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**23 March 2026**



## UPSC 360°

**The Hindu Unwrapped** - Daily Current Affairs Mastery for UPSC CSE (Clear that it's based on The Hindu editorials / news analyses - very aspirant-friendly)

### Significance

Agri-Photovoltaics (AgriPV) is significant for India as it enables dual land use, combining agriculture and solar energy generation. It enhances farmer income, improves climate resilience, reduces land-use conflicts, and supports clean energy targets. It also promotes sustainable rural development while ensuring food security alongside energy security in a resource-constrained economy.

## Agri-Photovoltaics (AgriPV)

### 1. Concept of AgriPV

Agri-Photovoltaics (AgriPV) refers to the integration of solar power generation with agriculture on the same land parcel, enabling dual use of land resources.

#### Key Characteristics:

- Solar panels installed **above crops / between crop rows**
- Elevated mounting structures (2-5 meters height)
- Allows **simultaneous farming + electricity generation**
- Designed to optimise both **crop yield and solar output**

### 2. Why AgriPV is Important for India

#### (a) Energy Transition Goals

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- India targets:
  - 300 GW solar capacity by 2030
  - Net-zero emissions by 2070
- Solar expansion requires **large land areas**, creating land-use conflicts

## (b) Agricultural Constraints

- Shrinking landholdings
- Climate variability (droughts, heatwaves)
- Low farm incomes

## (c) Land Use Conflict

- Traditional solar parks compete with agriculture
- AgriPV provides a **win-win solution (food + energy)**

## 3. Types of AgriPV Systems

### (a) Elevated Panel Systems

- Panels mounted high above crops
- Allows machinery movement and normal farming

### (b) Inter-row Systems

- Panels placed between crop rows
- Crops grown in gaps

### (c) Vertical Solar Panels

- Panels installed vertically
- Useful in regions with **space constraints**

### (d) Greenhouse-integrated Systems

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- Panels installed on greenhouse roofs
- Controls temperature and light

## 4. Scientific & Agronomic Benefits

### (a) Microclimate Regulation

- Partial shading reduces **soil temperature**
- Protects crops from **heat stress**

### (b) Water Efficiency

- Reduces evapotranspiration
- Improves **soil moisture retention**

### (c) Crop Productivity

- Shade-tolerant crops perform better:
  - Vegetables (tomato, brinjal)
  - Pulses
  - Leafy crops

### (d) Climate Resilience

- Protects crops from:
  - Excess sunlight
  - Extreme weather

## 5. Economic Advantages

### (a) Dual Income Source

- Income from:
  - Crop yield

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- Solar electricity (selling to grid)

## (b) Reduced Risk

- Income diversification reduces dependency on monsoon

## (c) Rural Development

- Promotes:
  - Rural entrepreneurship
  - Agro-processing activities

## (d) Employment Generation

- Installation, maintenance, and operation jobs

## 6. Government Initiatives

### (a) PM-KUSUM Scheme

- Promotes:
  - Solar pumps
  - Decentralised solar plants
- Focus on **farmer-centric solarisation**

### (b) Budget Push (2026-27)

- Increased allocation to expand solar in agriculture

### (c) Policy Developments

- Proposal for:
  - National AgriPV Mission
  - PM-KUSUM 2.0 integration
- Dedicated funding for capital costs

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## 7. Challenges in AgriPV Implementation

### (a) High Capital Cost

- Elevated structures increase installation cost
- Financing barriers for small farmers

### (b) Lack of Policy Clarity

- No uniform guidelines
- Absence of design benchmarks

### (c) Technical Constraints

- Balancing:
  - Sunlight for crops
  - Solar efficiency

### (d) Land Ownership Issues

- Leasing complexities
- Revenue-sharing disputes

### (e) Limited Awareness

- Farmers lack technical knowledge
- Need for training and extension services

## 8. Institutional & Market Barriers

- Weak coordination between:
  - Agriculture sector
  - Energy sector
- Issues in:

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- Grid connectivity
- Tariff structures
- Power purchase agreements
- Investor hesitation due to:
  - Regulatory uncertainty
  - Long-term land rights issues

## 9. Status in India

- Around **50 pilot projects** implemented
- Different crop-panel combinations tested
- Large-scale adoption still at **nascent stage**

## 10. Global Examples (Comparative Insight)

- Countries like:
  - Germany
  - Japan
  - USA
- Have successfully implemented AgriPV
- Provide:
  - Policy support
  - Technological innovation

## 11. Way Forward

### (a) Policy Framework

- Clear national guidelines

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- Dedicated AgriPV mission

## (b) Financial Support

- Subsidies for installation
- Low-interest loans

## (c) Technological Innovation

- Region-specific designs
- Efficient panel structures

## (d) Capacity Building

- Farmer training programs
- Awareness campaigns

## (e) Institutional Reforms

- Strengthening Farmer Producer Organisations (FPOs)
- Encouraging cooperatives

## 12. Significance for India

- Resolves **land-use conflict**
- Enhances **farmer income**
- Supports **clean energy transition**
- Improves **climate resilience**
- Promotes **sustainable agriculture**

## Conclusion

AgriPV is a transformative approach that aligns **energy security with food security**. With proper policy support, technological advancement, and farmer participation, it can become a key pillar of India's sustainable development and rural economy.

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## UPSC CSE & State PCS Relevance

### Prelims

- Key terms: Agri-Photovoltaics (AgriPV), Run-of-the-River Solar, PM-KUSUM, National AgriPV Mission
- Data: Target 10 GW by 2031, Capital subsidy structure, Dual land use model
- Related: National Solar Mission, Net-Zero 2070, Land Use Conflict

### GS-3 (Economy & Agriculture)

- Sustainable agriculture & renewable energy integration
- Farmer income diversification

### GS-3 (Environment)

- Climate-resilient farming and clean energy transition

### GS-2 (Governance)

- Centrally sponsored schemes and inter-ministerial coordination

### Essay / Interview

- “AgriPV: Resolving the Food-Energy-Water Nexus in a Climate-Constrained World”
- “Dual-Use Land Models: A Game-Changer for India’s Sustainable Development Goals”

## MCQs

1. With reference to Agri-Photovoltaics (AgriPV), consider the following statements:
2. It allows simultaneous electricity generation and crop cultivation on the same land.
3. The National AgriPV Mission targets 10 GW capacity by 2031.
4. Elevated panel systems are the only design used in AgriPV.

Which of the statements given above is/are correct?

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- (a) 1 only
- (b) 1 and 2 only
- (c) 2 and 3 only
- (d) 1, 2 and 3

**Answer: (b)**

2. Which ministry is the nodal agency for the National AgriPV Mission?

- (a) Ministry of Agriculture & Farmers Welfare
- (b) Ministry of New and Renewable Energy
- (c) Ministry of Power
- (d) NITI Aayog

**Answer: (b)**

3. AgriPV systems are particularly beneficial for:

- (a) Reducing water consumption through microclimate regulation
- (b) Increasing fossil fuel dependency
- (c) Promoting large-scale monoculture
- (d) Eliminating the need for subsidies

**Answer: (a)**

4. The primary advantage of run-of-the-river style AgriPV systems is:

- (a) Large reservoir creation
- (b) Minimal land submergence and ecological disruption
- (c) Higher power generation than thermal plants
- (d) Complete elimination of grid dependency

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Answer: (b)

## Mains Questions

1. "Agri-Photovoltaics offers a sustainable solution to the competing demands of food security and clean energy in land-scarce India." Discuss the concept, benefits, and challenges of scaling AgriPV in the country. (15 marks / 250 words)
2. Analyse how the National AgriPV Mission can contribute to India's 500 GW non-fossil energy target while supporting farmer incomes and climate resilience. (10 marks / 150 words)
3. "Dual-use land models like AgriPV can resolve the food-energy-water nexus." Critically examine this statement and suggest measures for effective implementation in India. (15 marks / 250 words)
4. **Essay (250 marks)** "Harvesting Sun and Soil Together: AgriPV as a Pathway to Sustainable Rural Development in India."

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