopted by farmers. However, the biochar synthesis process would become economically viable after all the useful goods and co-products, such as heat energy, gas like H2, and bio-oil, were gathered and employed.
2. Developing a low-cost pyrolysis kiln is necessary to produce biochar from surplus crop leftovers, which are now burnt on farms.

Conclusion

In addition to enhancing the physical and chemical qualities of soils and substrates used in agriculture and horticulture, biochar can save money by minimizing water and nutrient losses. Because biochar is manufactured using various techniques, it might potentially be produced and recommended for a particular crop, soil, or substrate.

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QUALITY SEED PRODUCTION OF SPONGE GOURD *(LUFFA CYLINDRICA L.)*

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Abstract

Sponge gourd **(*Luffa cylindrica*)** as reinforcement in resin matrix composite substances is evaluated. The morphology of the fibrous vascular gadget of Luffa's fruit is offered, and the benefits of using this natural mat cloth are highlighted. The use of untreated Luffa does not now increase the mechanical properties of the bare resin. However, its incorporation produces an exchange in the fracture mode of the composites from an abrupt one to a managed and more secure one. This result and the values acquired from mechanical checks show that, without any surface treatment. Luffa already has an excessive potential for use as a center fabric in hybrid composites.

Keywords : Hybrid composites, Mechanical behaviour, Natural fibers

Introduction

The sponge gourd **[*Luffa cylindrica* (Roem.) L.]** is an important cucurbit vegetable grown on the Asian continent. It belongs to the family Cucurbitaceae. In India, it's widely cultivated, and you can find it developing at almost every roof pinnacle or outdoor structure in the rural areas. Sponge gourd is grown for its fleshy, immature, non-bitter end result and natural sponge, which is mostly eaten as cooked vegetable curries. Early and total yield were the main breeding goals. In India, aside from stepped-forward sponge many landraces are also being grown for exceptional components having wide variants in form, size, colour, and maturity. The landraces are grown by way of farmers the usage of their personal saved seeds. The Luffa genotypes are of diverse flowering habits, i.e., monoecious and tri monoecious, andromonoecious, gynoecious, and hermaphrodite **(Singh *et al*., 2004).** The incidence of gynoecism in sponge gourd is uncommon, although populations with excessive proportions of pistillate flowers were developed and utilized for hybrid development **(Qinghua *et al*., 1996**; **Jianning, 2000).** In this paper, we discuss the development of sponge gourd **(*Luffa cylindrica* (Roem.) L.)** populations with a high percentage of pistillate plant life and improved agronomic performance.

Figure-1 Sponge gourd

Variety: Varieties of sponge gourd with rate, required spacing and features are mentioned below:

Variety	Rate	Spacing	Features
Kashi Rakshita	3.5 kg/ha	Row to row: 3.5cm Plant to plant: 75cm	Resistant to Mosaic Virus, fruit colour is dark green.
Kashi Shreya	3.5 kg/ha	Row to row: 3.5cm Plant to plant: 75cm	Resistant to downy mildew, suitable for river bed cultivation.
Kashi Divya	3.5-4.0 kg/ha	Row to row: 3.5cm Plant to plant: 75cm	Cylindrical fruit, high yield potential, suitable for distant marketing, successful in summer and rainy season.
Kashi Saumya F_1 Hybrid	3.5 kg/ha	Row to row: 3.5cm Plant to plant: 75cm	Medium maturing hybrid, dark green fruit, resistant to Sponge Gourd Mosaic.

Crop husbandry

Selection of variety : Range is now primarily advocated for regions or zones of cultivation, and with high ability yields, recuperation must be chosen for multiplication. Records on *Luffa cylindrica* varieties launched at the ICAR-Indian Agricultural Studies Institute, New Delhi.

Time of Sowing : The seeds are sown two times inside the year. the right time for sowing is inside the month of mid-February to March and second time within the month of mid-may additionally to July.

Isolation distance : Sponge gourd is a cross-pollinated crop, so producing good seed necessitates a thousand-meter separation distance between varieties to avoid unwanted cross-fertilization.

Sowing Time: It is particularly dependent on the winning weather conditions and the length of the types.

Seed treatment : Scrape the seed coat of the seed with a filer, then soak the seeds in water for twenty-four hours for better viability and a higher germination percentage.

Field Preparation

- The pH of the soil should be between 5.5 and 6.5.
- Although cultivation of sponge gourd can take place in all kinds of soils, the soil should have good moisture-keeping capability, especially in the summer time.
- Soil ought to be wealthy in organic matter.
- Sandy loam soil is relatively good for the cultivation of sponge gourd.

Weed control : To make the sector weed-free, mulching and then weedicides are essential. Practice Pendimethalin at 1 ltr/acre or Fluchloralin at 800 ml/acre as a pre-emergence herbicide.

Seed Production : Keep an isolation distance of 1,000 meters from different forms of sponge gourd. Remove diseased flowers from the field. An appropriate time for developing the seed crop is in the months of February and March because harvesting seeds will be less complicated throughout the dry month. For seed production, the culmination are harvested when they get

physiologically mature. After harvesting seeds are taken out form pulp, then they're packed and are saved.

Harvesting : Vegetation are prepared for harvesting after 70-80 days of sowing. carry out choosing on the c program language period of three-four days. harvesting of soft and medium-sized fruits must be completed. It gives a mean yield of sixty six-eighty three qtl in step with acre.

Conclusion : Sponge is fast becoming an indispensable crop because of its very extensive industrial uses. Within the context of morphosynthesis, the capability of replication of the loofa sponge opens the opportunity for the use of biodiversity in obtaining new substances. An effort is being made to bring the possibility of harnessing, changing, and recycling waste seeds from edible fruits and those considered weeds (non-edible ones), such as L. cylindrica, closer to industrial, home, or technological resources. Loofa sponge is a suitable herbal matrix for immobilization of microorganisms and has been a hit in the biosorption of heavy metals from wastewater. This emerging coin crop will improve the economies of many international locations within the nearest future due to its severe potential**.**

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