NABARD

RURAL PULSE
Issue : XX March - April 2017

Protected Cultivation of Horticulture Crops

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Protected cultivation practices can be defined as a cropping technique wherein the micro environment surrounding the plant body is controlled partially/ fully as per plant need during their period of growth to maximize the yield and resource saving. The different type of structures and technologies are used in commercial protected cultivation. The level and type of adoption of technology depends upon location, type of crops grown, type of market targeted and quality of production required. Various types of structures and technologies adopted for commercial protected cultivation are given in this issue.

1. Types of Protected Cultivation

Green House

Green houses are climate controlled with cooling and heating system and mainly used growing exotic varieties of vegetables, off-season growing of vegetables, floriculture, planting material acclimatization and plant breeding and varietals improvement under adverse agro climatic conditions. The degree of sophistication of greenhouses include fully automated systems with poly carbonate sheet roofing (double walled), heating and cooling system and full scale computerized with combination of various other components.

Poly House

Poly house is less sophisticated version of green house with naturally ventilated climate controlled as against the fully climate controlled green houses. Usage of poly houses are similar to green houses for growing exotic varieties of vegetables, off season vegetables, floriculture, planting material acclimatization, etc., under ideal agro climatic conditions suitable for growing these crops.

Poly Tunnel

Poly tunnels are basically naturally ventilated climate controlled. Poly tunnels have a variety of applications, the majority being, growing of vegetables, floriculture, planting material acclimatization, Poly tunnels are built of a pre-galvanized tubular structure and mainly uses in hilly and temperate regions with moderate temperature.

Shade Net House

Net houses are basically naturally ventilated climate controlled strcuture. Net houses have a variety of applications, the majority being, growing of vegetables, floriculture and for nurseries. Net houses are built of a pre-galvanized channel cum tubular structure/ tubular structure, wooden or bamboo structures mainly used in regions with less rainfall.

Hydroponics

Hydroponics is a method of growing plants without soil, using water enriched with balance mineral nutrients essential for plant growth and yield. The nutrients and PH level are maintained suiting to the selected crop for better growth. Hydroponics is proved to have several advantages over soil media such as:

- Suitable for vertical farming under greenhouse conditions other modified structures
- Efficient use of plant nutrients without any fixation or leaching like in soil culture
- Maintains right PH , Oxygen levels for improved growth and productivity
- Less incidence of pest and diseases, especially non incidence of soil borne diseases

Aeroponics

Aeroponics is the process of growing plants in an air or mist environment without the use of soil or an aggregate medium. Aeroponics is proved to have several advantages over soil based gardening and hydroponics:

- As aeroponics is conducted in air combined with micro-droplets of water helps in faster and better growth of plants with a plentiful supply of oxygen, water and nutrients
- Plants in a true aeroponic conditions have 100% access to the CO_2 concentrations for photosynthesis
- Aeroponics can limit disease transmission since plant-to-plant contact is reduced and each spray pulse can be sterile. In the case of soil, aggregate, or other media, disease can spread throughout the growth

2. Components of Protected Cultivation Structures

Depending upon the type of covering structure like green house, poly house, poly tunnels and shade net and type of crops proposed for growing and the level of control of atmosphere required, the commponets varies from strcuture to strcuture and location to location. The broad list of components of the protectecded strcutures and advantages of protected cultivation technolgies are given below:

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Green House/ Poly House Components
Pre galvanised Iron / wooden and bamboo structure
UV stabilized covering materials of Polyethylene / Polycarbonate / Acrylic
Heating system in cold climate
Cooling pad and Fan System
Shading / Thermal Net
Trellising system for vegetable
Trestles system for flowers
Side wall roll up curtains
Micro Irrigation System
Fertigation System
Misting System
CO2 Generator
Control System /Weather Station
Planting material, artificial growing media
Hydroponics/aeropoins

Advanatges of techncolgy
Off season production
Production exotic varieties with high quality standards
Yield is 5 - 15 times more than open cultivation
Less chances of disease attack, thus reduction in disease control cost
Higher Efficiency of Water & Fertilizer Use
Cultivation in problematic topography, soil conditions and climate conditions
Can be fully automated requiring very less labor and manual intervention

3. Growth of Protected Cultivation

The commercial protected cultivation was first introduced to the country in 1990s for establishing 100% export oriented units for Rose cultivation. The first few projects were set up in Bangaluru and Pune regions as these centers were found to be ideal with suitable agro climatic conditions and proximity to airports for quick exports. Most of the projects came up with collaboration from companies from Netherland and Israel having expertise in building and managing ploy houses. Entire poly house structures and plant materials were imported from these countries and with O&M contract for first one year or more. At that time, unit size of 4 ha with all production and captive post-harvest management infrastructure like pre cooling, grading and packaging, cold room and refrivans etc., was considered to be viable unit size. Average cost was about Rs. 200 to Rs. 250 lakh per hectare of poly house. Majority of the unit came up during initial period suffered losses due to following reasons:

- Very high cost of project due to 100% import technology and components
- Focus on only Rose production, lack of diversification
- Gaps in production technology and quality
- Lack skilled manpower
- Lack of adequate cold chain infrastructure
- Poor air connectivity to importing countries and higher air fright
- Import restriction from EU countries with additional import duty on Indian flowers
- Lack of domestic market for high priced cut flowers

With initial experience gained from imported technology, many companies started promoting indigenous technologies substituting the imported components of poly houses and also standardizing technology of low cost poly houses and poly tunnels and shade nets, etc. Along with technologies, the crops cultivated under poly house got diversified with commercial cultivation of varieties of flowers, vegetables, herbs, etc. The expansion of protected cultivation further boosted by introduction of capital subsidy under schemes of National Horticulture Boards, National Horticulture Mission, Mission Integrated Development of Horticulture, etc. The major factors responsible for high growth under protected cultivation are as under:

- Reduced cost of poly houses and viability of smaller size poly houses
- Development of low cost poly houses and other structures
- Growing domestic market for exotic vegetable and cut flowers
- Attractive enterprise for new generation farmers and entrepreneurs with high returns per unit area.
- Availability technical /skilled manpower for construction and management of poly houses
- Capital subsidy schemes of GOI and State Governments

There is no authentic data on the total area under protected cultivation. However different sources indicate that about 40000 ha is under commercial protected cultivation. The major states having area under protected cultivation and major crops/plants and commercial use of protected cultivation are indicated below:

Major States	Major crops/purpose
• Karnataka • Tamilnadu • Andhra Pradesh • Kerala • Telangana • Maharashtra • Gujarat • Haryana • Punjab • Himachal Pradesh • West Bengal • Noth Eastern States	• Vegetables : Colored Capsicum, English Cucumber, Cherry Tomato, Tomato, Pole beans, colured Cabbage, Bottle brijnal, brocoli and other off season vegetables • Flowers: Rose, Gerbera, Carnation, Tiger lilies, Anthurium, Orchids • Others: Lettuce, parsely, celery chives, Vanilla • Fruits: Cantaloupe, Water Melon, Strawberry • Nursery: Hybrid vegetable seedlings, hardening of tissue culture plants, micro tubers of potato. Exotic flowers nursery

4. Potential Growth Centers and Clusters for Protected Cultivation

Protected cultivation is feasible in all regions of the country. The southern states and some parts of Maharashtra are suitable for naturally controlled tubular poly houses, low cost poly houses with wooden and Bamboo frames and other low structures like poly tunnels and shade nets could be used during all the seasons for cultivation of potentials crops/plants. The protected cultivation in these regions has the advantages less capital cost of growing structures.

The State-wise potential clusters and feasible commercial crops are indicated in the table below:

Southern India	Cluster	Potential Crops/plants
Karnataka	Bangaluru and Mysore	• Flowers: Rose, Gerbera, Carnations • Vegetables: Colored Capsicum, English Cucumber, Cherry Tomato, Tomato, Pole Beans, off season vegetables etc. • Fruits: Melons and Cantaloupe • Exotic herbs: Chives etc. • Nurseries
	Balgaum Region	• Vegetables: Colored Capsicum, off season vegetables • Flowers: Anthurium and Orchids
	Malanad Region	• Flowers: Gerbera, Carnations, off season vegetables etc. • Vegetables: Colored Capsicum • Nurseries
Tamil Nadu	Dharmapuri and Salem	• Flowers: Rose, Gerbera, Carnations • Vegetables: Colored Capsicum, English Cucumber, Tomato and other off season vegetables etc. • Nurseries
	Ooty and Kodaikanal	• Flowers: Tiger lilies, Gerbera, Carnations and other exotic flowers • Exotic vegetables and herbs
Andhra Pradesh	Kuppum , Ananthapur and Kurnool	• Flowers: Gerbera, Carnations • Vegetables: Colored Capsicum and Tomato • Nurseries
Telangana	Hyderabad	• Flowers: Gerbera, Carnations • Vegetables: Colored Capsicum, English Cucumber, Lettuce, off season vegetables etc.
Kerala	Central Region	• Flowers: Anthurium and Orchids • Vegetables: Colored Capsicum, English Cucumber and Tomato
Western and Central India	**Cluster**	**Commercial plants grown**
Maharashtra	Western Maharashtra covering Pune, Nasik, Sangali, Satara, Palghar	• Flowers: Rose, Gerbera, Carnations • Vegetables: Colored Capsicum, English Cucumber, Cherry Tomato, Tomato, Pole Beans, off season vegetables etc. • Fruits: Melons and Cantaloupe • Nurseries
Gujarat	Ahmedabad, Mehasana, Sabarkantha	• Vegetables: Colored Capsicum, English Cucumber, off season vegetables etc.
Madhya Pradesh	Indore	• Vegetables: Colored Capsicum, English Cucumber etc.
Northern India	**Cluster**	**Commercial plants grown**
Rajasthan	Jaipur	• Vegetables: Colored Capsicum, English Cucumber, off season vegetables etc.
Haryana	Sonipat , Panipat, Karnal , Rohtak	• Vegetables: Colored Capsicum, English Cucumber, Tomato, off season vegetables etc. • Others : lettuce and Leafy vegetables
Punjab	Ludhiana, Kapurthala, Hoshiarpur	• Vegetables: Colored Capsicum, English Cucumber, Tomato, off season vegetables etc. • Others : Lettuce and Leafy vegetables
Hilly Regions	Cluster	Commercial plants grown
Uttarakhand	Dehradun and Pantnagar	• Vegetables: Colored Capsicum, English Cucumber, off season vegetables etc. • Others: lettuce and Leafy vegetables
Himachal Pradesh	Shimla, Solan, Palampur	• Vegetables: Colored Capsicum, English Cucumber, off season vegetables etc. • Nurseries: Seed production
Sikkim		• Off season vegetables • Flowers: Orchids and anthuriums
Manipur , Meghalaya, Arunachal Pradesh		• Off season vegetables • Flowers: Anthuriums, Tiger lilies and orchids

5. Economics

The poly house structure is the major cost of investment. The cost of poly house depends upon the type of ploy houses like fully controlled, naturally ventilated, walk in tunnels, shade nets etc., and also depends upon the type of frame like galvanized iron, wooden or bamboo. The indicative cost for various types of poly houses including poly house structure, irrigation, fertigation etc. are given below. The capital cost assumed is indicative and may vary from location to location and level of automation and control systems built in the project. The planting material cost assumed is average of various types of vegetables and flowers. This may vary depending upon the varieties and types of plants and source of planting material.

Type of ploy house	Cost of poly house Rs / sqm	Cost of Planting Material Rs / sqm		Total unit cost Rs lakh /acre		Economic life of structure
1. Green House (Pad and fan system)	1400	Vegetables	50	Vegetables	58.00	25 years for frame and 4 years for cover
		Flowers	300	Flowers	68.00	
2. Naturally ventilated (GI frame)	800	Vegetables	50	Vegetables	34.00	25 years for frame and 3-4 years for cover
		Flowers	300	Flowers	44.00	
3. Naturally ventilated (Wooden frame)	600	Vegetables	50	Vegetables	26.00	5- 10 years for frame and 3-4 years for cover
		Flowers	300	Flowers	36.00	
4. Naturally ventilated (Bamboo frame)	500	Vegetables	50	Vegetables	22.00	5-10 years for frame and 3-4 years for cover
		Flowers	300	Flowers	32.00	

The investment in the polyhouse is economical as reflected in the net income and IRR. The IRR ranged from 17 per cent for Green House to 32 per cent for naturaly ventilated polyhouse.

Type of ploy house	Vegetables		Flowers	
	Net Income (Rs./sqm)	IRR (%)	Net Income (Rs./sqm)	IRR (%)
1. Green House (Pad and Fan System)	230	12	380	17
2. Naturaly ventilated polyhouse	190	25	340	32
3. Shade Net	150	20	290	27
4. Walk in Poly Tunnels	130	20	240	20

5. Market

Major market for produces from protected cultivation is domestic market, only Rose and colored capsicum is being exported. The product wise competitiveness and potential are presented in the table below:

Product	Major market	Competitiveness
Rose	Export	With the growing domestic consumption the price realization in the domestic market is very close to export prices. Many small units are now focusing on domestic market. The large volumes are exported on valentine and new year days.
Gerbera	Domestic	Not economical to export due to un competitive price and fright rates
Carnation	Domestic	Not economical to export due to un competitive price and fright rates
Orchids and Anthurium	Domestic	International prices are less than the domestic prices
Colored Capsicum	Mainly domestic. Small exports to Gulf and Asian Countries	Growing domestic market. Less competitive export market in terms of quality and price
Other vege-tables	Domestic	Growing domestic market. Less competitive export market in terms of quality and price

7. Issues in Protected Cultivation

The protected cultivation technology is wide spread across the country. The commercial viability and sustainability of the technology is limited to few clusters in traditional states like Karnataka, Tamil Nadu and Maharashtra. The issues and suggestions for sustainable growth of protected cultivation technology are as under:

- High capital investment
  - The present cost of investment is unsustainable without capital subsidy support from Government
  - There is need for developing low cost poly house designs suitable for various agro climatic zones.
- High cost of planting material
  - 100% planting material of the poly house varieties are imported and cost of seeds and planting materials is very high
  - Need for developing domestic varieties matching with the productivity and quality of imported seeds
- Lack of diversification
  - There is monopoly of few crops like colored Capsicum, Gerbera, Carnation, Rose etc.,
  - There is a need for promoting more crops under protected cultivation for sustainability of protected cultivation
- Lack of institutional arrangement
  - There is no dedicated institutional arrangement for R&D, planning and promoting protected cultivation and for providing backward and forward linkages
- Lack of markets information
  - Market for produce from protected cultivation is highly fragmented and privately operated by very few aggregators. Growers are over depend on these aggregators
- Credit support
  - Since investment cost of protected cultivations is very high, providing adequate collaterals is a concern and is affecting the credit flow to the sector
  - The production credit for crops cultivated under protected cultivation is very high as compare to open cultivation. In absence of scale of finance for crops under protected cultivation, the banks are applying the scale of finance of open cultivated varieties leading to under finance
  - Lack of insurance coverage against income and production risks is detrimental for growth of area under protected cultivation

Publisher :- Shri M. V. Ashok, CGM, Department of Economic Analysis and Research (DEAR), NABARD, Head Office: Plot No. C-24, 'G' Block, Bandra-Kurla Complex, Bandra (E), Mumbai- 400051

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