

Plasticulture:

changing face of Indian agriculture

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Plasticulture, or the use of plastics in agriculture is a new approach for boosting agricultural yield. This is a potential means of aiding agricultural development that has applications beyond agricultural land i.e. in food storage, water management, horticulture, and other fields which would help increase farm production in the future. India has enormous potential for plasticulture application and development. PE [Polyethylene (LLDPE, LDPE, and HDPE)], PP (Polypropylene) and PVC (Polyvinyl chloride) are extensively used in agricultural, water management and related applications. Plasticulture applications are one of the most useful and indirect agriculture inputs, which hold the promise to transform the face of agriculture in India

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INDIA's agriculture progressed through critical stages and has reached food self-sufficiency. Even though the country sustains more than 17.7% of the world's population with only 2.4% land and 4% water resources, the country's agricultural achievements are impressive. Agriculture employs 42.6% of the country's population. Agriculture and the allied sector proved to be the most resilient to the Covid-19 shocks as it registered a growth of 3.6% in 2020–21 and improved to 3.9% in 2021–22, driving the overall Indian economy's real GDP expansion of 9.2%, according to the Economic survey 2021–22.

The country's potential for plasticulture application and development is enormous. Plastic as an agricultural input breaks the technological barrier and offers fuel for a new period of rapid expansion following the green revolution. The Government of India agreed to form a national committee to promote plasticulture development in the country in order to promote and develop the use of plastic materials in agricultural and related fields. The use of plastics in agriculture,

water management and other related fields would be contingent on several important elements, including:

- Government policies on irrigation water tariffs and tax breaks for new irrigation techniques.
- Government policy on a new farming system based on modern materials.
- Access to plastic products and a grassroot distribution network.
- Extension measures to provide know-how and technical information at the grassroot level.

Plastic testing and standard facilities for agricultural and irrigation applications, natural resources particularly land and water, are under tremendous stress in many parts of the world, including India. In near future, meeting food and raw material demands in the face of rising population and decreasing resource bases will be a challenge. Achieving food security is a high priority in many countries including India, and agriculture must not only provide food for rising population but also save critical inputs for agriculture and their better management.

Food production's long-term viability is becoming increasingly reliant on smart and effective crop management and conservation methods, especially irrigation development and management in agriculture and other associated fields.

PE [Polyethylene (LLDPE, LDPE, and HDPE)], PP (Polypropylene) and PVC (Polyvinyl chloride) are the most extensively used polymers in agricultural, water management and related applications. The range of plastic raw materials is continually being upgraded to offer cost economy and technological advantages to the farming community. Plasticulture applications such as micro-irrigation and controlled environment agriculture help in better utilization of land, water, sunlight and raising crops in extreme climatic conditions. Advanced irrigation techniques such as drip and sprinkler irrigation have allowed crops to be grown on undulating terrains, saline soils and areas with brackish water, while also saving water and other inputs such as fertilizer, increasing productivity, and improving product quality, thus benefiting the environment.

Scope of Plasticulture

With its concentration on irrigation, high yielding cultivars, fertilizers, pesticides and scientific farming methods, the Green Revolution spread over the country, transforming India from a food deficient to a food surplus nation. The increased agriculture productivity, better quality of produce as well as crop diversification necessitates a closer examination of the agriculture and horticulture sectors in terms of quality and quantity of output for the Indian farming industry to remain competitive. Innovative agro practices must be employed to convert Indian agriculture precision farming techniques, resulting in the multiplication of our agro input resources to increase agricultural production in terms of both quality and quantity. Plasticulture applications are one of the most useful indirect agriculture inputs, which hold the promise to transform agriculture towards second green revolution in India. Major Plasticulture application are given here.

Table 1. Benefits of Plasticulture applications

Plasticulture Application	Water Saving (%)	Water Use Efficiency (%)	Fertilizer Use Efficiency (%)
Drip irrigation system	40–70	30–70	20–40
Sprinkler irrigation system	30–50	35–60	30–40
Plastic mulching	40–60	15–20	20–25
Greenhouse	60–85	20–25	30–35
Shade nets	30–40	30–50	not available
Plastic Tunnel	40–50	20–30	not available
Farm pond lined with plastic film	100	40–60	not available

Table 2. Type of Plasticulture Application in Agriculture

Plasticulture Application	Polymers Used
Drip irrigation system	LLDPE, PVC, PP
Sprinkler irrigation system	HDPE, PVC
Sub-surface Drainage	PVC
Canal Lining	LDPE, PVC
Pond Lining	LDP, LLDPE, EVA
Greenhouse	LLDPE, LDP, EVA
Plastic Tunnel	LLDPE, HDPE
Shade net House	HDPE
Plant Protection Nets	HDPE
Mulching	LLDPE, PP Non-woven
Soil Solarisation	LLDPE
Cap Covers	LDPE



Plastic mulch for Tomato cultivation

Source: Tsering Stobdan. Plasticulture in Cold Arid Horticulture, DRDO Science Spectrum, February 2015

Water Management

- Plastic film lining of canals, ponds and reservoirs.
- Irrigation system with drips and sprinklers.
- Water transportation utilising PVC and HDPE pipes.
- Drainage beneath the surface.
- Nursery bags, pots, pro-trays, root trainers, hanging baskets, plastic trays, and other nursery supplies (Table 1).

Surface cover cultivation

- Soil solarisation.
- Plastics mulching.

Controlled environment agriculture

- Greenhouses.
- Shade net houses.
- Plastic tunnels.
- Plant protection nets.

Innovation packing solution

- Plastic crates, bins, boxes, leno bags, unit packaging nets, and so on

- CAP [referring to both controlled and modified atmospheric packaging (MAP)]

Plasticulture applications in the field of water management, *in situ* moisture conservation, protected technologies, nursery management and non-active packaging for pre and post-harvest losses can provide a solution to locations with low periodicity. This would help the country to meet both food and nutrition in current scenario of depleting natural resources. Type of plasticulture applications in agriculture are given in Table 2.

India's overall geographical area is 329 million hectares (mha), with net sown area of 141 mha and gross cropped area of 193.7 mha. More than 62.25 mha are irrigated by various methods, with more than 5 mha under micro-irrigation. Coconut mango, banana, cashew, almonds, grains, ginger, turmeric and black pepper are all produced in India. In addition, it is the world's second largest producer of rice, wheat, cotton, sugar, fruits and vegetables.

Horticulture covers over 20 mha of the net sown area. Between 2001–02 and 2008–09, the CAGR of area was 3% and the CAGR of total production was 5%. Between 2007–08 and 2009–10, the horticultural sector added more than 10 lakh acres. In India's agriculture industry, plastics are still underutilized at 1%, compared to 7% in affluent countries. In India, the majority of plasticulture business prospects are subsidised. Agriculture and related industries' growth continues to be a major aspect in India's overall economic performance. The agriculture and allied sector accounted for 14.2% of the gross domestic product

Table 3. Plasticulture components under different government programmes

Scheme	Plasticulture component
National Mission on Micro = irrigation (NMMI)	Drip and sprinkler irrigation system
National Horticultural Mission (NHM)	Greenhouse, shade net house, plastic mulching, plastic tunnel, community pond, HDPE vermin bed, protection nets etc.
Horticultural Mission for North East and Himalayan states (HMNH)	Greenhouse, shade net house, plastic mulching plastic tunnel, community pond, hail protection nets
Rashtriya Krishi Vikas Yojana (RKVY)	Drip and sprinkler irrigation, greenhouse, shade net house, hail protection nets
Integrated Scheme on Oilseeds, Pulses, Oilpalm and Maize (ISOPOM)	Drip and sprinkler Irrigation system
National Food Security Mission (NFSM)	Drip and Sprinkler Irrigation system
Vegetables Initiative for urban clusters	Drip and sprinkler irrigation greenhouse, shade net house, plastic mulching plastic tunnel
Rain fed Area Development Programme	Greenhouse, plastic tunnel, pond lining, micro irrigation, HDPE vermin bed, mulching

(GDP) in 2010–11, according to the Central Statistics Office's (CSO) preliminary estimates. One of the primary objectives is to increase agricultural output to fulfil the growing need for food security for the entire population by maximising agricultural land, water and agri-inputs through enhanced farming practices and plasticulture application. Plastics are critical inputs in all these sectors, and only expanded use of diverse Plasticulture applications in water management, protected farming, and post-harvest measures can greatly contribute to India's food security. The National Committee on Plasticulture Application in Horticulture (NCPAH) is a national agency within the Ministry of Agriculture of India that promotes precision farming and the use of various plasticulture applications as part of the country's central sector mission for plasticulture development. The major flagship

programmes in which plasticulture is a component are given in Table 3.

SUMMARY

India has a huge potential for plastic use in agriculture. Various plasticulture applications are employed for improving productivity, quality and reducing cultivation costs, as well as post-harvest losses in the agri/horti sector. Some of these are plant protection nets, plastic tunnels, drip and sprinkler irrigation system. Plasticulture applications in water management, protected farming, and post-harvest measures can greatly contribute to India's food security.

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Know Krishi Unnati Yojana

The *Krishi Unnati Yojana*, a central sector scheme, is envisaged as umbrella programme for focusing on food security, by merging schemes on Soil-health Card, Integrated Scheme on Agricultural Co-operation and Agricultural Marketing, National Mission on Agriculture Extension, Horticulture Development, Price Stabilization Fund, National Mission on Sustainable Agriculture and other programmes.