The Case for Community-Based Agrivoltaics

Community-based agrivoltaics in Bihar shows potential to enable highly productive, environmentally sustainable agriculture

Agrivoltaics is a relatively new concept that is broadly defined as the co-production of food and energy on the same land. Although only a few countries have officially recognized agrivoltaics through a legal framework, the concept is being tested in numerous geographies. Given that solar radiation, land availability, average plot size, common agricultural practices, cropping calendars, and patterns vary across regions, it is not surprising that different stakeholders view the concept of agrivoltaics differently.

In India, where 90% of farms are classified as small- or medium-sized, agrivoltaics will need to be tailored to the needs of smallholders.

The experience of a group of farmers in Bihar, who were empowered to use agrivoltaics by the Tata–Cornell Institute for Agricultural and Nutrition (TCI), shows that a community-based model offers a beneficial way forward to reduce greenhouse gas emissions, improve productivity, and improve farmers' livelihoods.

Agrivoltaics in India

Agrivoltaics is still in a nascent phase in India. There are currently around 40 agrivoltaics installations in the country, ranging from 3 kilowatts to 4.5 megawatts. Most installations are experiments conducted by research institutions and utility companies, primarily aimed at analyzing the compatibility of solar panels with various crops grown directly beneath or between panels.

In most of these experiments, the assumption is that the solar electricity generated will be fed into the grid rather than used in agriculture. Although this rationale is justified for larger solar arrays, especially those exceeding 500 kilowatts, the reality is that such large investments are attractive mostly to big landowners but are prohibitively expensive for small- and medium-sized farms.

Smaller installations, which are better suited for small- and medium-sized farms, which constitute more than 90% of farms in India, require a different approach. Such installations are typically not designed to produce power to be fed into the grid, because the quantity of power is not attractive enough or economically justifiable to distribution companies. Instead, the solar power is used in the same location where it is produced, mostly for agricultural purposes. In these smaller installations, the two elements of agrivoltaics—agriculture and solar power generation—are truly integrated and power generation installation is designed to maximize agricultural

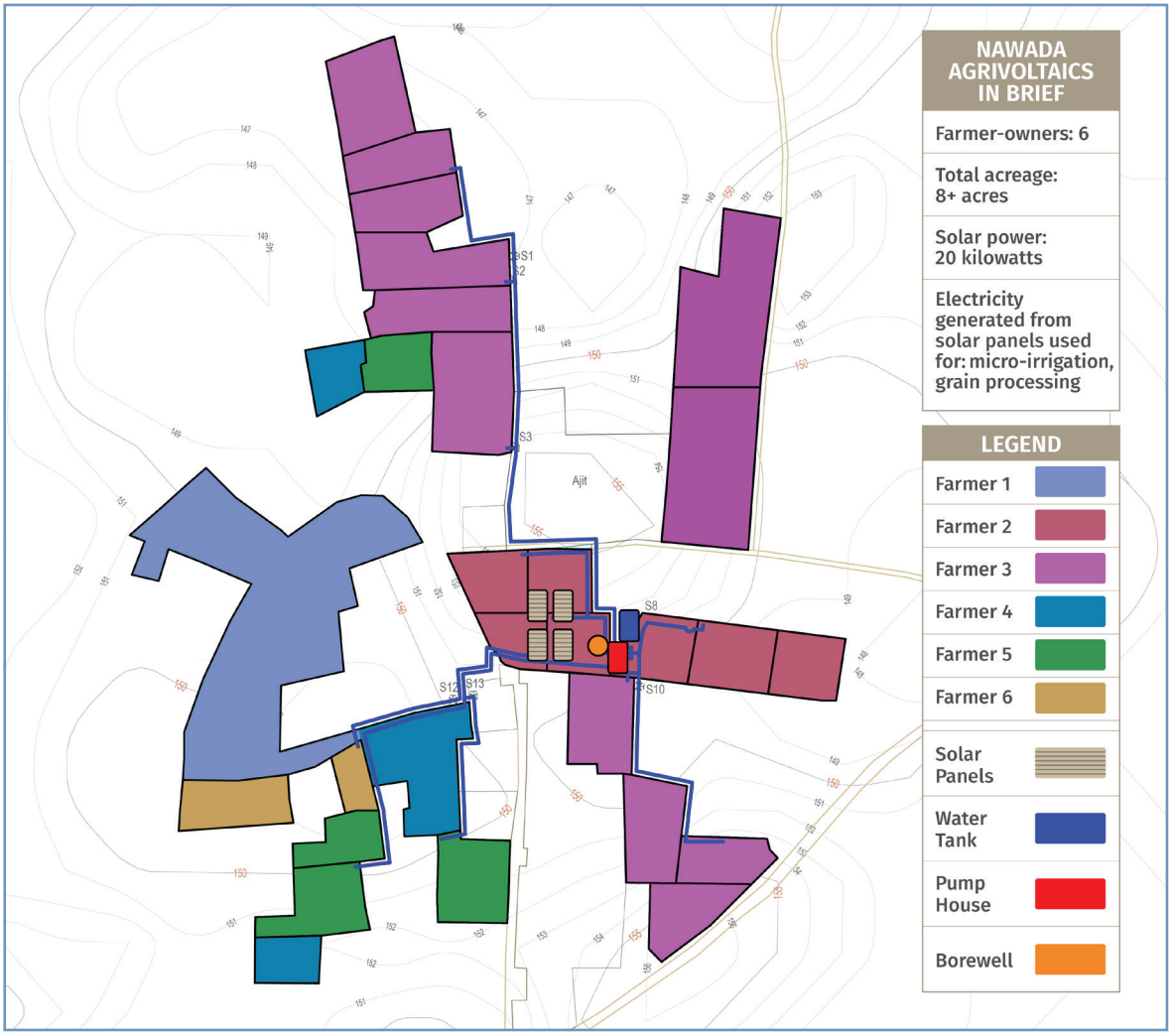
output, rather than a primary emphasis on power generation. The land that benefits from this setup greatly exceeds the area under solar panels.

Community-Based Agrivoltaics in Bihar

As part of its Zero-Hunger, Zero-Carbon Food Systems project in Bihar, TCI and Preservation and Proliferation of Rural Resources and Nature (PRAN) established the state's first agrivoltaics installation in Nawada village in the Gaya Ji district. With support from TCI, the participating farmers have co-financed and collectively own the installation.

At the TCI–PRAN site, energy generated by a 20-kilowatt solar array is used to power a grain mill and micro-irrigation systems. Although the solar panels cover around 1,200 square feet of land, the area benefiting from solar-powered micro-irrigation exceeds 8 acres. Access to reliable and affordable irrigation allows the farmers to grow crops during dry seasons.

Nawada Village Agrivoltaics Design



The farms utilize drip and sprinkler systems, reducing the amount of water needed for cultivation. The farmers will also generate income by charging for grain mill services.

Benefits of Community-Based Agrivoltaics

Community-based agrivoltaics is uniquely positioned to promote sustainable use of natural resources, economic progress, and cohesion among farmers. Although the main motivation for farmers joining an agrivoltaics group is related to irrigation, this model has several advantages over traditional solar irrigation systems. Excess irrigation, which usually occurs when electricity is "free," and which can negatively impact water resources and soil health, is minimized by two mechanisms. Over-irrigation by individual farmers, or by the group, can lead to water shortages that ultimately could undermine the agricultural productivity and income of every group member. Additionally, the opportunity cost of over-irrigation is high, because excess power could otherwise be used for income-earning activities, such as food processing.

The success and sustainability of the agrivoltaics group are closely related to the success of each farmer. This model favors creative and resource-conscious farmers, who not only care about their own benefits, but also about the benefits of the group.

While the power generated at the Nawada site is used for irrigation and a grain mill, excess electricity from agrivoltaics could potentially also be used for a variety of other applications, such as small- and medium-sized cold storage units, chargers for electric vehicles, and even households or streetlights.

Increasing Productivity, Reducing Emissions

Community-based agrivoltaics provide hope for small- and medium-sized farmers to be part of a new agricultural revolution in India—with the potential to reduce hunger, increase agricultural productivity and rural income, and reduce dependence on fossil fuels. The versatility of agrivoltaics allow for location- and need-based designs in which farmers decide how to best utilize the systems. The installation in Nawada unlocked the creativity of the farmers, who are now empowered to experiment with various intercropping systems and micro-irrigation arrangements. Community-based agrivoltaics empowers not only the groups that own the installations, but also the individuals within the groups.

Large-scale agrivoltaics will undoubtedly play a role in securing sustainable development in India, but community-based agrivoltaics are empowering small-scale farmers to be active participants in the country's food systems and energy transition.

Zero-Hunger, Zero-Carbon Food Systems

This policy brief was produced as a part of TCI's project on Zero-Hunger, Zero-Carbon Food Systems. The project aims to support the reduction of GHG emissions associated with agriculture while improving productivity and benefiting farmer livelihoods.

Learn More

To learn more about the Zero-Huger, Zero-Carbon Food Systems project, visit:

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