Vigyan Ashram

PROTECTED CULTIVATION

GUIDE TO HELP YOU ASSES POLYHOUSE RETURN AND RISK

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INTRODUCTION – WHY THIS GUIDE

Why This Guide?

Protected cultivation is one of the most effective ways to improve farm income. By using structures like shade nets and polyhouses, farmers can protect crops from harsh weather, pests, and diseases, and create better growing conditions for higher yield and quality. This allows farmers to produce off-season crops, access premium markets, and earn more from the same land.

But choosing the right protected structure is not simple. Many farmers invest in systems that don't match their crops, market conditions, or budget. We've seen cases where expensive polyhouses were poorly managed because farmers lacked buyers or technical knowledge. Others faced losses when crop prices fell or when poor-quality structures failed in the first season.

This manual was created to prevent that.

At Vigyan Ashram, we've worked closely with farmers and learned how misinformation and sales pressure can lead to poor decisions. Many farmers rush into high-cost systems without understanding risks, return, or the technical skills required. Our goal is to make sure you have all the facts before investing your hard-earned money.

This guide is designed to help you make the best decision for your farm based on:

- Independent data from field experience
- Practical return on investment estimates
- Risk assessment for each option

INTRODUCTION – PROTECTED CULTIVATION

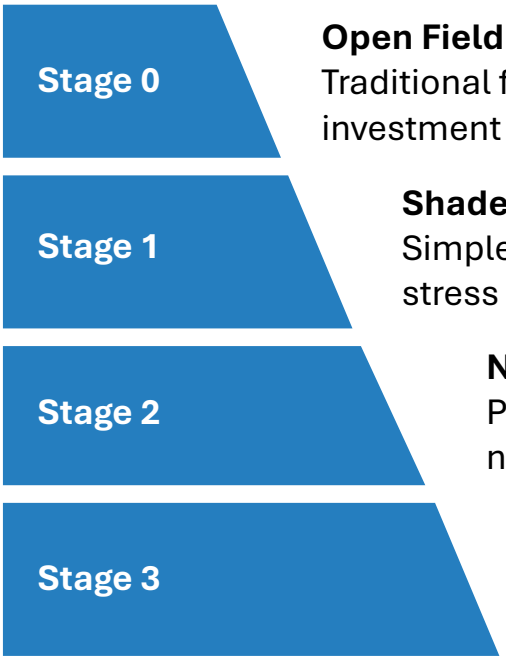
Protected cultivation means growing crops under structures that protect plants from extreme weather and pests while creating a more favorable microclimate for better yield and quality.

Unlike open-field farming, protected cultivation uses structures and technology that allow you to control temperature, humidity, and sunlight, and reduce crop damage from rain, wind, and pests. Some of the benefits of protected cultivation include:

- Produce higher yield output (reduced crop damage).
- Produce better quality yield (improved color, size, shape) for better prices.
- Grow high-value crops off-season for better prices.
- More efficient resource use (saves water, reduces pesticide use).

Not all farmers need the same structure. Protected cultivation is a spectrum of solutions, from simple shade nets to advanced climate-controlled polyhouses.

We break it into 4 stages:



Open Field Farming (Baseline)
Traditional farming with no protective cover and very low investment (basic irrigation and seeds).

Shade Net House
Simple frame covered with shade net. Reduces heat stress and some damage but no climate control.

Naturally Ventilated (NV) Polyhouse
Polyethylene-covered structure with side vents for natural airflow. More shelter and improved climate.

Climate-Controlled Polyhouse
High-tech polyhouse with fans, pads, foggers for precise climate control and year-round yield.

To choose the right stage it is critical you match your crop and market and consider the trade-offs of each system, so you correctly understand and assess your own risk appetite.

INTRODUCTION – RETURN AND RISK

Investing in protected cultivation comes with different implications for return on your crops and risks.

Return on Investment (ROI)

ROI implies what type of return you get on your investment. Main drivers of ROI in protected cultivation include:

1. **Capital cost:** More complex structure typically requires higher investment.
2. **Crop type:** High-value crops typically more volatile but can have higher return.
3. **Market access:** Proximity to cities or less middlemen typically means higher selling prices.
4. **Yield & quality boost:** Improved product quality and yield from protected cultivation can mean higher returns.
5. **Seasonal advantage:** Off-season production can lead to higher selling prices.

Risk

Protected cultivation can reduce some risks (weather, pests) but introduce new risks (capital, technical, market). Risks considered in this manual include:

1. **Capital risk (biggest factor):** High cost of polyhouses means if crop fails or prices crash, payback period extends.
2. **Market risk:** Price volatility is common in high value crops (e.g., some vegetables, flowers) typically grown in polyhouses.
3. **Technical risk:** Advanced structures need training for irrigation, fertigation, and pest control. Poor management can lead to big losses.
4. **Climate risk:** Protected cultivation reduces weather damage but not fully immune (e.g., extreme heat can still affect crops in shade nets).
5. **Community risk:** If nobody around you uses these systems, you may lack local advice/support and expose yourself to higher risk.

You can take practical steps to reduce risk. We encourage you to reference information and get training (use this manual and other resources from Vigyan Ashram, KVKs or agri-extension centers), start small and then scale up after 1–2 successful cycles, secure buyers before investing big, make your own return calculations from local prices, and use subsidy schemes (MIDH/NHM can cover 40–50% of polyhouse cost).

INTRODUCTION – FARMER STORIES

Farmer Success Story – From Open Field to Polyhouse Roses

For over twenty years, Mr. Ramesh, farmer from Pune District grew roses in open field. He knew the market well and which varieties sold best, but open farming came with limits – unpredictable weather, pest damage, and inconsistent quality kept him from reaching premium buyers.

In 2021, he made a big change, investing in a naturally ventilated polyhouse covering 0.68 acres. The set-up cost ₹28 lakh, including ₹8 lakh for soil preparation brought in through 40 truckloads. A drip irrigation system was ₹3.5 lakh, and planting and maintenance cost around ₹3.75 lakh. To ensure success, he hired an expert to visit weekly at ₹500 per visit.

Results were clear. The protected environment reduced weather damage and improved consistency, allowing sales to higher-paying markets. He recovered his investment in just 3 years and now earns about ₹1.2 crore per acre per year (~45% more than open-field rose cultivation) while supplying roses year-round. Looking back, he says good-quality materials and understanding market demand before switching were the keys to transforming his farm into a stable, profitable business.

Farmer Learning Story – Switching from Polyhouse to Shade Net

When Mr. Sunil, also a farmer from Pune District, first built a polyhouse for his 0.23 acre farm, he had high hopes. Growing capsicum and cucumbers in the controlled environment gave him better yields and brighter, higher-quality produce. Buyers noticed the difference, and he was able to sell at higher prices compared to shade net cultivation.

But there was one problem he hadn't fully anticipated – wind. In his region, strong gusts would tear and damage the polyhouse paper, forcing him to replace it regularly. Each replacement cost between ₹1–2 lakh, and over time, the repair bills became too much to manage.

Eventually, he made the difficult decision to dismantle the polyhouse paper and replace it with a shade net. While the yields dropped by 20–30% and quality was slightly lower, the running costs were far more manageable, and he no longer had to worry about sudden wind damage destroying his covering.

Today, he is satisfied with the lower-maintenance shade net system. He says that if he ever returns to a polyhouse, it will only be with much strongest and thicker paper – a lesson learned from years of costly repairs.

PROTECTED CULTIVATION DECISION MATRIX

The following matrix gives you a sense of **return on investment (ROI) and risk level for every crop and structure combination.** Detail to follow in the deep dives. (Crops with "*" have a deep dive specific to that crop).

	Open Field	Shade Net	NV Polyhouse	Climate Controlled
Tomato*	Low Return	Low Return	Good Return & Risk	Not Necessary
Capsicum*	Low Return	Good Return & Risk	Good Return & Risk	Not Necessary
Cucumber*	Low Return	Low Return	Good Return & Risk	Not Necessary
Brinjal*	Low Return	Low Return	Good Return & Risk	Not Necessary
Chili	Low Return	Low Return	Good Return & Risk	Not Necessary
Okra	Low Return	Low Return	Good Return & Risk	Not Necessary
Spinach	Low Return	Good Return & Risk	Good Return & Risk	Not Necessary
Coriander	Low Return	Good Return & Risk	Good Return & Risk	Not Necessary
Lettuce*	Not Ideal	Good Return & Risk	Good Return & Risk	Not Necessary
Strawberry	Low Return[1]	Low Return	Good Return & Risk	Good Return & Risk
Rose*	Not Ideal	Low Return	Good Return & Risk	Good Return & Risk
Gerbera	Not Ideal	Low Return	Good Return & Risk	Good Return & Risk
Marigold*	Low Return	Good Return & Risk	Good Return & Risk	Not Necessary
Broccoli	Not Ideal	Good Return & Risk	Good Return & Risk	Not Necessary
Herbs/Basil	Not Ideal	Good Return & Risk	Good Return & Risk	Not Necessary

[1] Not ideal in certain area like Mahableshwar (cold climate)

Tag explanation:

Not ideal: High risk of low yield and quality, particularly for high-value crops

Low Return: Low investment, simple and familiar practices, but typically have low returns.

Good Return & Risk: Investment typically paid back relatively quickly; expect good returns. Any additional investment has good benefits in yield and quality to justify cost.

Not Necessary: Requires high investment, automation and continuous monitoring, that typically do not always justify yield and quality benefits.

OPEN FIELD CULTIVATION

Description:

Traditional farming method where crops are grown directly in natural conditions without any protective structures. Involves minimal investment and is suitable for low-value crops or farmers with limited capital. Exposes crops to weather fluctuations and pests.

Why choose open field farming?

- Lowest initial cost of all cultivation methods.
- Simple and familiar to most farmers.
- No special structures or complex systems needed.
- Best for hardy crops or when markets are unstable.

Best for:

- Basic veggies: Okra, Brinjal, Chili
- Leafy greens in mild climates: Spinach, Coriander
- Low-risk crops for local sales

Investment:

No additional investment other than standard farming costs applicable to all cultivation types (basic land preparation, irrigation setup, seeds, fertilizers, labor, etc)

Possible variations & additions:

	Benefit	Impact	Additional Cost (₹)
+ Drip irrigation system	Saves water, improves yield	10–15% yield boost	₹25,000–₹30,000 per 1,000 m^2
+ Mulching sheets	Reduces weeds, conserves soil moisture	5–10% yield boost	₹5,000–₹7,000 per 1,000 m^2
+ Basic insect net fencing	Reduces pest pressure in high-risk seasons	Quality improvement	₹8,000–₹12,000 per 1,000 m^2
+ Sprinkler irrigation	Improves uniform watering	Better crop health	₹15,000–₹18,000 per 1,000 m^2
+ Organic soil conditioning	Enhances soil fertility and water retention	Long-term ROI benefit	₹3,000–₹5,000 per 1,000 m^2

Pros:

✓ Lowest investment requirement
✓ Easy to manage, minimal technical skill
✓ Works for crops with stable prices or home consumption

Cons:

✗ Fully exposed to weather risks (drought, heavy rains, heat)
✗ Higher pest and disease pressure → frequent spraying
✗ Lower quality → less access to premium market
✗ More unpredictability in returns each season

Tips:

- Use mulching and drip irrigation for better water management.
- Plan cropping calendar around local climate patterns to avoid losses.
- Join farmer groups for input cost sharing and collective marketing.
- Consider upgrading gradually to Stage 1 (Shade Net) for better yield and quality.

SHADE-NET CULTIVATION

Description:

Simple protective structure made by covering a frame with shade netting to reduce sunlight intensity and provide mild temperature control. It shields crops from excess heat, wind, and some pests, making it an affordable first step into protected cultivation.

Why choose shade net?

- Reduces temperature by 2–5°C in summer.
- Provides shade from scorching sun rays.
- Cuts wind speed → less plant damage.
- Reduces water evaporation → saves irrigation cost.
- Some protection against pests and mild rain.

Best for:

- Leafy greens (spinach, coriander, lettuce)
- Basic vegetables (okra, brinjal, chili)
- Flowers like marigold

Investment:

	Cost	Includes
Initial cost	₹50,000–₹1,00,000 per 1,000 m^2	• Shade Net: 35%, 50%, or 75% UV-stabilized • Frame: GI pipes (preferred) or bamboo for low cost • Anchors & ropes for stability • Optional insect net (mesh) for additional pest control
Operating cost	₹2,000–₹3,000	Net repairs, tie replacements

Possible variations & additions:

	Benefit	Impact	Additional Cost (₹)
+ Manual side curtains	Improves airflow; reduces humidity & fungal diseases	Better crop health	₹5,000–₹8,000 per 1,000 m^2
+ Mulching sheets	Conserves soil moisture; reduces weeds	10–15% yield boost	₹5,000–₹7,000 per 1,000 m^2
+ Drip irrigation + fertigation	Saves water; efficient nutrient delivery	20–30% yield boost	₹25,000–₹35,000 per 1,000 m^2
+ Insect-proof netting	Reduces pest damage; lowers pesticide cost	Quality improvement	₹12,000–₹18,000 per 1,000 m^2
+ Partial polyfilm on roof	Additional rain protection during monsoon	Crop survival in heavy rain	₹10,000–₹15,000 per 1,000 m^2

Pros:

✓ Low initial investment
✓ Easy to build & manage
✓ Improves quality compared to open field
✓ Can be constructed with local materials

Cons:

✗ No full climate control
✗ Pest & disease pressure still possible
✗ Quality and size of produce slightly lower than NV or CC for some crops
✗ Net roof may need replacement every 3-4yrs

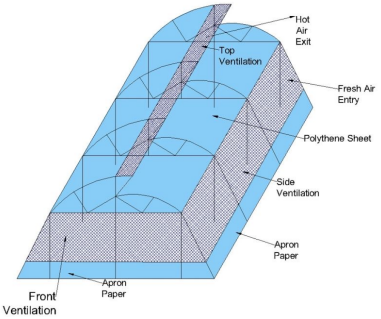
Tips:

- Choose correct shading % for crop (35% for flowers, 50–75% for vegetables).
- Combine with mulching and drip irrigation for best results.
- Paper or partial polyfilm roof may need replacement every 3–4 years.
- In high wind areas invest in a thick net – extends life and reduces replacement frequency.
- Add well-drain red lateritic soil and fertigation unit for better nutrient management.

NATURALLY VENTILATED POLYHOUSE

Description:

A naturally ventilated polyhouse is a framed structure covered with UV-stabilized polyethylene film. Side and top openings allow natural airflow, reducing humidity buildup. This stage is ideal for crops that require consistent growing conditions without full climate control.



Why choose naturally ventilated?

- Protects crops from rain, wind, and extreme weather.
- Maintains stable temperature for better yield / quality.
- Improves crop uniformity and reduces diseases.
- Enables off-season production for premium pricing.
- Higher CO_2 levels, humidity & protection from UV rays.

Best for:

- Higher-value fruits and vegetables (Capsicum, Tomato, Cucumber)
- Flowers like Rose, Gerbera
- Exotic herbs (basil)

Investment:

	Cost	Includes
Initial cost	₹3,00,000–₹3,50,000 per 1,000 m^2	• UV-stabilized polyfilm (200 micron) • GI pipe frame • Drip irrigation & fertigation unit • Manual side curtains
Operating cost	₹10,000–₹15,000	Film cleaning, curtain repairs, drip maintenance

Possible variations & additions:

	Benefit	Impact	Additional Cost (₹)
+ Insect-proof netting	Blocks pest entry, reduces pesticide use	Quality improvement	₹15,000–₹20,000 per 1,000 m^2
+ Automated side curtains	Improves ventilation control, saves labor	Better disease control	₹20,000–₹25,000 per 1,000 m^2
+ Mulching sheets	Conserves moisture, reduces weeds	10–15% yield boost	₹5,000–₹7,000 per 1,000 m^2
+ Foggers/Misters	Lowers temperature in hot months	Better crop health	₹18,000–₹25,000 per 1,000 m^2
+ Plastic gutter & rainwater harvest	Prevents waterlogging, saves water	Resource efficiency	₹8,000–₹12,000 per 1,000 m^2

Pros:

✓ High ROI potential for premium crops
✓ Protection against rain and harsh weather
✓ Improved crop quality and uniformity
✓ Enables off-season cultivation

Cons:

✗ Higher initial investment vs. shade net
✗ Requires technical know-how for fertigation & pest control
✗ Polyfilm replacement every 3-4 yrs adds cost

Tips:

- Always install proper side ventilation to prevent humidity buildup.
- Combine with insect netting and mulching for best results.
- Thicker polyfilm (200+ micron) recommended in high-wind areas to avoid frequent tearing.

CLIMATE CONTROLLED POLYHOUSE

Description:

A climate-controlled polyhouse is equipped with automated systems for temperature, humidity, and ventilation control. It uses fans, cooling pads, foggers, and sometimes heaters to maintain an optimal microclimate year-round, regardless of external weather.

Why choose climate-controlled polyhouses?

- Enables year-round production of high-value crops.
- Provides full control of temperature and humidity.
- Reduces risk of weather-related crop loss.
- Achieves premium prices for export-quality produce.

Best for:

- High-value and exotic flowers, fruits, vegetables, and herbs: Roses, Gerbera, Strawberry, Lettuce, Broccoli, and Basil

Investment:

	Cost	Includes
Initial cost	Initial cost: ₹6,00,000–₹8,00,000 per 1,000 m^2	• UV-stabilized polyfilm (200 micron) • GI pipe frame with foundation • Cooling pad & fan system • Foggers/misters • Drip irrigation & fertigation unit • Automated/manual side curtains
Operating cost	₹20,000–₹30,000	Electricity for fans/pads, fogger maintenance, film cleaning

Possible variations & additions:

	Benefit	Impact	Additional Cost (₹)
+ Fully automated climate control	Reduces labor, precise parameter control	Consistent quality, fewer losses	₹1,00,000–₹1,50,000 per 1,000 m^2
+ CO_2 Enrichment System	Enhances photosynthesis for select crops	10–20% yield boost	₹15,000–₹25,000 per 1,000 m^2
+ Solar-powered backup system	Ensures climate stability during power cuts	Reduces risk of crop loss	₹80,000–₹1,20,000 per 1,000 m^2
+ More insect-proof netting	Blocks pest entry despite frequent venting	Quality improvement	₹15,000–₹20,000 per 1,000 m^2
+ Water filtration for cooling pads	Prevents scale buildup, improves pad efficiency	Cooling efficiency improved by 5–15%	₹5,000–₹15,000 per 1,000 m^2

Pros:

✓ Highest ROI potential for premium crops
✓ Full weather protection and climate control
✓ Allows for off-season and export production
✓ Year-round cropping possible

Cons:

✗ Extremely high initial investment
✗ Requires skilled technical and monitoring
✗ Dependency on premium markets or contracts
✗ High electricity and maintenance costs

Tips:

- Only invest if you have assured buyers or export contracts.
- Train in automation, fertigation, and climate management before starting.
- Install power backup (solar or generator) to prevent crop damage during outages.
- Replace polyfilm every 3–4 years; service climate control equipment regularly.

Vigyan Ashram work on solar PV based climate control system and structural drawing (link)

CROP DEEP DIVE: TOMATO

Crop properties:

- **Climate Needs:** Ideal Temp: 18–28°C; Humidity: 60–70%
- **Fertilization Method:** Drip irrigation with fertigation
- **Disease Risks:** Early blight, bacterial wilt, fruit borer
- **Crop Cycle:** 4–5 months per cycle under protected cultivation

Market potential:

- **Price Range:** ₹20–₹60/kg (premium for uniform, high-quality fruits)
- **Market Volatility:** High during peak season
- **Off-Season Advantage:** 30–50% higher price in summer/monsoon
- **Demand:** Strong in cities, hotels, processing industry

ROI and risk table:

Assumes price per kg: ₹30 (average for tomato); Crop cycle: 4–5 months (max 3 cycles/year under polyhouse); ROI after deducting inputs, labor, and amortized structure cost over 5 years.

Volume	Details	Open Field	Shade-Net	Naturally Ventilated	Climate Controlled
Low (500 m^2)	Structure Cost (₹)	Spray cost*	50,000	1,80,000	3,50,000
	Yield (kg/m^2)	3	4.5	8	10
	Expected Return (₹/cycle)	₹90,000–₹1,20,000	₹1,20,000–₹1,50,000	₹2,40,000–₹3,00,000	₹4,00,000–₹4,50,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
Medium (1,000 m^2)	Structure Cost (₹)	Spray cost*	1,00,000	3,50,000	7,00,000
	Yield (kg/m^2)	3	4.5	8	10
	Expected Return (₹/cycle)	₹1,80,000–₹2,40,000	₹2,40,000–₹3,00,000	₹4,80,000–₹6,00,000	₹8,00,000–₹9,00,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
High (2,000 m^2)	Structure Cost (₹)	Spray cost*	2,00,000	7,00,000	14,00,000
	Yield (kg/m^2)	3	4.5	8	10
	Expected Return (₹/cycle)	₹3,60,000–₹4,80,000	₹4,80,000–₹6,00,000	₹9,60,000–₹12,00,000	₹16,00,000–₹18,00,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4

**No structure cost, but open field means higher pest spray cost*

Recommended

High spray requirement in open field can be around 10 sprays per cycle (~₹20,000/acre)

Pros:

✓ Strong market demand across India
✓ Can fetch premium prices off-season
✓ Performs very well under NV polyhouse

Cons:

✗ Prone to diseases if humidity is not managed
✗ Prices can crash during peak supply season
✗ Requires trellising and pruning for good yield

Tips for cultivation:

- Use trellising (support system) to prevent lodging and improve airflow.
- Maintain humidity below 75% to avoid fungal diseases.
- Choose hybrids like Arka Rakshak, NS 516, or Abhinav for protected cultivation.
- Adopt staking and pruning early for uniform fruit setting.
- Install yellow and blue sticky traps for whiteflies and thrips.
- Harvest at breaker stage for distant markets; fully ripe for local sale.

CROP DEEP DIVE: CAPSICUM

Crop properties:

- **Climate Needs:** Ideal Temp: 18–30°C; Humidity: 50–70%
- **Fertilization Method:** Drip irrigation with fertigation
- **Disease Risks:** Powdery mildew, root rot, thrips, mites
- **Crop Cycle:** 4–5 months per cycle under protected cultivation

Market potential:

- **Price Range:** ₹50–₹150/kg (higher for colored capsicum)
- **Market Volatility:** Medium
- **Off-Season Advantage:** Up to 40–60% price increase during summer and monsoon seasons
- **Demand:** Strong in metros, supermarkets, hotels, and export channels

ROI and risk table:

Assumes price per kg: ₹50; Crop cycle: 4–5 months (max 3 cycles/year possible under polyhouse); ROI calculated after deducting inputs, labor, and amortized structure cost over 5yrs

Volume	Details	Open Field	Shade-Net	Naturally Ventilated	Climate Controlled
Low (500 m^2)	Structure Cost (₹)	Spray cost*	50,000	1,80,000	3,50,000
	Yield (kg/m^2)	2.5	4	8	10
	Expected Return (₹/cycle)	1,25,000–1,50,000	1,00,000–1,20,000	2,80,000–3,20,000	4,50,000–5,00,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
Medium (1,000 m^2)	Structure Cost (₹)	Spray cost*	1,00,000	3,50,000	7,00,000
	Yield (kg/m^2)	2.5	4	8	10
	Expected Return (₹/cycle)	2,50,000–3,00,000	2,00,000–2,40,000	5,60,000–6,40,000	9,00,000–10,00,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
High (2,000 m^2)	Structure Cost (₹)	Spray cost*	2,00,000	7,00,000	14,00,000
	Yield (kg/m^2)	2.5	4	8	10
	Expected Return (₹/cycle)	5,00,000–6,00,000	4,00,000–4,80,000	11,20,000–12,80,000	18,00,000–20,00,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4

Recommended

**No structure cost, but open field means higher pest spray cost*

High spray requirement in open field can be around 10 sprays per cycle (~₹20,000/acre)

Comparing Shade-Net and Naturally Ventilated:

- **Yield:** Naturally-ventilated produces 20–25% more yield than shade-net.
- **Fruit Size:** Naturally-ventilated capsicum average ~200 g, while shade-net averages ~150 g.
- **Appearance:** Naturally-ventilated delivers brighter color, better shape, and fewer blemishes; shade-net quality is lower, which can reduce price (typically ₹30 difference).
- **Lifespan:** Shade-net lasts 5-7 years; naturally-ventilated can last 10-15 years.
- **Pest Pressure:** Thrips and other pests are more common in shade-net; Naturally-ventilated can reduce incidence slightly but still faces thrips issue.
- **Season Length:** Naturally-ventilated can sustain capsicum harvests for 7–8 months; shade-net cycles are similar but slightly shorter.

Tips for cultivation:

- Monitor for thrips; outbreaks are harder to control later. Insect spraying helps reduce.
- Thrips increases when temp drops – climate control helps reduce them.
- Avoid excessive humidity (>95%) to reduce fungal disease risk.
- Available 7-8 months without replanting; pick regularly to encourage continuous fruiting.

CROP DEEP DIVE: ROSE

Crop properties:

- **Climate Needs:** Ideal Temp: 18–28°C; Humidity: 60–70%
- **Fertilization Method:** Drip irrigation with fertigation; micronutrients essential. Roses require more intensive labor and frequent pest monitoring than most crops in the manual.
- **Disease Risks:** Powdery mildew, black spot, aphids, mites. Thrips and fungal diseases can cause rapid quality loss.
- **Crop Cycle:** Continuous flowering; economic life 3–4 years under protected conditions

Market potential:

- **Price Range:** ₹3–₹10 per stem (higher during festivals, weddings, and export season)
- **Market Volatility:** High; depends on occasions and export market trends
- **Off-Season Advantage:** Strong premium during festive seasons.
- **Demand:** Urban retail, bouquet market, export hubs (Middle East, Europe)

ROI and risk table:

Assumptions: Price ₹5 per stem (average), yield per m^2 under polyhouse = 150–200 stems/month; calculations after deducting inputs, labor, and amortized structure cost over 5 years.

Volume	Details	Open Field	Shade-Net	Naturally Ventilated	Climate Controlled
Low (500 m^2)	Structure Cost (₹)	*Growth not possible at this stage*	80,000	2,50,000	4,50,000
	Yield (kg/m^2)		1200	2400	3000
	Expected Return (₹/cycle)		₹3,50,000–₹4,00,000	₹7,00,000–₹8,00,000	₹10,00,000–₹12,00,000
	Estimated Payback (yrs)		2–2.5	2–2.5	3
Medium (1,000 m^2)	Structure Cost (₹)		1,60,000	5,00,000	9,00,000
	Yield (kg/m^2)		1200	2400	3000
	Expected Return (₹/cycle)		₹7,00,000–₹8,00,000	₹14,00,000–₹16,00,000	₹20,00,000–₹24,00,000
	Estimated Payback (yrs)		2–2.5	2–2.5	3
High (2,000 m^2)	Structure Cost (₹)		3,20,000	10,00,000	18,00,000
	Yield (kg/m^2)		1200	2400	3000
	Expected Return (₹/cycle)		₹14,00,000–₹16,00,000	₹28,00,000–₹32,00,000	₹40,00,000–₹48,00,000
	Estimated Payback (yrs)		2–2.5	2–2.5	3

Recommended

Tips for cultivation:

- Grafting/seedling preparation requires artificial ventilation (climate controlled), main cultivation can be done in a naturally-ventilated structure.
- Some rose farmers pay for weekly expert visits (~₹500/week) to maintain export-quality blooms.
- Roses are labor-intensive – labor availability is critical before starting.
- Polyhouse roses can yield premium prices but are highly sensitive to pest damage and market fluctuations.
- Plant spacing 15–20 cm between plants for high density.
- Maintain 4–6 healthy canes for continuous flowering.
- Frequent, light irrigations; avoid waterlogging.
- Harvest early morning for better freshness; store at 2–4°C before transport.
- Choose export-quality hybrids like Taj Mahal, First Red, Gold Strike.
- Secure contracts with florists/export houses before planting.

CROP DEEP DIVE: CUCUMBER

Crop properties:

- **Climate Needs:** Ideal Temp: 18–30°C; Humidity: 50–70%
- **Fertilization Method:** Drip irrigation with fertigation (high potassium during fruiting)
- **Disease Risks:** Powdery mildew, downy mildew, fruit fly, whiteflies
- **Crop Cycle:** 3–4 months per cycle under protected cultivation

Market potential:

- **Price Range:** ₹20–₹50/kg (higher for off-season production and premium varieties)
- **Market Volatility:** Medium; peak demand in summer
- **Off-Season Advantage:** 30–50% higher prices during monsoon and early summer
- **Demand:** Strong in urban retail, supermarkets, hotels, and processing

ROI and risk table:

Assumes price per kg: ₹25 (average for cucumber); crop cycle: 3–4 months (max 3 cycles/year in polyhouse); ROI after deducting inputs, labor, and amortized structure cost over 5 years.

Volume	Details	Open Field	Shade-Net	Naturally Ventilated	Climate Controlled
Low (500 m^2)	Structure Cost (₹)	Spray cost*	50,000	1,80,000	3,50,000
	Yield (kg/m^2)	5	6	10	12
	Expected Return (₹/cycle)	₹60,000–₹80,000	₹90,000–₹1,20,000	₹1,80,000–₹2,40,000	₹2,80,000–₹3,50,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
Medium (1,000 m^2)	Structure Cost (₹)	Spray cost*	1,00,000	3,50,000	7,00,000
	Yield (kg/m^2)	5	6	10	12
	Expected Return (₹/cycle)	₹1,20,000–₹1,60,000	₹1,80,000–₹2,40,000	₹3,60,000–₹4,80,000	₹5,60,000–₹7,00,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
High (2,000 m^2)	Structure Cost (₹)	Spray cost*	2,00,000	7,00,000	14,00,000
	Yield (kg/m^2)	5	6	10	12
	Expected Return (₹/cycle)	₹2,40,000–₹3,20,000	₹3,60,000–₹4,80,000	₹7,20,000–₹9,60,000	₹11,20,000–₹14,00,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4

**No structure cost, but open field means higher pest spray cost*

Recommended

High spray requirement in open field can be around 10 sprays per cycle (~₹20,000/acre)

Pros:

✓ Very short crop cycle → faster returns
✓ High off-season demand in summer
✓ Responds well to protected cultivation with drip & fertigation

Cons:

✗ Sensitive to fungal diseases under high humidity
✗ Requires pollination management
✗ Price volatility during peak harvest season

Tips for cultivation:

- Maintain humidity below 75% to prevent downy mildew.
- Use mulching to avoid soil-borne diseases and maintain moisture.
- Install yellow and blue sticky traps for whiteflies and thrips.
- Use bee boxes or hand-shake plants to ensure pollination.
- Harvest every 2–3 days to maintain fruit size and quality.
- Prefer parthenocarpic hybrids (*imported cucumber types*) for polyhouses for better yield and uniform size.

CROP DEEP DIVE: MARIGOLD

Crop properties:

- **Climate Needs:** Ideal Temp: 18–30°C; Tolerates 50–80% humidity; prefers full sunlight
- **Fertilization :** Basal dose + top dressing; drip irrigation recommended for water savings
- **Disease Risks:** Powdery mildew, leaf spot, root rot
- **Crop Cycle:** 2.5–3.5 months from transplanting to peak flowering

Market potential:

- **Price Range:** ₹20–₹60/kg (varies by season and color)
- **Market Volatility:** Medium–High; festival season peaks
- **Off-Season Advantage:** Prices can double during weddings and festivals (e.g., Diwali, Ganesh Chaturthi)
- **Demand:** Strong in local mandis, religious events, weddings, garland-making

ROI and risk table:

Assumes price per kg: ₹30 (average for marigold); Crop cycle: ~3 months (max 3–4 cycles/year possible under polyhouse); ROI after deducting inputs, labor, and structure cost over 5 years.

Volume	Details	Open Field	Shade-Net	Naturally Ventilated	Climate Controlled
Low (500 m^2)	Structure Cost (₹)	Spray cost*	50,000	1,80,000	3,50,000
	Yield (kg/m^2)	3	3.5	4.5	5
	Expected Return (₹/cycle)	₹45,000–₹55,000	₹52,500–₹63,000	₹67,500–₹81,000	₹75,000–₹90,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
Medium (1,000 m^2)	Structure Cost (₹)	Spray cost*	1,00,000	3,50,000	7,00,000
	Yield (kg/m^2)	3	3.5	4.5	5
	Expected Return (₹/cycle)	₹90,000–₹1,10,000	₹1,05,000–₹1,26,000	₹1,35,000–₹1,62,000	₹1,50,000–₹1,80,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
High (2,000 m^2)	Structure Cost (₹)	Spray cost*	2,00,000	7,00,000	14,00,000
	Yield (kg/m^2)	3	3.5	4.5	5
	Expected Return (₹/cycle)	₹1,80,000–₹2,20,000	₹2,10,000–₹2,52,000	₹2,70,000–₹3,24,000	₹3,00,000–₹3,60,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4

**No structure cost, but open field means higher pest spray cost*

Recommended

High spray requirement in open field can be around 10 sprays per cycle (~₹20,000/acre)

Pros:

✓ Steady demand during festivals and events
✓ Short crop cycle allows multiple harvests
✓ Performs well even under basic protection structures

Cons:

✗ Price crashes in peak season without forward contracts
✗ Flowers are perishable; need to sell quick
✗ Sensitive to waterlogging during heavy rains

Tips for cultivation:

- Plant in staggered cycles to target multiple festivals and avoid glut.
- Pinch the terminal bud at 30–35 days after transplanting to encourage branching and more flowers.
- Ensure well-drained soil to avoid root rot in monsoon.
- Regularly scout for powdery mildew and leaf spot; use preventive sprays.
- Harvest early morning or late evening for best freshness.
- Grade flowers before selling to get better market price.

CROP DEEP DIVE: BRINJAL

Crop properties:

- **Climate Needs:** Ideal Temp: 20–35°C; Humidity: 50–70%; sensitive to frost
- **Fertilization Method:** Drip irrigation with fertigation recommended; high potassium demand during fruiting
- **Disease Risks:** Fruit borer, bacterial wilt, shoot borer, aphids, mites
- **Crop Cycle:** 4–5 months from transplanting to last harvest

Market potential:

- **Price Range:** ₹15–₹40/kg (premium for hybrid or off-season produce)
- **Market Volatility:** Medium; steady local demand but prices drop in peak season
- **Off-Season Advantage:** Prices may rise by 30–50% during monsoon and winter scarcity
- **Demand:** Strong in local markets, hotels, and supermarkets; year-round household use

ROI and risk table:

Assumes price per kg: ₹25 (average for brinjal); Crop cycle: ~4.5 months (2–3 cycles/year possible under polyhouse); ROI after deducting inputs, labor, and amortized structure cost over 5 years.

Volume	Details	Open Field	Shade-Net	Naturally Ventilated	Climate Controlled
Low (500 m^2)	Structure Cost (₹)	Spray cost*	50,000	1,80,000	3,50,000
	Yield (kg/m^2)	4	5	6.5	7
	Expected Return (₹/cycle)	₹50,000–₹60,000	₹62,500–₹75,000	₹81,250–₹97,500	₹87,500–₹1,05,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
Medium (1,000 m^2)	Structure Cost (₹)	Spray cost*	1,00,000	3,50,000	7,00,000
	Yield (kg/m^2)	4	5	6.5	7
	Expected Return (₹/cycle)	₹1,00,000–₹1,20,000	₹1,25,000–₹1,50,000	₹1,62,500–₹1,95,000	₹1,75,000–₹2,10,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4
High (2,000 m^2)	Structure Cost (₹)	Spray cost*	2,00,000	7,00,000	14,00,000
	Yield (kg/m^2)	4	5	6.5	7
	Expected Return (₹/cycle)	₹2,00,000–₹2,40,000	₹2,50,000–₹3,00,000	₹3,25,000–₹3,90,000	₹3,50,000–₹4,20,000
	Estimated Payback (yrs)		1.5–2	2–2.5	3–4

Recommended

**No structure cost, but open field means higher pest spray cost*

High spray requirement in open field can be around 10 sprays per cycle (~₹20,000/acre)

Pros:

✓ Steady year-round demand
✓ Performs well in protected structures with reduced pest damage
✓ Responds well to fertigation and pruning

Cons:

✗ Susceptible to fruit and shoot borer (can cause heavy yield loss)
✗ Price dips in peak production season
✗ Requires regular harvesting (labor intensive)

Tips for cultivation:

- Use resistant or tolerant varieties to combat bacterial wilt and borer.
- Install pheromone traps and practice regular scouting to control pests early.
- Prune excess foliage to improve airflow and reduce disease incidence.
- Maintain consistent moisture but avoid waterlogging.
- Harvest every 3–4 days to maintain quality and avoid oversized fruits.
- Plan planting dates to target higher price periods (before festivals or off-season).

CROP DEEP DIVE: LETTUCE 

Crop properties:

- **Climate Needs:** Ideal Temp: 15–22°C; prefers cool weather; sensitive to heat and bolting
- **Fertilization Method:** Drip + fertigation for steady moisture
- **Disease Risks:** Downy mildew, leaf spot, damping-off
- **Crop Cycle:** 45–60 days from transplanting to harvest (short cycle)

Market potential:

- **Price Range:** ₹40–₹150/kg (very high for premium, hydroponic-quality leaves)
- **Market Volatility:** High — depends on urban hotel/restaurant demand
- **Demand:** Niche but growing in metro cities, hotels, supermarkets; low in rural/wholesale markets

ROI and risk table:

Assumes price per kg: ₹80; Crop cycle: ~2 months (5–6 cycles/year possible under polyhouse); ROI after deducting inputs, labor, and amortized structure cost over 5 years.

Volume	Details	Open Field	Shade-Net	Naturally Ventilated	Climate Controlled
Low (500 m^2)	Structure Cost (₹)	*Growth not possible at this stage*	50,000	1,80,000	3,50,000
	Yield (kg/m^2)		1.6	2	2.5
	Expected Return (₹/cycle)		₹64,000–₹80,000	₹80,000–₹1,00,000	₹1,00,000–₹1,25,000
	Estimated Payback (yrs)		1.5–2	1.5–2	2–3
Medium (1,000 m^2)	Structure Cost (₹)		1,00,000	3,50,000	7,00,000
	Yield (kg/m^2)		1.6	2	2.5
	Expected Return (₹/cycle)		₹1,28,000–₹1,60,000	₹1,60,000–₹2,00,000	₹2,00,000–₹2,50,000
	Estimated Payback (yrs)		1.5–2	1.5–2	2–3
High (2,000 m^2)	Structure Cost (₹)		2,00,000	7,00,000	14,00,000
	Yield (kg/m^2)		1.6	2	2.5
	Expected Return (₹/cycle)		₹2,56,000–₹3,20,000	₹3,20,000–₹4,00,000	₹4,00,000–₹5,00,000
	Estimated Payback (yrs)		1.5–2	1.5–2	2–3
				Recommended	

Pros:

✓ Short crop cycle = faster cash flow
✓ High prices in premium urban markets
✓ Fits well into hydroponic or organic branding

Cons:

✗ Sensitive to heat, leads to bolting/bitterness
✗ Requires assured market before planting large volumes
✗ Niche demand; rural markets poor prices

Tips for cultivation:

- Target winter season for open/shade-net production; use climate control for summer crops.
- Grow varieties suited to Indian climate (*Green Ice*, *Grand Rapids*, *Romaine* for premium).
- Maintain cool root zone temperatures to avoid bolting.
- Avoid overhead irrigation late in the day to reduce leaf diseases.
- Harvest early morning for freshness; keep in cold storage if possible.
- Build relationships with hotels/restaurants to ensure stable sales.

Looking Ahead: Vigyan Ashram's Vision for Protected Cultivation

At Vigyan Ashram, our mission is to make protected cultivation technologies, such as polyhouses, shade nets, and climate-controlled units, more accessible, affordable, and effective for farmers across India. We focus not only on introducing these structures but also on helping farmers choose the right design for their crops, climate, and budget. This means working on low-cost innovations, open-source designs, and decision-making tools that farmers can adapt to their own needs.

Looking ahead, Vigyan Ashram is developing trainings, technologies, and data-driven research to empower farmers with clear, practical information before making an investment. We are experimenting with integrating simple sensors, low-cost automation, and renewable energy solutions to improve climate control without significantly increasing operational costs. Our goal is to reduce risks, extend crop seasons, and increase incomes, while ensuring that knowledge is shared openly so farmers can implement these methods themselves.

By combining hands-on training, farmer success stories, and continuous field research, Vigyan Ashram aims to create a strong support ecosystem where protected cultivation is not just a technology, but a sustainable pathway to higher productivity and resilience for rural communities.

Use the following resources on the next page for training, technical support, subsidies, and designs related to protected cultivation. Contact Vigyan Ashram for any additional help.

RESOURCES & SUPPORT

Polyhouse Designs and Technical Guidance:

- Vigyan Ashram – Open-source designs, training, and technical support
  → https://vigyanashram.com
  → vapabal@gmail.com
- National Committee on Plasticulture Applications in Horticulture (NCPAH) – Design standards and guidelines
  → https://ncpahindia.com
- Indian Council of Agricultural Research (ICAR) – Research and manuals for protected cultivation
  → https://icar.org.in

Training and Demonstration:

- Krishi Vigyan Kendras (KVKs) – Local training, demos, and farmer field schools
  → Find your nearest KVK: https://kvk.icar.gov.in
- Agri-Clinics & Agri-Business Centers (ACABC) – Entrepreneurship training for farmers
  → https://www.agriclinics.net
- State Horticulture Missions (NHM/MIDH) – Regional workshops and technical assistance
  → Check your state agriculture department website

Subsidies and Financial Support:

- NABARD – Subsidies and loans for protected cultivation structures
  → https://www.nabard.org
- MIDH (Mission for Integrated Development of Horticulture) – Central government subsidy up to 40–50%
  → https://midh.gov.in
- State Horticulture Departments – Additional state-level subsidies (check local guidelines)

Suppliers and Fabricators:

- Certified Vendors (Polyhouse & Shade Net) – Contact KVK or State Agri Dept for empaneled suppliers
- Local Fabricators – Ask at KVKs or Farmer Producer Companies (FPCs) for trusted builders
- Drip & Irrigation Providers – Jain Irrigation, Netafim India, Rivulis

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