



7TH AGRIVOLTAICS WORLD CONFERENCE 2026 · POWERING THE GLOBAL SOUTH

SESSION

Strengthening South–South Cooperation through Agrivoltaics:
Technology Transfer, Crop Diversity and Policy Frameworks

One Land, Two Harvests

Designing and Governing Agriphotovoltaics
for the Global South and ISA Member Countries

PRESENTING ISA KNOWLEDGE PRODUCTS



Climate-Zone Technical Framework



Policy and Regulatory Compendium



AgriPV Digital Toolkit



DATE
21–23 October 2026



VENUE
Bharat Mandapam, New Delhi, India



PRESENTER
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Why ISA Undertook This Work



18.4 GW

operating worldwide by mid-2025,
up from about 5 MWp in 2012

Up to 65% more output from the same land · 15–30% water saved in dry climates

BUT TWO GAPS HOLD IT BACK IN OUR MEMBER COUNTRIES



The design gap

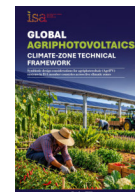
Guidance is rarely climate-specific, and many projects are designed around energy, with crops added afterwards.



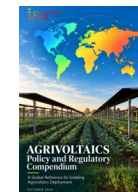
The governance gap

Most member countries have no legal definition and no test of genuine dual use; where incentives came first, token farming followed.

ISA'S RESPONSE



Technical Framework
how to design



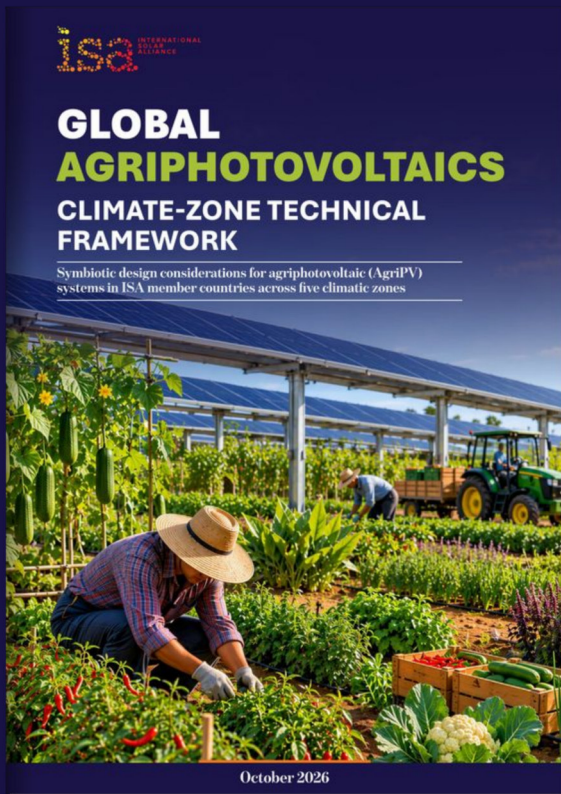
Policy Compendium
how to govern



Digital Toolkit
how to apply



The question is no longer whether AgriPV works, but how to scale it while keeping farming first.



Global Agriphotovoltaics Climate-Zone Technical Framework

PURPOSE To enable ISA member countries to expand solar power on agricultural land without sacrificing food production, through a climate-responsive, agriculture-first method for assessing, designing, financing and regulating AgriPV.

5

Köppen–Geiger climatic zones

13

project case studies

10 + 4

virtual consultations and site visits

4

worked demonstrations on real parcels

12

crop groups assessed for shade

16

operational risks scored by zone



Scan to download the full Framework

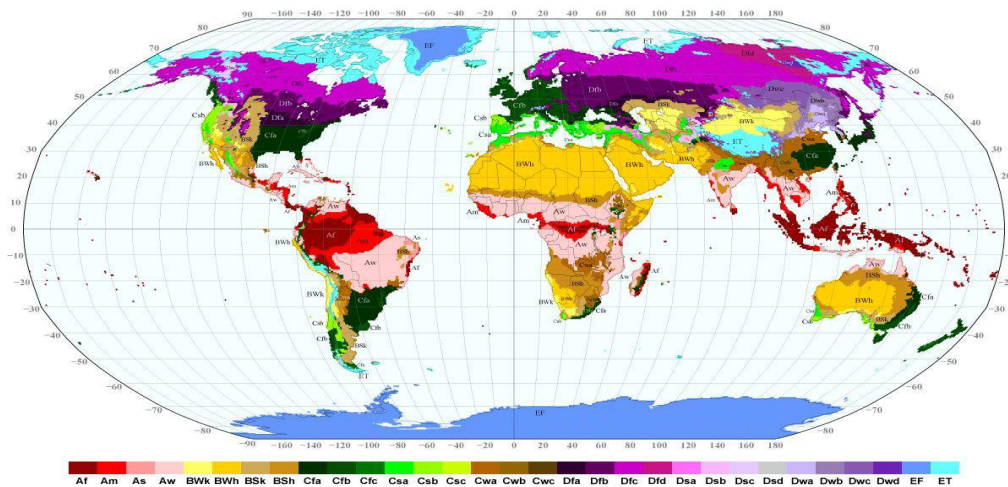
Prepared by ISA with PwC India as technical consultant; strengthened by structured external peer review.



The Framework offers one agriculture-first, climate-differentiated method, tested end to end on real sites in Egypt, India and Germany.

Why We Start with Climate

Technical Framework



Unique: one global, recognised climate system, so every member country can find itself on the map



Decisive: shade is an asset in hot, dry zones, but light is scarce in cool ones; one template cannot serve both



Useful: it fixes the farm goal first, then guides crops, structure, water use and O&M

FIVE PRIORITY ZONES AND THE JOB THE PANELS MUST DO

Arid

Köppen BW

Maximum water conservation

Under 250 mm rain; extreme heat, dust, salinity

Semi-arid

Köppen BS

Save water; stabilise yields

250–500 mm erratic rain; crops and livestock

Tropical

Köppen A

Shield from heat and downpours

20–35 °C all year; humid; intense sun and rain

Temperate

Köppen C

Protect quality from hail and frost

–5 to 30 °C; frost, hail, seasonal light

Continental

Köppen D

Extend a short season

Winters below –30 °C; short growing season



Climate defines the value of AgriPV: set design rules, crop lists and O&M by zone, not one national template.

Our Approach

Technical Framework



PHASE C: EIGHT LINKED STEPS



THE EVIDENCE BASE



Every recommendation traces back to evidence, and the method was tested on real farms in Egypt, India and Germany.

Agriculture First: The Core Principle



TWO WAYS TO DESIGN



Conventional solar

Energy first; crops fit in the gaps. Risk: token farming.



AgriPV, agriculture first

Farm goal first; energy optimised within. Result: genuine dual use.

THE TEST OF GENUINE DUAL USE

Crop ratio

+

Energy ratio

> 1.0

The land equivalent ratio (LER): shared land must produce more than the two uses kept apart. Documented: 1.2 (Sweden) to 1.65 (Junagadh, India). Apply it with a minimum crop yield.



Make agriculture-first an eligibility test: LER above 1.0, plus a minimum crop yield, separates genuine AgriPV from token farming.

Crops That Suit AgriPV

Technical Framework



68 crops and crop groups screened at four real sites

43 passed the shade-and-height test

24 finalists scored on eight criteria

10 crop categories found suitable (below)

CROP CATEGORY	EXAMPLES	SHADE TOLERANCE	Arid	Semi-arid	Tropical	Temperate	Continental
Leafy vegetables	spinach, lettuce, cabbage, amaranth	~40%	●	○	●	●	●
Herbs, medicinal and aromatic	basil, mint, chamomile, marjoram, lemongrass	20–40%	●	○	○	○	○
Spices	ginger, turmeric, black pepper, chilli	20–40%	○		●	●	
Beverage crops	coffee, cocoa, tea	~50%			●		
Roots, tubers and bulbs	potato, sweet potato, cassava, garlic, onion	~40%	●	○	○	●	○
Flowers	marigold, carnation, rose, gerbera	protected	○		●	●	
Fruits	berries, papaya, banana, strawberry	20–50%	○	○	○	○	●
Fruiting vegetables	tomato, capsicum, cucumber	light-managed	○	●	○	●	
Forage, fodder and legumes	alfalfa, clover, berseem, grasses, peas, beans	25–50%	○	●	○	○	●
Small-grain cereals	wheat, barley, oats, sorghum, millet	30–50%	○	●		○	●

Generally unsuitable under panels: maize, cotton, sugarcane, chickpea, lentil, soybean, sunflower, rapeseed. Keep them in bright strips or under vertical rows.

● strong fit

○ possible



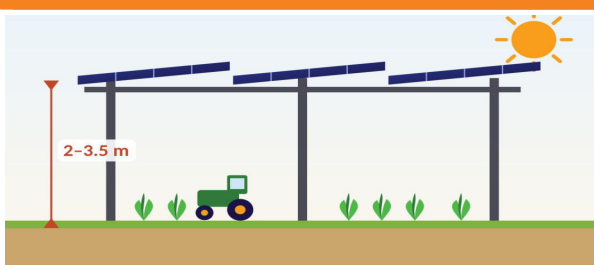
High-value, shade-tolerant crops give the strongest synergies; national crop lists should be set zone by zone.

Three AgriPV Configurations

Technical Framework



Elevated AgriPV

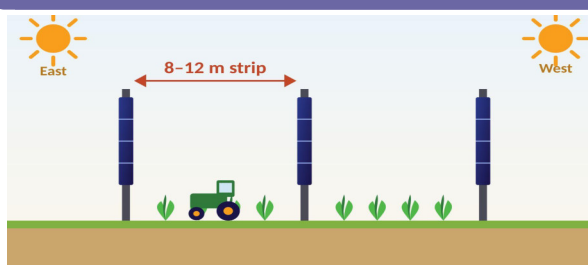


A raised canopy of panels on posts; farming continues underneath.

STRUCTURE	Panels 2–3.5 m high on posts
LIGHT BELOW	Partial shade; 25–50% ground cover
BEST FOR	High-value crops in hot, dry zones
TRADE-OFF	Highest structural cost; cleaning at height

Crop protection	● ● ● ●	Water saving	● ● ● ●
Machinery access	● ● ● ●	Energy per kWp	● ● ● ●
Capital cost	● ● ● ●	O&M effort	● ● ● ●

Vertical bifacial AgriPV

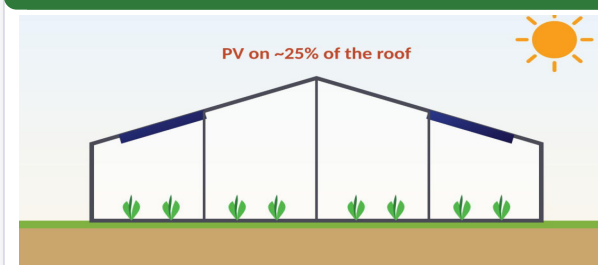


Two-sided panels stand upright in east–west rows, like a fence.

STRUCTURE	Upright rows; little ground used
LIGHT BELOW	Near-full sun in 8–12 m strips
BEST FOR	Mechanised farms, staples, cool zones
TRADE-OFF	53–66% of elevated output per kWp

Crop protection	● ● ● ●	Water saving	● ● ● ●
Machinery access	● ● ● ●	Energy per kWp	● ● ● ●
Capital cost	● ● ● ●	O&M effort	● ● ● ●

Polyhouse AgriPV



Semi-transparent panels form part of a greenhouse roof.

STRUCTURE	PV on about 25% of the roof
LIGHT BELOW	Controlled; 25–40% less light
BEST FOR	Premium, year-round horticulture
TRADE-OFF	Highest capital cost; heat management

Crop protection	● ● ● ●	Water saving	● ● ● ●
Machinery access	● ● ● ●	Energy per kWp	● ● ● ●
Capital cost	● ● ● ●	O&M effort	● ● ● ●

Design levers in any configuration: ≥ 2.5 m clearance for tractors · ≥ 6 m between rows for combines · tilt set from the sun path · bifacial or semi-transparent modules · trackers +15–25%



No single configuration is best everywhere: choose the structure by climate and crop, and justify it for every project.

Design Configurations We Assessed

Technical Framework



Elevated AgriPV



Panels sit 2–3.5 m high on posts, forming a continuous canopy; full farming continues underneath.

- + Best crop protection and water saving.
- Highest structural cost; cleaning at height needs lifts or robots.

Crop and weather protection	Orange	Orange	Orange
Water conservation	Orange	Orange	Orange
Machinery access	Orange	Orange	Grey
Energy yield per kWp	Orange	Orange	Orange
Capital cost (higher = more)	Orange	Orange	Orange
O&M complexity	Orange	Orange	Orange

Best for: Harsh-climate horticulture; water-scarce, high-value crops

Vertical bifacial AgriPV



Two-sided panels stand upright in east–west rows; crops grow in wide, sunlit strips between them.

- + Machinery access; morning and evening power; acts as a windbreak.
- 53–66% of elevated output per kWp; more land per MW.

Crop and weather protection	Blue	Grey	Grey
Water conservation	Blue	Grey	Grey
Machinery access	Blue	Blue	Blue
Energy yield per kWp	Blue	Grey	Grey
Capital cost (higher = more)	Blue	Blue	Grey
O&M complexity	Blue	Grey	Grey

Best for: Mechanised arable farms; morning and evening demand peaks

Polyhouse AgriPV

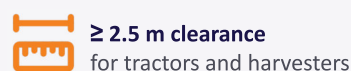
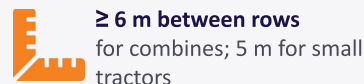
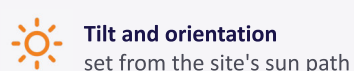
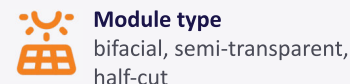


Semi-transparent panels form part of a greenhouse roof, covering about a quarter of it.

- + Full climate control; premium crops all year.
- Highest capital cost; heat management is demanding.

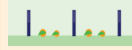
Crop and weather protection	Green	Green	Green
Water conservation	Green	Green	Green
Machinery access	Green	Grey	Grey
Energy yield per kWp	Green	Green	Grey
Capital cost (higher = more)	Green	Green	Green
O&M complexity	Green	Green	Green

Best for: Premium, year-round crops in a controlled climate



Stay technology-neutral, but require every project to justify its configuration against local farming priorities.

Suitable Configurations by Zone

Arid	Semi-arid	Tropical	Temperate	Continental
3 designs	2 designs	3 designs	3 designs	3 designs
10 crops	12 crops	14 crops	12 crops	7 crops
 Elevated canopy Aromatics, garlic, leafy greens, onion, potato <i>Shade saves water; cuts heat and dust</i>	 Elevated, with windbreaks Tomato, capsicum, cucumber, cabbage, kale, leafy greens <i>Proven at Junagadh, Isinya and Sagar (3–3.5 m)</i>	 Ventilated elevated Leafy greens, marigold, chillies, turmeric, tomato <i>Relieves heat; height and airflow limit disease</i>	 Elevated (4–5 m) Ginger, flowers, off-season legumes, capsicum, tomato <i>Shields from hail, frost and heavy rain</i>	 Vertical bifacial Wheat, barley, rye, rapeseed, sugar beet, potato <i>Keeps the mechanised rotation in near-full sun</i>
 Vertical bifacial Wheat, berseem, sugar beet, fava beans	 Vertical, with windbreaks Sorghum, millet, pulses, forage and grazing	 Polyhouse Capsicum, salad tomato, cucumber, exotic greens	 Polyhouse Capsicum, hybrid tomato, cucumber, strawberry, carnation	 Low-cover elevated Berries and orchard fruit; salads, herbs
 Polyhouse Tomato, cucumber, pepper, strawberry, herbs	<div>  Polyhouse <i>Not assessed for this zone</i> </div>	 Vertical bifacial Groundnut, pulses, millets, fodder	 Vertical bifacial Maize, wheat, fodder, mustard, fruit-tree rows	 Low-cover polyhouse Premium berries, salads and herbs

 Most zones can use all three designs; what changes is the lead design and the crops under each, so every project must justify its choice.

Operations, Risk and Returns

Technical Framework



16 RISKS SCORED

CLIMATE AND SITE

- Extreme temperatures
- Reduced light
- Uneven water distribution
- Humidity and heavy rain
- Icing and snow
- Uneven terrain
- Wind and hail
- Dust on panels

FARM AND CROP

- Pests and diseases
- Water quality
- Machinery access

ELECTRICAL AND OPERATIONS

- Transformer failure
- Corrosive environment
- Power curtailment
- Data connectivity
- Lack of skilled labour

	Arid	Semi-arid	Tropical	Temperate	Continental
Extreme temperatures	High	Medium	Low	Medium	High
Reduced light	Low	Low	Medium	High	High
Uneven water distribution	Low	Low	High	Medium	Medium
Humidity and heavy rain	Low	Medium	High	Low	Low
Icing and snow	Low	Low	Low	Medium	High
Uneven terrain	Low	Low	Medium	High	High
Wind and hail	Low	Low	Low	Low	Low
Dust on panels	Medium	Medium	Low	Low	Low
Pests and diseases	Low	Medium	High	Low	Low
Water quality	Medium	Medium	Low	Low	Low
Machinery access	Medium	Medium	Medium	Medium	Medium
Transformer failure	Medium	Medium	Low	Low	Low
Corrosive environment	Low	Low	Low	Low	Low
Power curtailment	Low	Low	Low	Low	Low
Data connectivity	Low	Low	Low	Low	Low
Lack of skilled labour	Low	Low	Low	Low	Low

RESPONSES THAT WORK

- Dust:** soiling sensors; dry or robotic cleaning
- Heat and storms:** toughened glass; sealed enclosures
- Transformers:** cooling and spares; a failure can idle a plant for months
- Humidity:** drainage; galvanised hardware; airflow
- Low light:** wider spacing or vertical rows
- Snow and wind:** rated structures; tracker stow

DOES IT PAY? ILLUSTRATIVE 10 MW

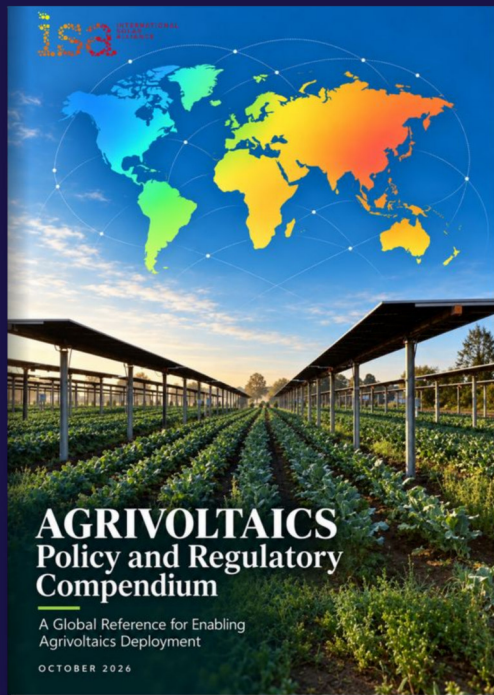
14–18% equity IRR **INR 3.5–5** LCOE per kWh

1.25–1.40 debt cover (DSCR) **5–8 yrs** payback

Ownership decides who benefits: farmer and FPO models keep the most value on the farm.

Risk = likelihood × impact on power and crops. Every site still needs its own risk assessment.

Standard solar O&M understates AgriPV costs: budgets, insurance, module standards and contracts must be climate-specific.



AgriPV Policy and Regulatory Compendium

PURPOSE To review the laws, regulations and incentives shaping AgriPV worldwide, country by country, and distil what can inform frameworks in ISA member countries.

METHOD Primary legal texts first · one standard profile per country · 12 policy routes grouped into 5 approaches · maturity kept separate from deployment · status 13 Oct 2026 · peer-reviewed

8 Europe

Germany, France, Italy, Spain, Netherlands, Austria, Greece, Czechia

8 Asia-Pacific

Japan, South Korea, China, India, Vietnam, Thailand, Australia, Israel

8 Africa

Egypt, Morocco, Tunisia, South Africa, Rwanda, Togo, Mali, The Gambia

8 Latin America & Caribbean

Brazil, Chile, Colombia, Argentina, Cuba, Jamaica, Barbados, Dominican Republic

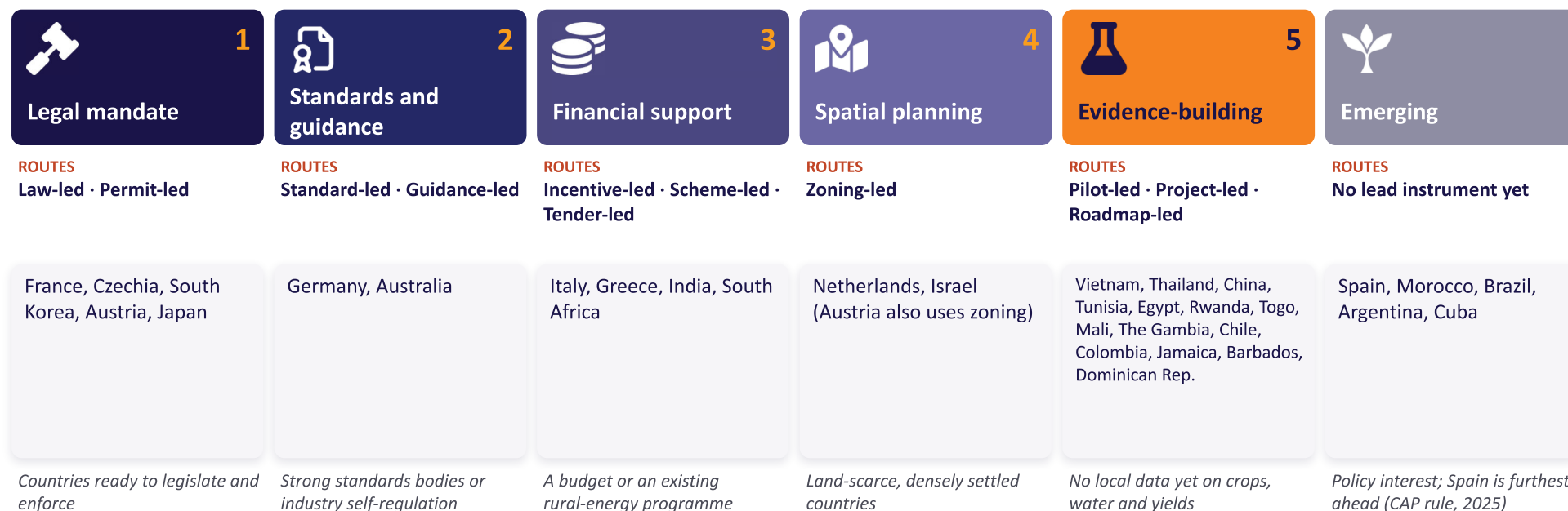


Scan to download
the full Compendium

Prepared by ISA with EY as technical consultant.

 Thirty-two national frameworks, eight in each ISA region, distilled into a menu of tested options and a model that any member can adapt.

Policy Pathways: Twelve Routes, Five Approaches



No route works alone: an incentive needs a legal definition, a standard needs laws that point to it, and a zoning plan needs a permitting route.



Choose the entry route that fits your institutions, then add the missing pieces: every route eventually needs a legal basis.

Leading Countries and the Rest

5 Advanced

Binding definition, safeguards, support and checks

France

Law: farming benefit is mandatory; checked during operation

Germany

DIN SPEC 91434 standard: at least 66% of yield kept

Italy

Funding tied to design: $\leq 40\%$ coverage, $\geq 70\%$ farmed, ≥ 2.1 m

Japan

Temporary farmland permits, withdrawn if farming fails

Czechia

Crop list and design ratios fixed upfront

7 Developing

Dedicated rules adopted recently or in part

South Korea

2026 Act: only farmers and local cooperatives may operate

Israel

National zoning plan: $\leq 30\%$ coverage, $\geq 75\%$ yield

Greece

Farmer access with a ten-year yield test

India

10 GW AgriPV component in PM-KUSUM 2.0

Also: Austria, Netherlands, Spain

20 Nascent

No dedicated rules yet

China, Australia, Vietnam, Thailand, Morocco, Egypt, Tunisia, Rwanda, Togo, Mali, The Gambia, South Africa, Brazil, Chile, Colombia, Argentina, Barbados, Cuba, Jamaica, Dominican Republic

Rules $\neq$ deployment: China has about 31 GW (broad definition) without dedicated AgriPV rules.

Most ISA member countries are at the nascent stage.



Leaders defined AgriPV, set measurable safeguards and tied support to them; nascent countries can leapfrog by adopting these lessons from day one.

Our Policy Recommendations

Policy Compendium



START FROM THESE DEFAULT SAFEGUARDS, THEN TUNE BY CROP AND ZONE



70–80%

of reference crop yield kept

Range today: 60% to 90%



≤ 10–15%

land lost; ≥ 80% still farmed

Range: 70–95% farmed



≤ 30–40%

of ground covered by panels

Range: 30% to 40%



≥ 2.1 m

clearance where machines work

1.3 m for livestock



Every year

crop and energy reporting

Independent check every 3 years

RULES BEFORE INCENTIVES



Define AgriPV in law before offering incentives



Tie every subsidy, tariff or permit to that definition



Measure yield fairly: control plot, 3+ seasons, drought and pest exemptions



Make farmer benefit enforceable: revenue shares, FPO ownership

SEQUENCE REFORMS BY STARTING POINT

FIRST

THEN

FINALLY

Nascent

Share data; run monitored pilots

Crop standard from pilot results

Targeted incentives

Developing

Complete definition and rules

Align land, payments and tax

Monitor during operation

Advanced

Add monitoring in operation

Refine thresholds with data

Scale up or taper support



Define before you incentivise: start from these defaults, check compliance during operation, and sequence reforms to your starting point.

Ten-Part Model Policy Framework

Foundations (1–3)

Enabling rules (4–5)

Support and safeguards (6–8)

Delivery (9–10)

01


Objectives and targets

Energy and food goals; a dated capacity target

02


Definition and criteria

A separate category from ground PV; yield, coverage, clearance by crop and zone

03


Legal basis

Binding law or regulation; one lead agency

04


Remove legal barriers

Keep farmland status, farm payments and tax; set where AgriPV is allowed

05


Permitting

Clear, time-bound, single-window approval

06


Incentives and support

Only after step 4: tariffs, grants, VGF, concessional loans

07


Monitoring

Annual reporting; control plots; force majeure; dismantling guarantee

08


Value-sharing and data

Farmer revenue shares; FPO ownership; standard PPAs; open data

09


Planning, grid, offtake

Map land, solar, water and grid, incl. 11 kV feeder uptime

10


Crops and produce offtake

Crops by zone and design; offtake via FPOs and cold chains

Also cover: tenant protection · crop insurance and farm-subsidy retention · separate categories for PV greenhouses, livestock and aquavoltaics · decommissioning



Use the ten parts as a drafting checklist: foundations first, incentives only after barriers are removed, and monitoring from day one.

Key Findings and the Way Forward

The way forward



Technical Framework

- 1 Agriculture leads the design**
LER above 1.0 with a minimum yield
- 2 Climate decides the design**
Five zones, five different jobs
- 3 Crops are chosen, not assumed**
Shade-tolerant, high-value crops lead
- 4 Design follows crop and zone**
Elevated, vertical or polyhouse
- 5 Climate-specific O&M; it pays**
14–18% equity IRR; ownership matters

Policy Compendium

- 1 Rules must come first**
Where incentives came first, farming slipped
- 2 Twelve routes, five approaches**
No route works alone
- 3 Only 5 of 32 are advanced**
Most ISA members can leapfrog
- 4 A few numbers protect farming**
Yield, land, coverage, clearance, checks
- 5 A ready ten-part model**
A drafting checklist for any member

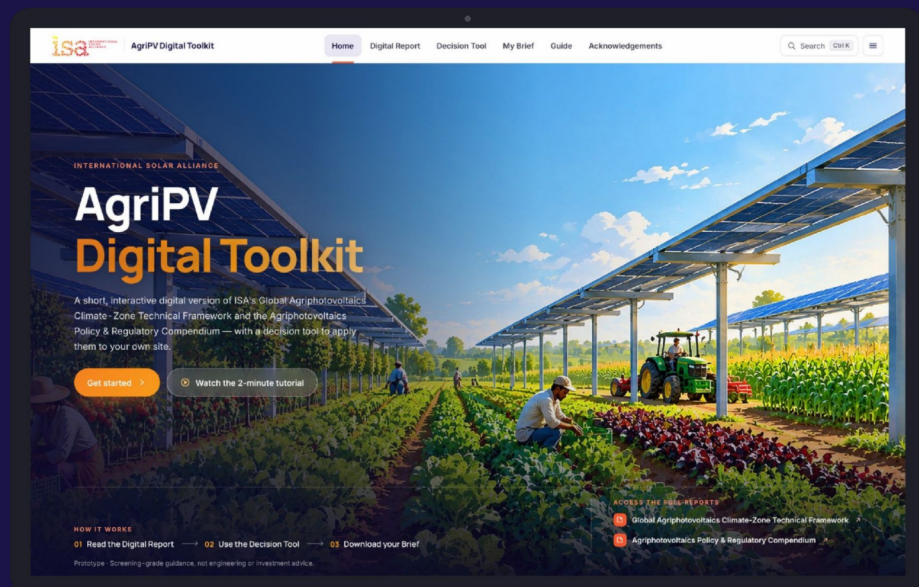
THE WAY FORWARD

- 1 Prepare** 0–12 months
Legal definition and LER test; joint energy–farm lead; map zones
- 2 Pilot** 1–3 years
Monitored pilots in every zone; open data; FPO-led models
- 3 Programme** 3–5 years
Dedicated tender or solarisation window; blended finance
- 4 Scale** 5+ years
In national energy and land-use plans; market-led

ISA will: support pilots in every zone, host an open performance database, build skills, and update both reports as evidence grows.



Design it well, govern it well, and move from pilots to national programmes with confidence.



ISA AgriPV Digital Toolkit

OBJECTIVE A short, interactive digital version of the Technical Framework and the Policy Compendium, with a decision tool to apply them to your own site.

HOW TO USE IT

- 01 Read the Digital Report**
Both reports in short, interactive form
- 02 Use the Decision Tool**
Pick a place on the map; a six-step site check covers land, farming, crops, system, policy and result
- 03 Download your Brief**
What to grow and build, risks, policy and next steps

Thank you

Design it well. Govern it well. Apply it everywhere.

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