German-Brazilian Energy Partnership

Factsheet

Potential for Agrivoltaics (Agri-PV) in Brazil

In recent years, solar power has experienced significant global growth. Particularly in Brazil's remote areas solar energy has a great potential since it enables decentralized and sustainable power generation with low maintenance. Yet, the land necessary for solar installations diminishes the available land for agriculture. One solution to this conflict is the implementation of agrivoltaic systems (Agri-PV) which optimize land use efficiency by integrating agricultural activities with photo-voltaic energy generation.

State of the Art

Agri-PV systems have gained global momentum since the early 2000s, particularly in Europe, Asia, and the United States, ranging from small family setups to large-scale installations. Especially Germany plays a crucial role in the domain of development and standardization of Agri-PV installations. In Brazil, Agri-PV technology is still in the pilot implementation phase. Hence, further studies are crucial for adapting the technology to local conditions and fully exploit Brazil's potential in this area.

Beyond the optimization of land use, agrivoltaics offer numerous technical advantages such as higher water use efficiency, protection against wind erosion, decreased pesticide use due to higher plant protection or greater module efficiency due to better convective cooling. Moreover, Agri-PV provides economic and social benefits for farmers, fostering energy autonomy, facilitating income diversification through surplus electricity sales, and addressing rural challenges such as depopulation and declining agricultural income.

Applications and business models

Agri-PV systems, adaptable in both elevated and lower configurations, have diverse applications ranging from crop and food production, animal husbandry to ecosystem services and solar greenhouses. Their versatility is evident in features like vertical systems, rainwater harvesting, and mobile solar panels. Specialized photovoltaic module designs tailored for optimal Agri-PV performance, include thin-film tubular modules and those with increased cell spacing.

HIGHTLIGHTS FOR AGRI-PV IN BRAZIL

- Agri-PV demonstrates adaptability across diverse Brazilian agricultural regions.
- Small-scale farmers can benefit from agrivoltaics within existing regulations.
- Main challenges are the high CAPEX, professional training and absence of guidelines.
- There are existing funding possibilities adequate for agrivoltaics in Brazil.
- Agrivoltaics can enhance food and energy security in the country.

Source: Laís Cassanta Vidotto, Kathlen Schneider, Ramom Weinz Morato, Lucas Rafael do Nascimento, Ricardo Rüther, An evaluation of the potential of agri-voltaic systems in Brazil, Applied Energy, Vol. 360, 2024.

Despite higher costs, Agri-PV systems offer various business models, including self-funding, external land ownership, external PV investment, as well as cooperative models.

Implementing Agri-PV systems in Brazil requires careful consideration of the country-specific circumstances, which are characterized by environmental sensitivity, a diverse agricultural landscape, varied climates, as well as unique socio-economic factors. This translates to potential benefits and challenges within the Brazilian context.

Potential benefits and challenges of Agri-PV in the Brazilian context

Benefits	Challenges
• The flexibility of agrivoltaic configurations makes this technology adaptable to different local circumstances. • In areas with high deforestation rates, the dual-use feature enables local families to generate extra income without the need of destroying forest vegetation. The income increase generated by higher profitability per area could be invested in more sustainable agricultural practices. • Irrigation optimization provided by Agri-PV provides benefits for regions suffering from water scarcity and high irradiation levels (e.g. Northeast). • Large-scale agriculture, particularly in the Central-West region, benefits from the use of taller structures tailored for accommodating large machinery, such as tractors.	• Agrivoltaic adapted modules and structures are not widely available in Brazil. • The lack of professionals with technical experience in agrivoltaic projects can be a challenge regarding the integration between these systems and the crops. • The high higher initial costs of Agri-PV compared to regular PV installations represent a challenge for family farming establishments. • The lack of national guidelines or regulations in Brazil might be a barrier for the development of agrivoltaic projects in the first place.

Conclusions

Brazil is a major global agricultural producer, with agribusiness playing a crucial role in its economy. The versatility of Agri-PV technologies allows adaptation to both large and small-scale agriculture. The high energy demand, especially in large-scale agriculture emphasizes the need for energy self-production. Vertically installed bifacial Agri-PV systems are seen as suitable solutions capable of supporting large-scale machinery.

In addition, family farming is very common in Brazil, representing 77% of agricultural establishments in Brazil and providing about 70% of the country's food (IBGE, 2019). These systems offer social and economic opportunities for family farmers by providing greater energy autonomy for self-consumption and the potential for income diversification.

Recommendations

- Elaborate a national guideline and/or legal framework that regulates the agrivoltaic technology in the country.
- Provide R&D project funding to advance research on the subject and assess the potential of agrivoltaics in the country, considering the country's regional diversity and seeking to identify the potential and particularities of each region.
- Create credit lines for family farming (including electrification of all transport and machinery involved in farming) that supports agrivoltaic installations for this public.
- Promote teacher training programs on agrivoltaic technology at federal institutes and other educational institutions.

Case Study: Implementation of small-scale Agri-PV systems for family farmers in the Amazonas region

The project aims to support four riverside families directly, impact 82 consumer families, and promote organic production and agroforestry practices. Despite slightly higher initial costs compared to conventional photovoltaic systems, the designed wooden structures align with farmers' economic realities and resource availability. The proposed 15.4 kWp systems are expected to generate 21.2 MWh of electricity annually. Economic analysis, considering productivity loss scenarios, indicates that agrivoltaics can be economically feasible, with a discounted payback period of 7 years and 10 months. The study suggests potential synergy with "shared energy" models, benefiting multiple families in the association.

Imprint

Editor: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Venue: Setor Comercial Norte Q 1, Bloco C, Sala 1401, 70711-902 Brasília-DF
Tel. +55 61 2101-2050
Website: https://www.energypartnership.com.br
E-mail: Kristina.kramer@giz.de

Authors: *Kramer, Kristina*
Concept & design: *Edelman GmbH, Berlin*
Status: 06/2025

Energy Partners

Federal Ministry for Economic Affairs and Energy
MINISTÉRIO DE MINAS E ENERGIA
GOVERNO FEDERAL BRASIL UNIÃO E RECONSTRUÇÃO
German-Brazilian Energy Partnership

Implementing organisation

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH