# Defining agriPV for the Indian context

*-By Saptak Ghosh*

**Synopsis: India's plans to add more than 200GW of solar PV capacity will include significant contribution of agriPV. Given the criticality of agriculture to the Indian economy and the diversity in crop production, there is need to understand in practical terms the impact of deploying agriPV on productivity, farmers incomes, linkages to foreign trade, domestic demand among other issues. This granular assessment must form the basis for developing clear guidelines, in consultation with stakeholders, on defining agriPV and parameters such as acceptable yield restriction.**

'AgriPV' or 'agrivoltaics' that is combining agriculture with photovoltaics (PV) to optimise land usage has gained traction in countries such as Germany, Japan and Italy and is being actively explored in India. As India explores agriPV in its quest to meet its 2030 targets and decarbonise its economy, it is crucial to address the fundamental question: What is agriPV (agriculture and photovoltaics) in the Indian context?

Clarity in definitions is critical if the transition to low carbon pathways and a net zero is to be achieved. Making the defining of agriculture and photovoltaics (agriPV) in the Indian context crucial. There are more than 55 major crops grown across the subcontinent in varying climatic and soil conditions. It is likely that most of these crops will show varying trends when combined with photovoltaics. India is still an agrarian economy; agriculture contributes approximately 17% to its gross domestic product. In the last financial year, agricultural exports crossed $50 billion, whereas imports tallied to ~$32.5 billion. Therefore, any changes in agricultural production resulting from the introduction of PV will have profound consequences for India's overall economy.

To understand the complex issue of agriPV definition, we take wheat as an example. Wheat is one of the most important staple crops in India. It ranks 2nd (after rice) in terms of area under cultivation (~33 million hectares) and production (~110 million tonnes). Despite consuming ~103 million tonnes internally, wheat exports raked in more than $2 billion last year. India produces ~13% of the world's wheat and is expected to increase production and exports. However, unpredicted heatwaves in April 2022 led to experts believing that production could drop to below 100 million tonnes for 2022–23. The recent Russia–Ukraine conflict further highlighted the volatile nature and prices of wheat as a commodity. These supply shortages, global dynamics, and domestic price surges forced the government to intervene and prevent exports.

Co-locating PV with wheat is bound to add to the plethora of variables associated with production. Wheat is grown across India, and there are more than 440 notified varieties. Each one has been developed over time, considering local climatic conditions and soil characteristics. PV panels installed at a height to allow farming and tractor movements below change the microclimatic conditions of a farm. Parameters such as soil and ambient temperatures, humidity below panels, and incident radiation that determine plant growth are affected. Wheat varieties will react differently in terms of yield and maturing time frames because of the impacts of PV. For example, a farmer growing Lokwan wheat in Jabalpur, Madhya Pradesh, produces ~18 quintals/acre. With elevated PV, this yield might increase to ~20 quintals/acre. On the other hand, a farmer growing Sharbati wheat in Bhopal, Madhya Pradesh, for exports might witness reduced yield from ~18 quintals/acre to ~16 quintals/acre. These subtle changes might seem innocuous at the farm level. However, they have far-reaching consequences in terms of economics when the millions of acres under cultivation are considered.

Moreover, wheat is grown typically only as a rabi/winter crop in India. Crop rotation for other seasons and years includes legumes, mustard, and sometimes even rice. The productivity variations of these crops because of PV installations need to be assessed. Changes in productivity and linkages to economics (foreign trade, domestic demand, and commodity prices) need to be analysed in detail. Compensation amounts (for farmers losing revenue because of crop yield reduction) need to be quantified. Minimum Support Prices (MSPs) might need to be adjusted on a regional basis. Lessons learnt from pilots in other countries will not apply to Indian wheat growing practices. Hence, it is imperative to generate primary data in the Indian context.

This food–energy nexus and overall macroeconomic linkages with national interests are applicable to all major crops. Population is slated to grow by 300 million in the next decade along with exponential growth in the demand for food grains. In the same time frame, India has announced that >200 GW of additional solar PV capacity will be installed. While agriPV is expected to contribute significantly to this, it should not come at undue costs to food production and the country's economy.

Similar to wheat, multiple pilots for major food crops across the country need to be set up. Agricultural universities, research institutes, think tanks, international experts, developers, farmers/farmer producer organisations and state/central governments need to collaborate and gather findings. Thorough analyses in terms of deviation from the baseline need to be conducted for each crop of interest. This includes agricultural yield, microclimate, soil conditions, farmer income/compensation, local/national/international economics and trade dynamics, and PV plant performance.

Germany, after several rounds of deliberation among stakeholders, arrived at a definition of agriPV that restricts yield reduction to a maximum of 33%. In Japan, this number is 20%. Guidelines in France recommend no yield loss whatsoever, whereas in Italy, the loss of arable land because of agriPV is limited to 20%. India needs to arrive at acceptable numbers for these criteria to define agriPV classifications for each major crop in each state. Only reliable and concrete data can resolve conflicts debated among all involved stakeholders for crops with reduced yield or reduction in arable area. However, there are crops such as tomatoes, leafy greens, herbs, and tubers that thrive under shaded conditions. India's agriPV journey can start with these crops and evolve over time with primary data-driven definitions and classifications for other major crops.

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