Status of Plasticulture Technologies in India

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Plasticulture is the use of plastics in agriculture, horticulture, water-management, food grains storage and related areas. A variety of plastics materials and end products are deployed in plasticulture applications - for water conservation, irrigation efficiency, crop and environment protection, as well as end product storage and transportation.
Why Plasticulture

- Energy conservation. Require minimum energy in production and conversion to finished products.
- Higher strength / weight ratio, Superior electrical properties.
- Superior thermal insulation properties, Excellent Corrosion resistance
- Superior flexibility, Impermeability to water, gas, etc.
- Resistance to chemicals, Less friction due to smoother surface.
Plasticulture Technologies:

Controlled environment agriculture
- Greenhouses
- Shade net houses
- Low tunnels
- Plant Protection nets

Surface cover cultivation
- Soil Solarisation
- Plastics Mulching

Packaging
Water management

✓ Lining of canals, ponds & reservoirs with plastics film
✓ Drip & Sprinkler Irrigation
✓ PVC & HDPE pipes for water conveyance
✓ Sub-surface Drainage

Nursery Management

✓ Nursery bags, Pro-trays, Plastic plugs,
✓ Coco-pits, Hanging baskets, Trays etc
Some Popular Plasticulture Technologies developed under AICRP-PET installed in farmers field

- Protected cultivation
  - Polyhouse
  - Shade net house
  - Low tunnel structure
  - Plastic mulching

- Aquaculture and animal husbandary
  - FRP carp hatchery
  - FRP automatic fish feeder

- Water management
  - Poly lined pond
  - Micro irrigation

- Post harvest Management
  - Foldable plastic box with cells
  - MAP of perishables
  - Shrink packaging
  - Polytuneel dryer
Plasticulture technologies have been proved to enhance productivity and profitability worldwide.

In India, Polymer utilization is just 2% as compared to the world average of 8%.

Agricultural output can be increased by Rs 74,000 crore through plasticulture.
Significance of Plasticulture

- Production improvement (50-60%)
- Water saving (60-70%)
- Fertilizer saving (30-40%)
- Labour saving (7-18%)
- Early fruiting (10-25 days)
- Excellent quality of seedlings
- Enhances quality of produce
Status of plastics

- Plastics demand growing rapidly @ ~10% CAGR
- Present consumption 14 MnTPA.
- India is net importer of PolyEthylene (PE),
- Significant regional diversity in consumption with Western India: 47%, Northern India: 23%, Southern India: 21% and Eastern India: 9%
- Per capita consumption: 9.7 Kgs (USA: 109 kg)
Most burning issues before Indian Agriculture

- Low productivity – ever increasing population, resource poor farmers.
- Improper use of natural resources.
- Uncertain and varying climatic conditions (Spatial as well as temporal)
- Climate change
- Needed diversification hindered due to climate and other natural resources and socio-economics.
Lant holdings

- Total operational land holdings: 138.35 million
- Avg. size of operational land holding: 1.15 ha
- Small & marginal: 85%
- Semi-medium: 14.3%
- Large: 0.7%
Average monthly income per agricultural household

- Punjab: Rs 18059
- Haryana: Rs 14434
- J&K: Rs 12638
- Bihar: Rs 3558
- West Bengal: Rs 3980
- All India Average: Rs 6426
Reasons for low adoption

- High capital cost
- Lack of technical knowledge
- Lack of awareness about subsidies
- Perception that the system is not economical
- Considered as pollutants in agronomy, mulch laying mechanization and removal from field
86% of land holdings are less than 2 hectares

India is among the top producers of several crops such as wheat, rice, pulses, sugarcane and cotton.

It is the highest producer of milk in world

Second highest producer of fruits and vegetables
Area: 329 million hectares
Average annual rainfall is 1190 millimeter
Temp: low (-45 °C) to high (51 °C)
Area protected cultivation (40,000 ha)

Supports nearly 18% of the world population, approx. 16 % of Cattle Population with 2.4% land and 4 % of water resources
Schemes/ policies by Govt. of India to promote protected cultivation in India

Ministry of Agriculture and Farmers Welfare
Government of India

National Horticulture Board

National Horticulture Mission

Dept of Agri. Res. & Edu.

Indian Council of Agricultural Research

National Committee on plasticulture Agriculture with the Horticulture

ICAR- Central Institute of Post Harvest Engg. & Tech., Ludhiana

Precision Farming Development Centre

All India Coordinated Research Project on Plasticulture Engg. & Tech.
Over the last decade, the area under horticulture grew by about 3% per annum and annual production increased by 5.4%.

During 2016-17, the production of horticulture crops was about 295.2 million tonnes from an area of 24.9 million hectares.

Source: NHB report, 2017
The production of vegetables has increased from 58.5 million tonnes to 175 million tonnes since 1991-92 to 2016-17.

Impact of Govt schemes/policies and intervention of protected cultivation.
## Pattern of Assistance under MIDH for Protected Cultivation

<table>
<thead>
<tr>
<th>Area Sq m</th>
<th>Greenhouse with Fan and Pad System (Rs. /Sq m)</th>
<th>Naturally Ventilated Greenhouse</th>
<th>Shade net house</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tubular Structure (Rs. /Sq m)</td>
<td>Wooden Structure (Rs. /Sq m)</td>
<td>Bamboo Structure (Rs. /Sq m)</td>
</tr>
<tr>
<td>Up to 500</td>
<td>1650</td>
<td>1060</td>
<td></td>
</tr>
<tr>
<td>&gt;500 to 1008</td>
<td>1465</td>
<td>935</td>
<td></td>
</tr>
<tr>
<td>&gt;1008 to 2080</td>
<td>1420</td>
<td>890</td>
<td>540</td>
</tr>
<tr>
<td>&gt;2080 to 4000</td>
<td>1400</td>
<td>844</td>
<td></td>
</tr>
</tbody>
</table>
## Financial Assistance on Plasticulture Components

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Components</th>
<th>Subsidy pattern assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Govt. of India</td>
</tr>
<tr>
<td>National Mission on Micro Irrigation (NMMI)</td>
<td>Micro-irrigation</td>
<td>General Farmer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small and Marginal farmer</td>
</tr>
<tr>
<td></td>
<td>Technology Demonstration</td>
<td></td>
</tr>
<tr>
<td>Mission for Integrated Development of Horticulture (MIDH)</td>
<td>Tanks lined with plastic films for Individual</td>
<td>i. Rs 1.50 lakhs for plain areas ii. Rs 1.80 lakhs for hilly areas (To irrigate 2 ha for plains as well as hilly areas)</td>
</tr>
<tr>
<td></td>
<td>Plastic Mulching</td>
<td>i. Rs 32000/ha for plain areas ii. Rs36800/ha for hilly areas (upto 2 ha)</td>
</tr>
<tr>
<td></td>
<td>Plastic Tunnels</td>
<td>i. Rs 60 per sq m in plain areas ii. Rs 75 per sq m in hilly areas</td>
</tr>
</tbody>
</table>
How many types of Greenhouses

<table>
<thead>
<tr>
<th>Greenhouse Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasshouse</td>
</tr>
<tr>
<td>Polly-house</td>
</tr>
<tr>
<td>Shade-net-house</td>
</tr>
<tr>
<td>I.P. net-house</td>
</tr>
<tr>
<td>FRP-house</td>
</tr>
<tr>
<td>Tunnels</td>
</tr>
</tbody>
</table>
Popular greenhouse structure using for production in India

Polyhouse

- Semi-control
- N.V
- 0- electric
- Force ventilated
- F-P-polyhouse
Dabble door, Span, 4 side and top ventilated naturally/ zero electric energy polyhouse (Butterfly model)
Semi Climate Controlled/ Fain-Pad, maltly-span, roof ventilation polyhouse with Full Proof Roof water harvesting System
Greenhouse Technology for Tomato (Var. GS-600) Production during year round

Yield 150-200q/1000m² area
Greenhouse Technology for Cucumber (Var. Kian) Production during year round

Yield 200-300q /1000m² area
Greenhouse Technology for Capsicum (Var. Swarna) Production during year round

Yield 80-100q /1000m2 area
Greenhouse Technology for Capsicum (Var. Indra) Production during year round

Yield 80-100q /1000m² area
Protected cultivation of capsicum and tomato

Capsicum: Poly-house (Ventilation by insect-net) maximum fruit yield per plant (1.4 kg/plant) with Net income of Rs. 17.6 lakh/- per hectare

The highest average fruit weight (95 g/fruit) in polyhouse and B:C ratio of 3.62.

Tomato: Poly-house (Ventilation by insect-net) fruit yield (1.7 kg/plant) and the highest average fruit weight (74 g/fruit) and Net income of Rs. 10.2 lakh per ha with B:C ratio of 2.60
Water use efficiency of tomato under drip irrigation and mulch

- Evapotranspiration based irrigation scheduling was developed for tomato to be irrigated by drip irrigation. Irrigation requirement of 128.97 mm (43.27 litres per plant) was obtained for the tomato crop by using the FAO CROPWAT software.

- Water Use Efficiency was found out to be 339, 365 and 381 kg/ha-mm in plots with no mulch, bio mulch and black poly mulch, respectively.

- This shows WUE increased by 7.66% and 12.42% with use of bio mulch and black poly mulch, respectively.
Effect of coloured plastic mulches on tomato crop

- Red plastic mulch better: crop parameters viz., plant height (95.50 cm), no. of branches/plant (20.25), no. of fruits/plant (51.93) and weight of fruits/plant (3.82 kg).
- Yield of the tomato crop (84.8 t/ha) red mulch
- silver mulch (73.63 t/ha).
- Minimum yield of tomato was found in control (52.59 t/ha)
Gerbera cultivation: indication of prosperity

This enterprise created confidence into him and he constructed another greenhouse of 4000 m² area in the year 2012 with investment of Rs. 45 lakh. He got 65% subsidy, 50% from GHM and 15% from Horticulture Department. He got net profit about Rs. 5.64 lakh for cultivation of cucumber within four months.

Polyhouse (2000 sq m)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Colored Capsicum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sowing time</td>
<td>August 1st week</td>
</tr>
<tr>
<td>Harvesting time</td>
<td>Nov 15 to July 15</td>
</tr>
<tr>
<td>Total expenditure(Rs.)</td>
<td>711000</td>
</tr>
<tr>
<td>Total yield(Kg)</td>
<td>48000</td>
</tr>
<tr>
<td>Selling price(Rs./Kg)</td>
<td>50</td>
</tr>
<tr>
<td>Total income(Rs.)</td>
<td>2400000</td>
</tr>
<tr>
<td>Net profit(Rs.)</td>
<td>1689000</td>
</tr>
</tbody>
</table>
Poly-Tunnel Structure of LDPE plastic film was found the best for cumin crop

- **Early maturity** (crop duration: 45-50 days compared to 60-75 days for control)
- **Minimum insects / pests incidence**
- **Water saving**: 37% (300 mm/ha as compared to 335 mm/ha in control)
- **Increased yield**: 67% (1267 kg/ha as compared to 758 kg/ha in control)
- **Better quality** of cumin seeds (1000 seed weight 5.85 g compared to 4.24g in control)
- **Highest net profit** of 2,28,060 Rs/ha (control: 1,36,440 Rs/ha)
Plastic Mulching and micro irrigation

**Effect of mulch on water use efficiency and yield of water melon**

Maximum crop yield (40.5 t/ha) in case of silver black plastic mulch.

Maximum water use efficiency (163.36 kg/ha-mm).

**Practical utility :** Water melon cultivation under mulching technology has been proved as a practice for water saving as well as good returns to farming community.

**Recommendation for farmers of South Saurashtra Agro-climatic Zone:** Use silver black plastic mulch (20 µ) with drip irrigation for cultivating water melon in summer season.
Evolvement of mulching technology for bunch type groundnut crop

Recommendation:
The farmers of South Saurashtra Agro climatic Zone are advised to use silver black plastic mulch (20 µm) with drip irrigation and raised bed for water saving and to achieve higher crop production of bunch type groundnut in summer season.
Cultivation of Bt cotton under silver black plastic mulch; Maximum crop yield (4979 kg/ha) was found under silver black plastic mulch with irrigation level of ETc = 0.8. While it was minimum (2693 kg/ha) for no mulch condition.

The farmers of South Saurashtra Agro Climatic Zone are advised to use silver black plastic mulch (20 µm) with irrigation level of ETc = 0.8 under drip irrigation for the cultivation of Bt cotton to increase crop yield (42 %) as compare to no mulch.
## Quonset shape GI frame Polyhouse

<table>
<thead>
<tr>
<th>Sizes</th>
<th>100 m² (Naturally ventilated)</th>
</tr>
</thead>
</table>
| Cost           | Rs 400-500 per m² (in Uttarakhand)  
                 | Rs 600-700 per m² (in Srinagar – snow bound area) |
| Cultivation    | Off-season vegetables, nursery, strawberry |
| Income         | Rs 1,20,000 per year or more |
## Modified low cost Net House for vegetable cultivation in hot climate (Punjab)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sizes</td>
<td>500 m²</td>
</tr>
<tr>
<td>Cost</td>
<td>R 1,80,000 per unit</td>
</tr>
<tr>
<td>Cultivation</td>
<td>Round the year cultivation of vegetables</td>
</tr>
<tr>
<td>Income</td>
<td>R 50,000 to 70,000 annually (as per farmers evaluation)</td>
</tr>
</tbody>
</table>
Technology for sunburn reduction in pomegranate fruits in hot and arid region

- Black net + fogger was found the best to reduce sunburn with almost nil burn.

- Black shade net (50%) 1-2% fruits were affected by sunburn compared to control where 40-45% fruits affected by sunburn.
Fruit colour affected by different treatments application

Fruit juice colour affected by different treatments application
Development and evaluation of polyhouse covered fish polytank for fish rearing for high hills

Polytanks were 9.8 m × 3.0 m top, 7.4 m × 0.6 m bottom, 1.2 m depth, 1:1 side slope with capacity of approximately 20 m³. Four of the polytanks were covered with dome shaped galvanized iron (GI) pipe polyhouse. The dimensions of the polyhouse were 11.0 m length, 4.2 m width and 1.0 m span with central height of 3.0 m. The size of the each polyhouse was 46.2 m². There was one ventilator of size 1.0 m × 0.8 m, one door of size 1.8 m × 1.05 m and there was wide opening in the two longitudinal sides fitted with insect proof net. The fish seeding in all the six polytanks was done on 6th August 2016. Monthly average water temperature and microclimate study has been carried out during winter season and found that water temperature was 2.5-4 °C
Indian Irrigation Sector: Overview

1950
22 Mha
55 MT

2016
89 Mha
270 MT
Indian Water Resources

Water Stress: 1700
Water Scarce: 1000

1951: 5177 cubic metre per year
1991: 2209 cubic metre per year
2001: 1820 cubic metre per year
2025: 1341 cubic metre per year
2050: 1140 cubic metre per year
Irrigation Scenario - India
Water productivity

- Average: 0.37 kg / m³
- Net Irrigated area: 88 million ha
- Micro irrigation: 7.8 million ha
- Potential for micro irrigation: 69.5 million ha
- Water availability vs water management
- Multiple use of water
LDPE lined Water harvesting structures
Use of harvested water
### Increase in yield and water savings in drip irrigation as compared to surface irrigation

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Crop</th>
<th>Increase in yield (%)</th>
<th>Water Saving (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pomegranate</td>
<td>20-40</td>
<td>50-60</td>
</tr>
<tr>
<td>2</td>
<td>Potato</td>
<td>20-30</td>
<td>40-50</td>
</tr>
<tr>
<td>3</td>
<td>Sugarcane</td>
<td>50-60</td>
<td>30-50</td>
</tr>
<tr>
<td>4</td>
<td>Tomato</td>
<td>25-50</td>
<td>40-60</td>
</tr>
<tr>
<td>5</td>
<td>Cauliflower</td>
<td>60-80</td>
<td>30-40</td>
</tr>
<tr>
<td>6</td>
<td>Brinjal</td>
<td>20-30</td>
<td>40-60</td>
</tr>
<tr>
<td>7</td>
<td>Cabbage</td>
<td>30-40</td>
<td>50-60</td>
</tr>
<tr>
<td>8</td>
<td>Okra</td>
<td>25-40</td>
<td>20-30</td>
</tr>
<tr>
<td>9</td>
<td>Chilli</td>
<td>10-40</td>
<td>60-70</td>
</tr>
<tr>
<td>10</td>
<td>Bottle Gourd</td>
<td>20-40</td>
<td>40-50</td>
</tr>
<tr>
<td>11</td>
<td>French Bean</td>
<td>55-65</td>
<td>30-40</td>
</tr>
</tbody>
</table>
Farmers first
Conserve more grow more
Thank you all