

Status of Plasticsulture Technologies in India

**Training on “Protected Agriculture Technology in Asian Countries”
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Dr. Rajesh Kumar Singh, Ph. D.

Project Coordinator,
All India Coordinated Research Project (Plasticsulture Engg.
& Tech) , Indian Council of Agricultural Research
Central Institute of Post Harvest Engg. &Tech. Ludhiana,
Punjab (India), Mb: +91 9436731762
Email: rksingh_ars@yahoo.com, pcapaldh@gmail.com



हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

AgriSearch with a human touch

Plasticulture



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 Plastics



- 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



Protected cultivation
 Polyhouse
 Shade net house
 Low tunnel structure
 Plastic mulching



Water management
 Poly lined pond
 Micro irrigation

**Some Popular
 Plasticulture
 Technologies
 developed under
 AICRP-PET
 installed in
 farmers field**



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



**Post harvest
 Management**
 Foldable plastic
 box with cells
 MAP of
 perishables
 Shrink packaging
 Polytunnel dryer



Significance of Plasticulture

- ▶ 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 74000 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.

Land 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

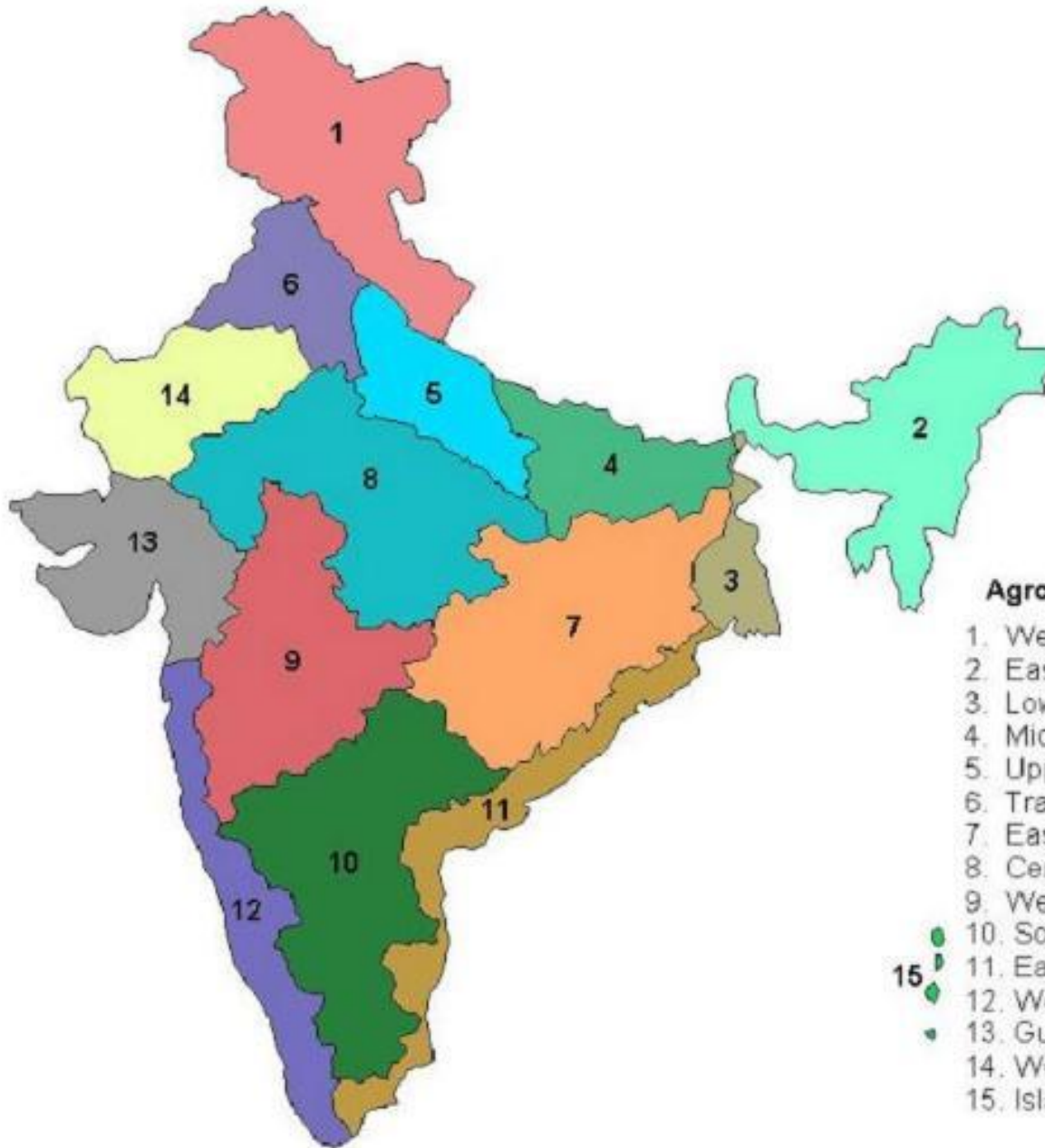
- ▶ All India Average: Rs 6426

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

Agro-climatic zones of India

- 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



Agro-Climatic Zone

1. Western Himalayan
2. Eastern Himalayan
3. Lower Gangetic Plains
4. Middle Gangetic Plains
5. Upper Gangetic Plains
6. Trans Gangetic Plains
7. Eastern Plateau & Hills
8. Central Plateau & Hills
9. Western Plateau & Hills
10. Southern Plateau & Hills
11. East Coast Plains & Hills
12. West Coast Plains & Hills
13. Gujarat Plains & Hills
14. Western Dry Region
15. Islands

India Climatic Zone Map

Climatic zones (Köppen classification)

- Montane
- Humid subtropical
- Tropical wet and dry
- Tropical wet
- Semi-arid
- Arid

- NATIONAL CAPITAL
- State Capital
- Union Territory Capital



Area: 329 million hectares

Average annual rainfall is 1190 millimeter

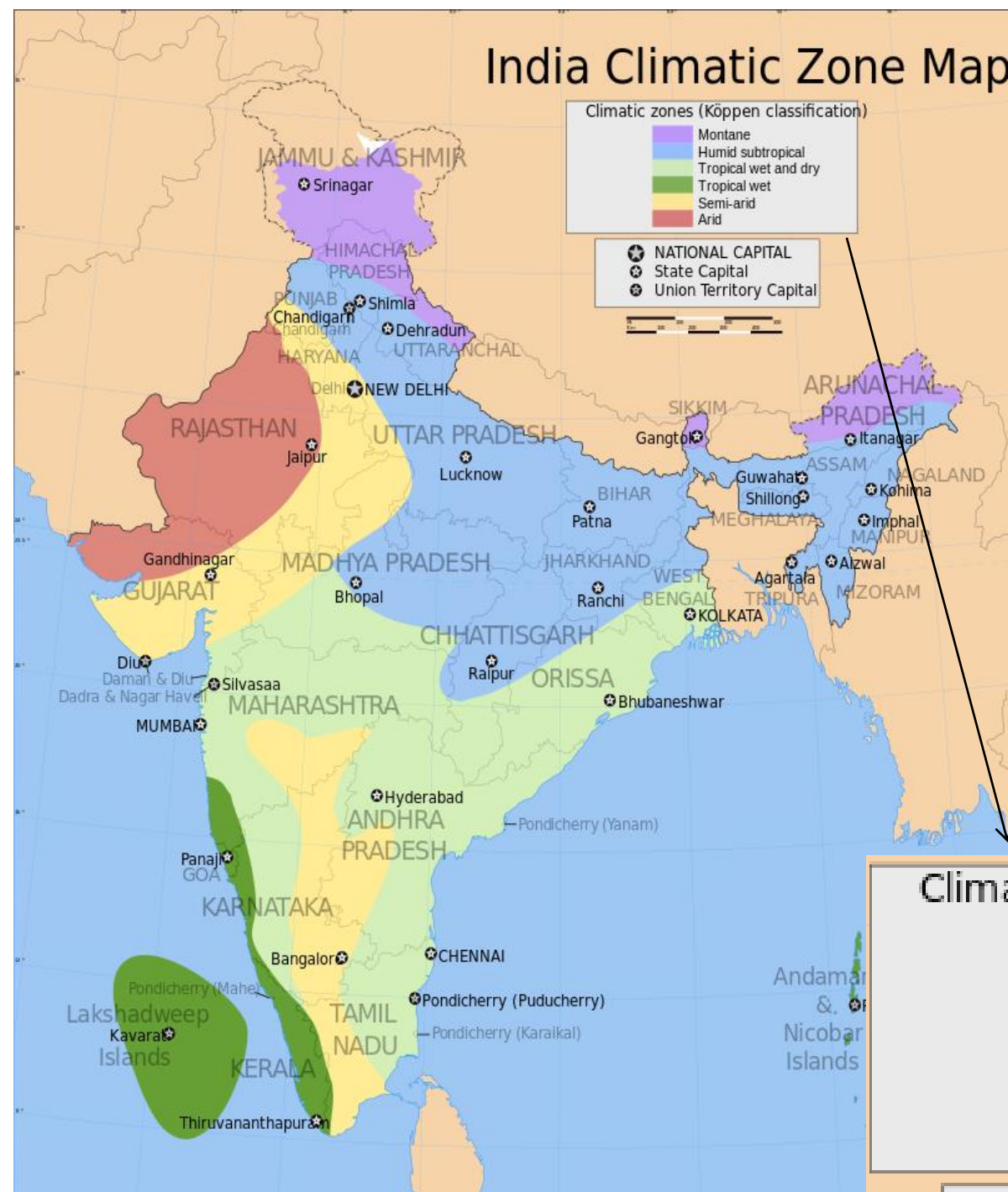
Temp: low (-45 °C) to high (51 °C)

Area protected cultivation (40,000 ha)

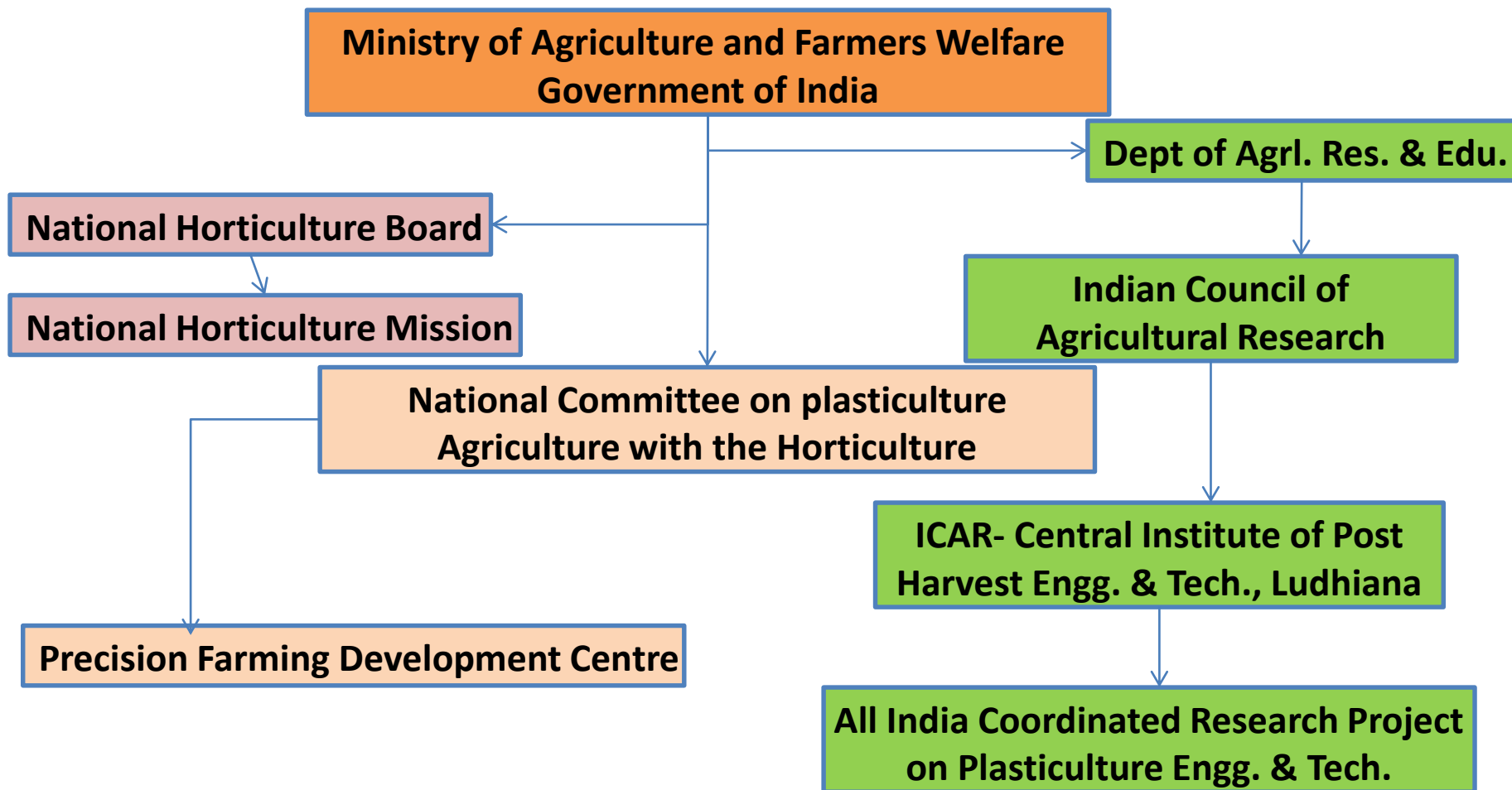
Supports nearly 18% of the world population, approx. 16 % of Cattle Population with 2.4% land and 4 % of water resources

Climatic zones (Köppen classification)

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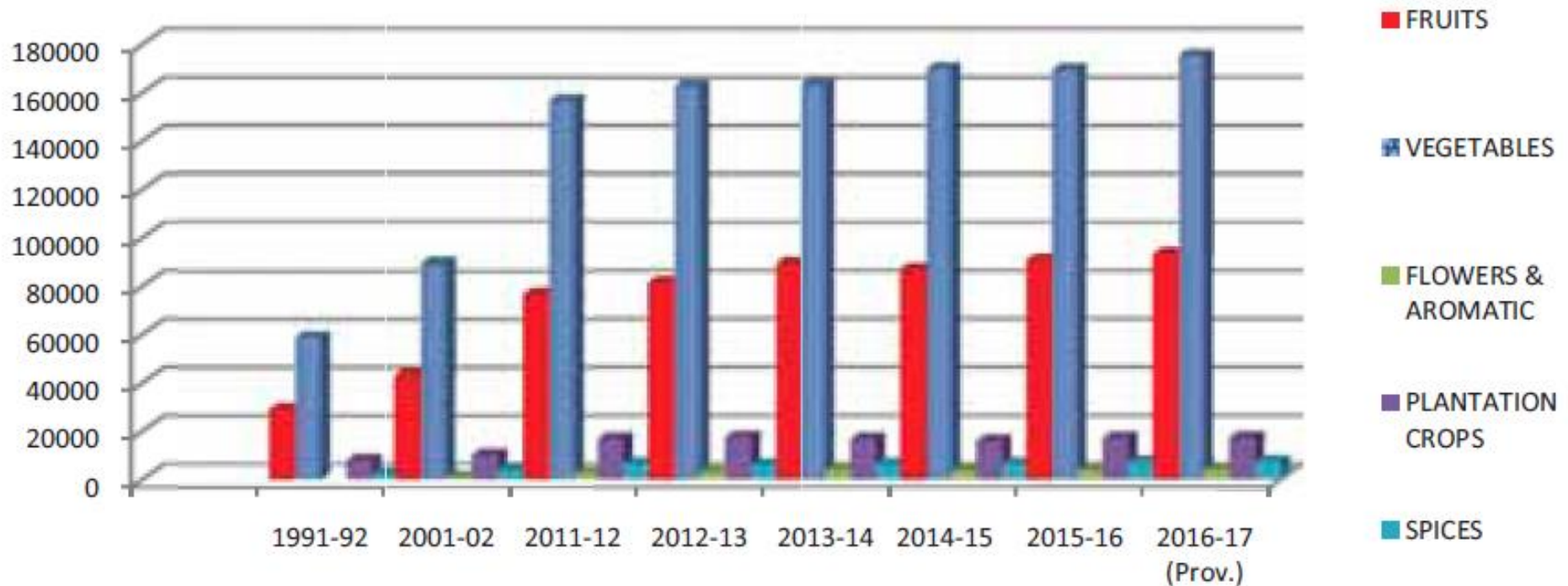


Schemes/ policies by Govt. of India to promote protected cultivation in India



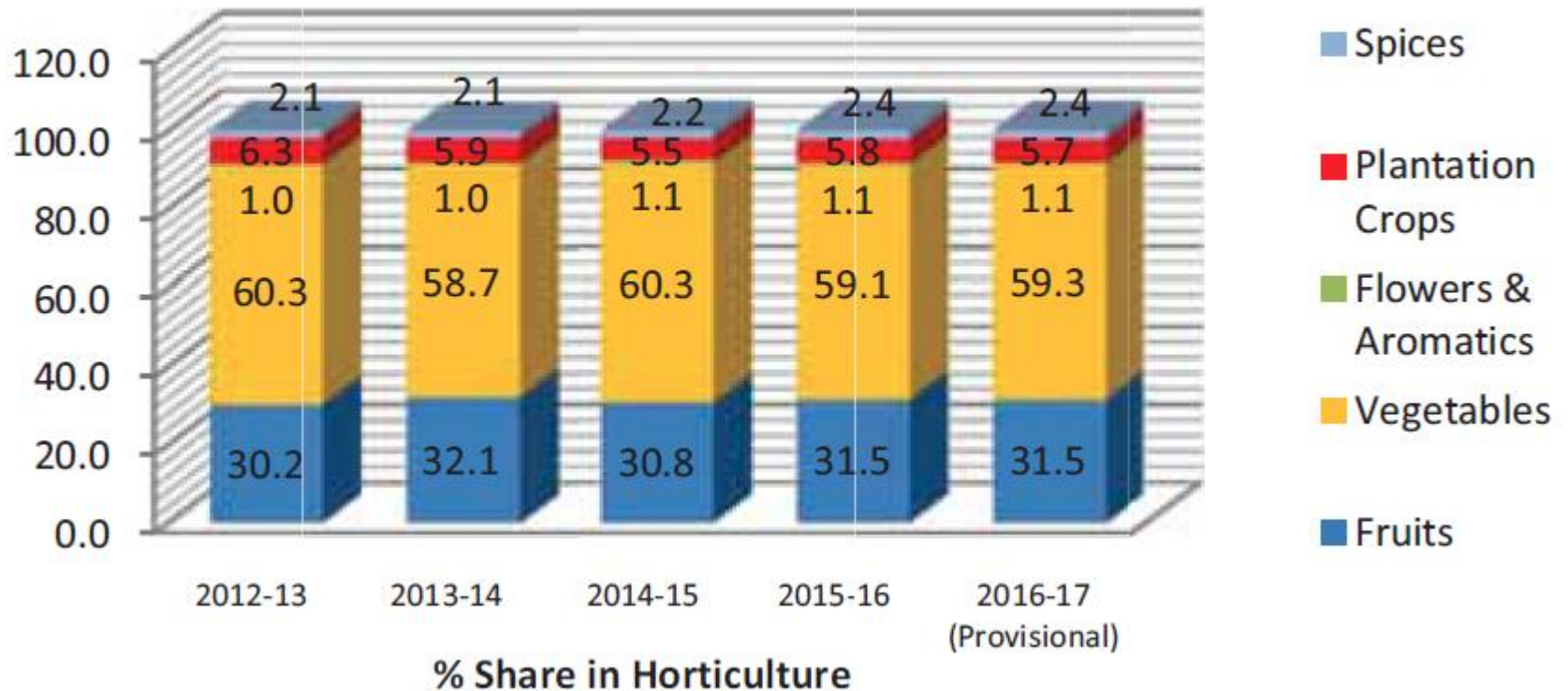
- Over the last decade, the area under horticulture grew by about 3% per annum and annual production increased by 5.4%.
- During 2016-17, the production of horticulture crops was about 295.2 million tonnes from an area of 24.9 million hectares

Production of various Horticulture Crops over the years

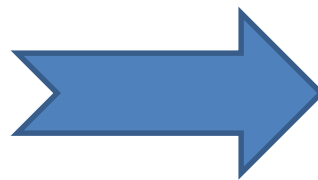


Source: NHB report, 2017

Production Share of various Horticulture crops



Impact of Govt schemes/policy and intervention of protected cultivation



The production of vegetables has increased from 58.5 million tonnes to 175 million tonnes since 1991-92 to 2016-17

Pattern of Assistance under MIDH for Protected Cultivation

Area Sq m	Greenhou se with Fan and Pad System (Rs. /Sq m)	Naturally Ventilated Greenhouse			Shade net house		
		Tubular Structure (Rs. /Sq m)	Wooden Structure (Rs. /Sq m)	Bamboo Structure (Rs. /Sq m)	Tubular Structure (Rs. /Sq m)	Wooden Structure (Rs. /Sq m)	Bamboo Structure (Rs. /Sq m)
Up to 500	1650	1060	540	450	710	492	360
>500 to 1008	1465	935					
>1008 to 2080	1420	890					
>2080 to 4000	1400	844					

Financial Assistance on Plasticulture Components

Scheme	Components		Subsidy pattern assistance		
			Govt. of India	State Govt.	Borne by farmer
National Mission on Micro Irrigation (NMMI)	Micro-irrigation	General Farmer	40%	10%	50%
		Small and Marginal farmer	50%	10%	40%
	Technology Demonstration		75%	-	25%
Mission for Integrated Development of Horticulture (MIDH)	Tanks lined with plastic films for Individual	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)	50%		
	Plastic Mulching	i. Rs 32000/ha for plain areas ii. Rs36800/ha for hilly areas (upto 2 ha)	50%		
	Plastic Tunnels	i. Rs 60 per sq m in plain areas ii. Rs 75 per sq m in hilly areas	50%		

How many types of Greenhouses

Greenhouse Groups

Glass-house

Polly-house

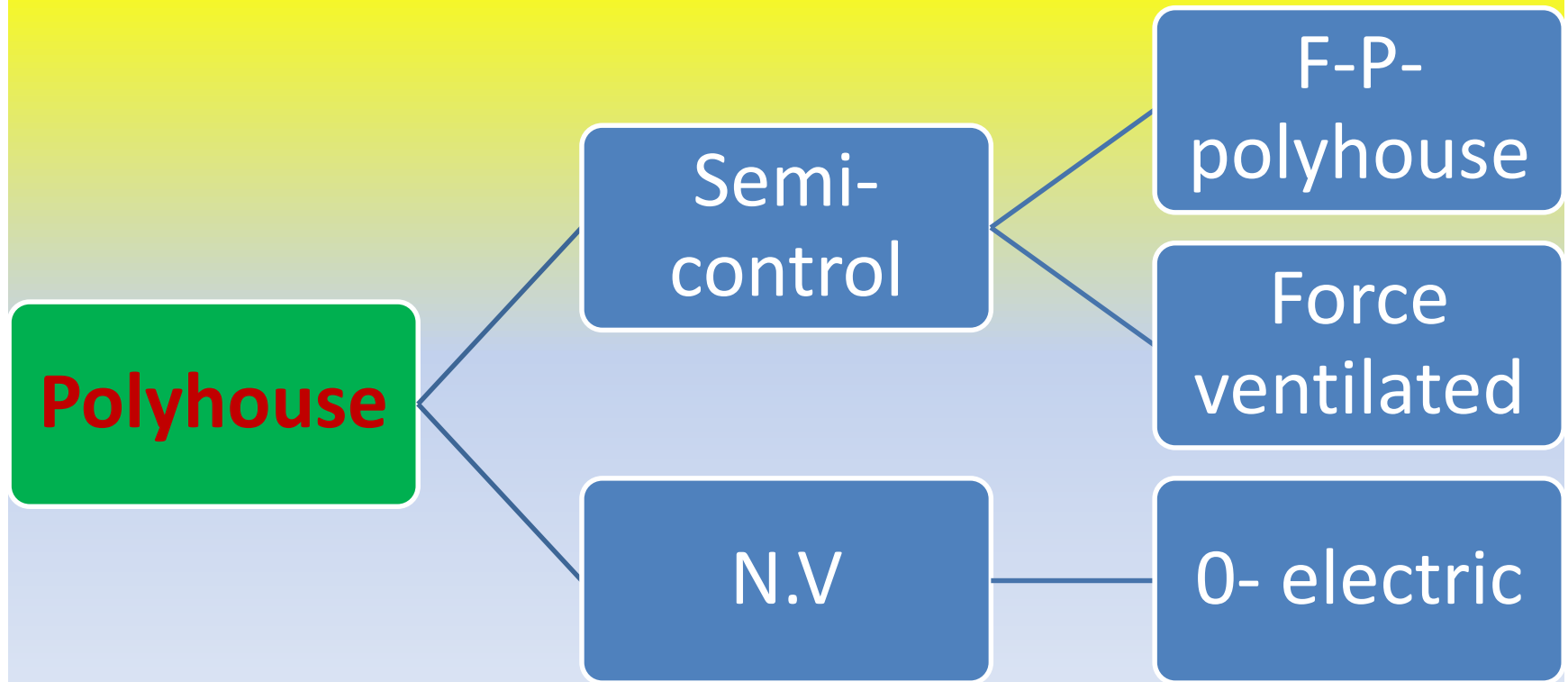
Shade-net-house

I.P. net-house

FRP-house

Tunnels

Popular greenhouse structure using for production in India





Dabble door, Span, 4 side and top ventilated naturally/ zero electric energy polyhouse (Butter fly model)

**Semi Climate
Controlled/ Fain-
Pad, maly-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



Yield 80- 100q
/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

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)



Success stories protected cultivation

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)

Crop	Colored Capsicum
Sowing time	August 1st week
Harvesting time	Nov 15 to July 15
Total expenditure(Rs.)	711000
Total yield(Kg)	48000
Selling price(Rs./Kg)	50
Total income(Rs.)	2400000
Net profit(Rs.)	1689000



Protection of CUMIN crop against adverse climate

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



Evolution 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 $ET_c = 0.8$. 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 $ET_c = 0.8$ under drip irrigation for the cultivation of Bt cotton to increase crop yield (42 %) as compare to no mulch.



Quonset shape GI frame Polyhouse

Sizes	100 m² (Naturally ventilated)
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



Agribusiness as vegetable grower/ nursery grower

Modified low cost Net House for vegetable cultivation in hot climate (Punjab)

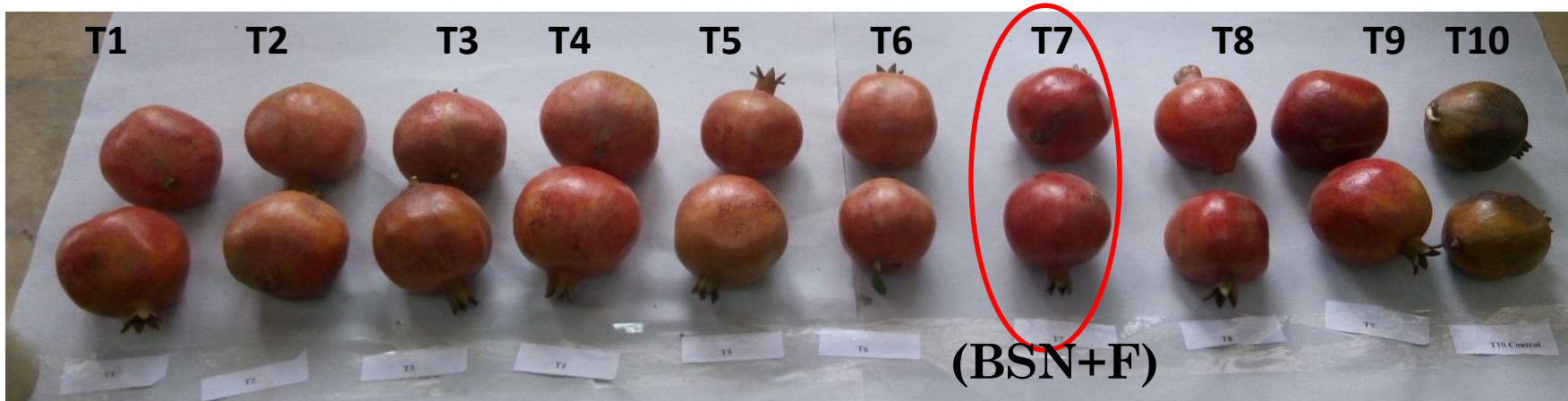
Sizes	500 m²
Cost	R 1,80,000 per unit
Cultivation	Round the year cultivation of vegetables
Income	R 50,000 to 70,000 annually (as per farmers evaluation)



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 sun burn 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

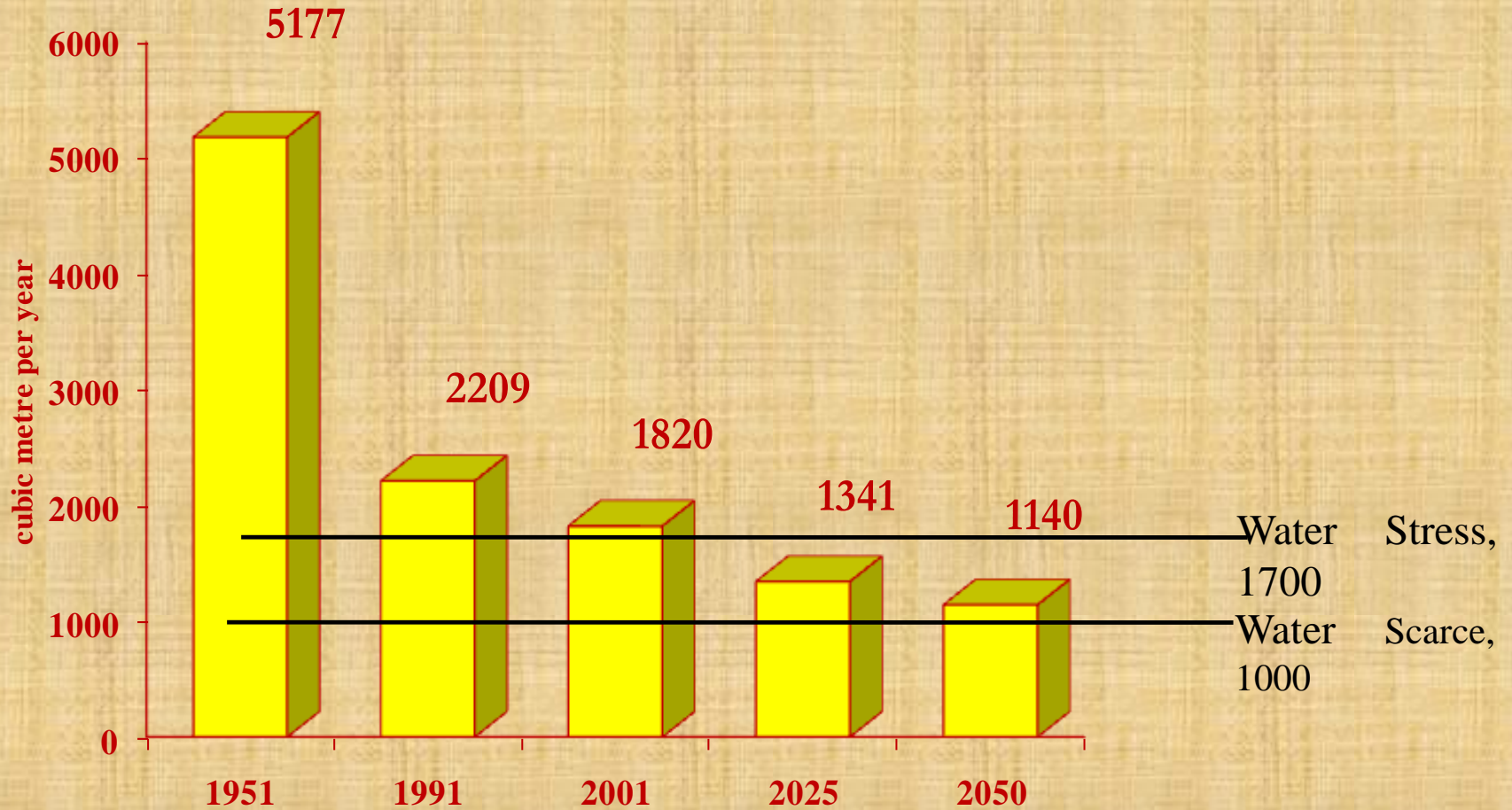
1950



2016

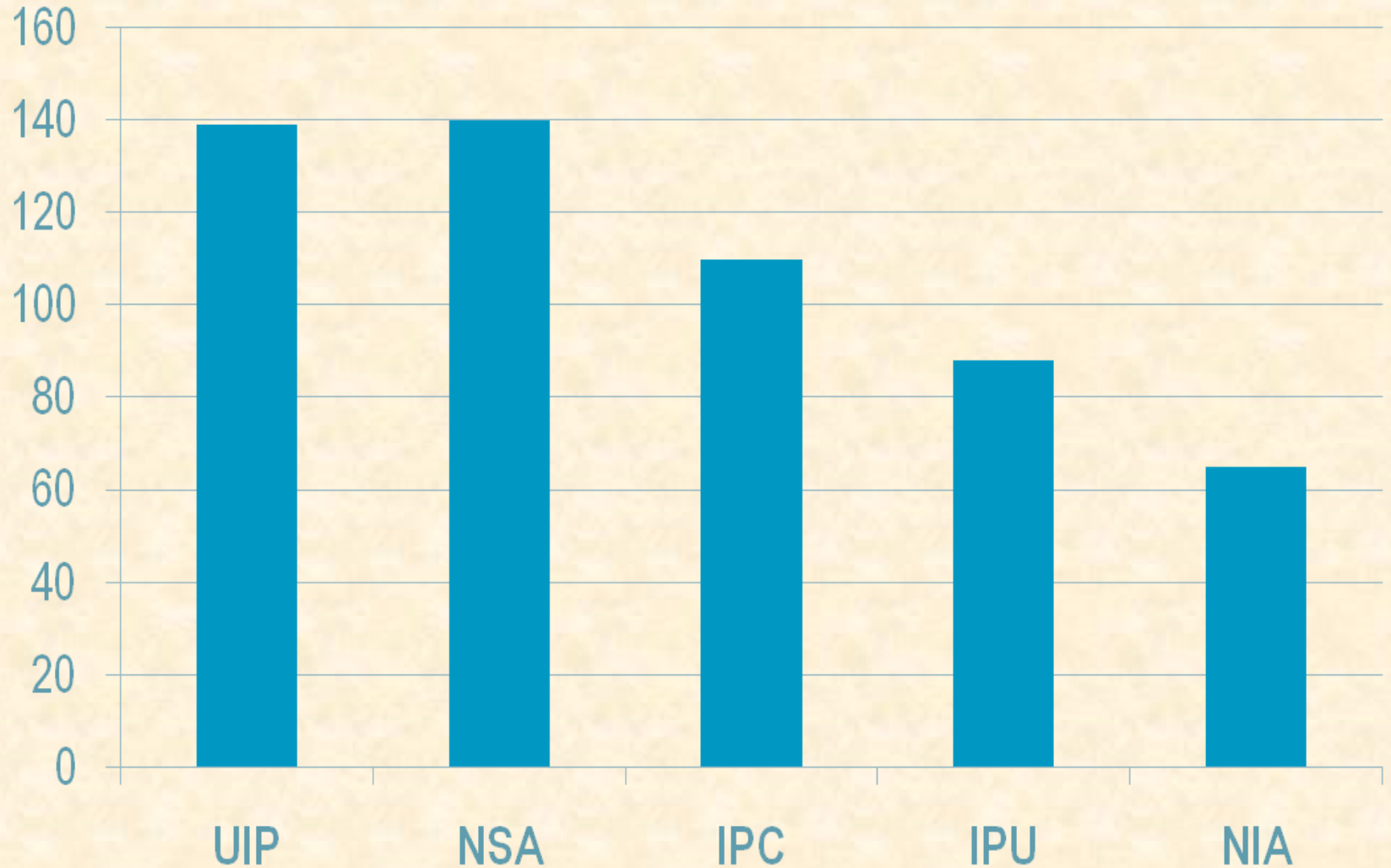


Indian Water Resources



Irrigation Scenario - India

Irrigation Scenario

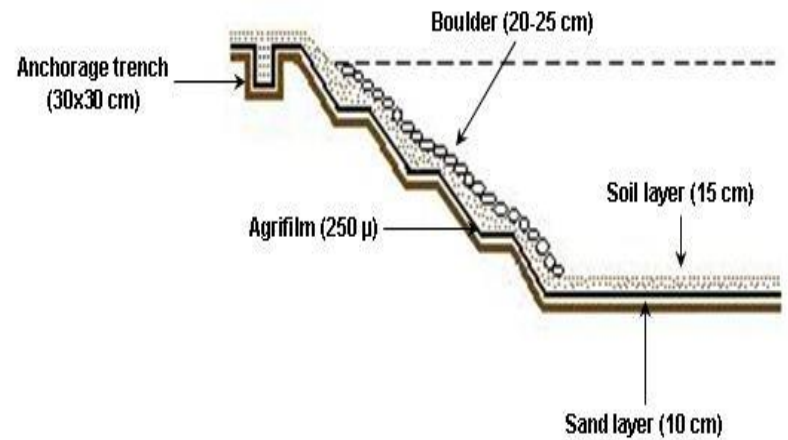


Water productivity

- 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

S.No.	Crop	Increase in yield (%)	Water Saving (%)
1	Pomegranate	20-40	50-60
2	Potato	20-30	40-50
3	Sugarcane	50-60	30-50
4	Tomato	25-50	40-60
5	Cauliflower	60-80	30-40
6	Brinjal	20-30	40-60
7	Cabbage	30-40	50-60
8	Okra	25-40	20-30
9	Chilli	10-40	60-70
10	Bottle Gourd	20-40	40-50
11	French Bean	55-65	30-40



Farmers first

Conserve more grow more

Thank you all

