Research Progress Brief

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Transition to low-carbon agricultural technologies: The case of farmers in Burkina Faso

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Key messages

- In Burkina Faso, smallholder farmers face pressing challenges of water scarcity, rising fuel costs, and climate variability that threaten agricultural productivity and incomes. This project responds by testing innovative ways to promote the adoption of solar-powered irrigation pumps; a clean, affordable, and climate-resilient solution. Through information campaigns, cost-benefit training, and hands-on demonstrations in partnership with Africa Energy Solaire, a company providing solar-powered irrigation pumps, and microfinance institutions, the project will engage 1,700 farmers across cooperatives in the Centre and Plateau-Central regions.
- By showcasing the economic and environmental advantages of solar pumps compared to manual or fuel-based irrigation, the initiative aims to strengthen farmers' knowledge, increase willingness-to-pay, and foster greater adoption of renewable energy technologies. Special emphasis is placed on empowering women farmers, who often face barriers in accessing agricultural innovations. Ultimately, the project seeks to boost farm productivity, expand cultivated land, and improve household incomes while advancing inclusive climate resilience. The evidence generated will inform policies and programs that scale sustainable energy solutions for agriculture, contributing to Burkina Faso's food security and its transition toward greener, more inclusive growth.

Anticipated Policy and Practice Relevance

It is clear that if the intervention yields positive results, the findings will provide strong evidence to guide both policy and practice in Burkina Faso's agricultural and energy sectors. Demonstrated improvements in knowledge and willingness to adopt solar-powered irrigation pumps would justify broader integration of clean energy agricultural technologies into government-led rural development programs. For example, the Ministry in charge of agriculture and the Ministry in charge of environment could scale the intervention through national extension services, while the Ministry of Gender and Social Affairs could leverage the approach to promote women's participation in climate-smart agriculture.

Donors and development partners, including multilateral agencies, may use these results to prioritize investments that simultaneously address food security, climate resilience, and women's economic empowerment.

Training session on how to use solar water pump during the intervention

The model could also inform microfinance institutions in designing tailored financial products (such as pay-as-you-go schemes) that improve affordability and access to solar irrigation technologies. Moreover, MSMEs engaged in the agri-energy value chain would benefit from clearer evidence on market potential, opening pathways for private sector-led scale-up.

At the local level, municipalities and farmer cooperatives could integrate solar irrigation into community-based initiatives to improve water management and productivity. Importantly, the intervention aligns with Burkina Faso's national development goals of agricultural modernization and poverty reduction, national strategies (SNER 2024–2028, Vision 2050) as well as its climate commitments under the Paris Agreement and the country's Nationally Determined Contributions (NDCs). In addition, the intervention aligns with the Politique Nationale Genre (2016–2025) by explicitly targeting women farmers, addressing their knowledge gaps, and promoting their access to productive technologies.

By demonstrating both economic and social benefits, the study offers a replicable model for other regions in West Africa facing similar challenges of water scarcity, energy dependence, and gender inequality. In doing so, it creates actionable pathways for sustainable, inclusive, and climate-resilient rural development.

Co-creation and Stakeholder Engagement

The Burkina Faso intervention was shaped through extensive collaboration with SMEs, government agencies, donors, and farmer cooperatives to ensure both contextual relevance and long-term ownership.

Private sector engagement

Early consultations with Africa Energy Solaire (AES and Green Engineering Services (GES, two SMEs with experience in rural energy solutions, revealed lessons from past clean energy initiatives. Their business models, which link technology provision with NGO and microfinance partnerships, highlighted both the potential and the pitfalls of scaling solar technologies. This input was critical in ensuring that the project design incorporated practical financing options and after-sales support from the outset.

Policy alignment

National-level discussions with the Ministry of Agriculture, the National Agency for Renewable Energies and Energy Efficiency (ANEREE, as well we development partners such as Practical Action and Sida, helped validate the project's theory of change. Importantly, these stakeholders advised the research team to pivot from an initial focus on solar milling toward irrigation, recognizing that water access is farmers' most pressing need. This shift ensured that the intervention aligned closely with government agricultural priorities, particularly its emphasis on women's access to irrigation technologies. To further strengthen policy linkages, the Director General of the Burkinabe Agency for Rural Electrification (ABER joined the project team, offering ongoing advisory support and direct connections with decision-making processes. The Ministry of Agriculture also appointed the Director of its General Directorate for Studies and Sectoral Statistics as focal person to liaise with the team and keep the Ministry informed of progress and outcomes.

Workshop with cooperative leaders to prepare intervention

Community and cooperative inputs

At the community level, cooperative leaders played a central role in adapting the intervention to local realities. Their emphasis on affordability led to the inclusion of the microfinance institution Graine, which now facilitates pay-as-you-go credit schemes. Farmers also requested hands-on learning, resulting in the integration of live pump demonstrations and farmer testimonials into training sessions. These elements increased the credibility of the intervention and enhanced peer-to-peer learning.

Defined roles for scale-up

Through iterative co-creation, each stakeholder assumed a clear role: AES provides technical training and technology, Graine offers financing solutions, cooperatives mobilize farmers, and government agencies serve as policy enablers. This multi-actor structure not only shaped the intervention's design but also built trust and accountability across partners.

By embedding co-creation at every level, from national ministries to grassroots cooperatives, the project now reflects farmer needs, market realities, and policy priorities. This collaborative foundation increases the likelihood that, if proven effective, the intervention can be scaled and replicated in other regions of Burkina Faso.

Intervention Design

The Burkina Faso intervention tests whether targeted information campaigns, cost–benefit training, and hands-on demonstrations can increase farmers' willingness to adopt and use solar-powered irrigation pumps. The project directly responds to the challenges revealed in baseline data: heavy reliance on rain-fed agriculture, high dependence on diesel pumps, limited awareness of solar alternatives, and severe financial exclusion, particularly for women.

Intervention components

The design combines three elements:

1. Information campaigns and cost–benefit training to raise awareness of the economic, technical, and environmental advantages of solar pumps compared to diesel and manual irrigation.
2. Live demonstrations and farmer testimonials, delivered in partnership with Africa Energy Solaire (AES), to provide practical, credible exposure to the technology.
3. Financing support mechanisms, introduced through the microfinance partner Graine, including pay-as-you-go options to address affordability concerns.

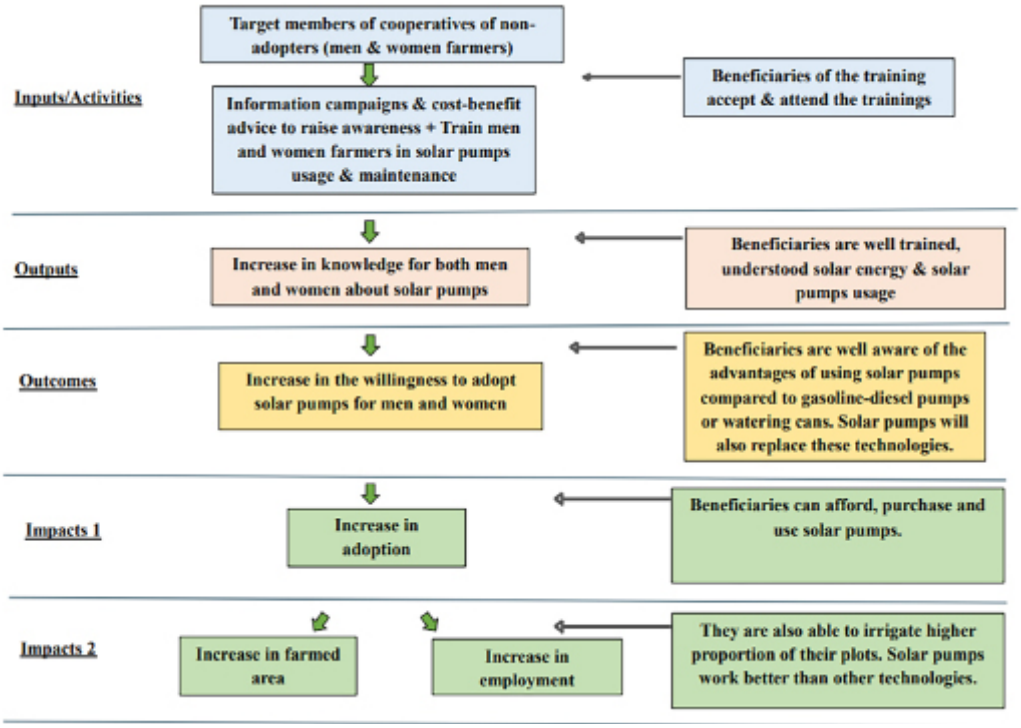
Theory of Change

The intervention logic is captured in the project's theory of change (Figure 1. Information campaigns and training are expected to increase farmers' knowledge and shift perceptions of solar pumps' viability. Demonstrations and peer testimonies strengthen trust and intention to adopt. Access to tailored credit allows farmers to act on this knowledge, overcoming affordability constraints. In the short term, this is expected to raise willingness-to-pay and intent to adopt among both men and women. In the longer term, increased adoption should improve irrigation reliability, expand cultivated land, and boost productivity and incomes, while reducing dependence on fossil fuels and advancing women's empowerment.

Experimental design

The study employs a stratified cluster-randomized controlled trial (RCT with cooperatives as the unit of randomization. A total of 1,748 farmers across 175 cooperatives in the Centre and Plateau-Central regions were selected, reflecting both high agricultural potential and low existing adoption of solar irrigation. Stratification was based on geography, cooperative size, and gender composition to ensure balance and allow subgroup analysis. Randomization at the cooperative level minimizes contamination within farmer groups.

Theory of change



Gender inclusiveness

Gender equality is integrated into both sampling and implementation. Cooperatives with different membership compositions (female-only, male-only, mixed were intentionally included, and training activities are designed to ensure women farmers are equally represented. Outcomes will be analyzed separately for men and women to capture heterogeneous effects, particularly on access to knowledge and adoption decisions.

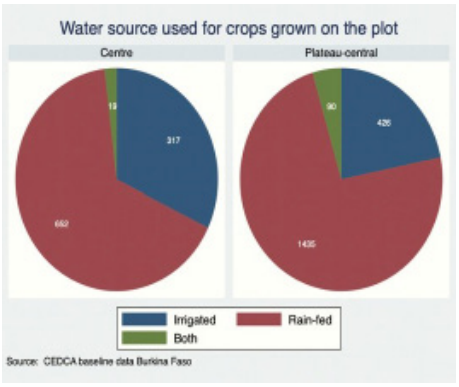
Baseline Insights

The baseline survey across the Centre and Plateau-Central regions highlights structural barriers and emerging opportunities for the adoption of solar-powered irrigation pumps. Four themes stand out: irrigation practices, awareness, technology preferences, and financial readiness.

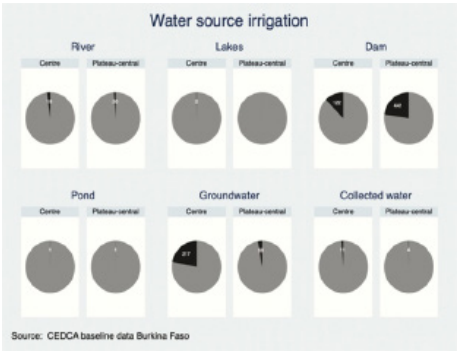
Workshop with stakeholders for the theory of change

Water use and irrigation practices

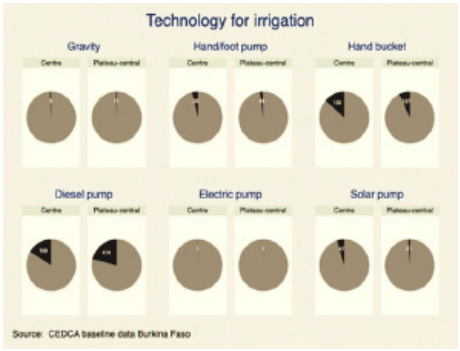
Crop production remains overwhelmingly rain-fed, with irrigation used only on a minority of plots. When irrigation is applied, dams are the dominant water source in both regions, with some reliance on groundwater in the Centre but almost none in the Plateau-Central. Farmers mainly use diesel pumps and hand buckets, while solar pumps are only beginning to appear (Figure: irrigation practices. This points to strong dependence on traditional methods and the early but promising emergence of cleaner options.



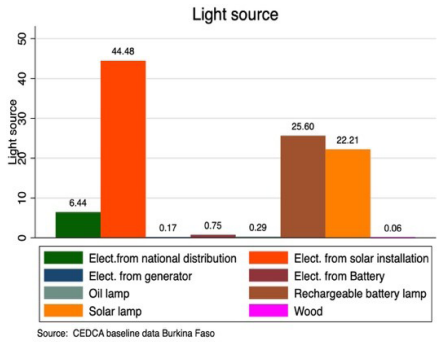
This figure provides an overview of the water sources used for crop production across the Centre and Plateau-Central regions. It shows that crops are predominantly grown under rain-fed conditions, followed by irrigation, and, to a lesser extent, through a combination of both rain-fed and irrigation practices.



This figure gives the sources of irrigation in the Centre and Plateau-Central regions. Dams constitute the primary source of irrigation in both areas. In the Centre region, a notable share of plots is also irrigated using groundwater, whereas in the Plateau-Central region, only a very limited number of plots rely on this source.



Here, this figure is about irrigation technologies. Diesel pump and Hand buckets are mostly used by farmers in both regions. It is important to note that a handful of farmers also use solar-water pumps in the Centre and Plateau-Central regions.



This figure shows that farmers use solar technology in their households. But it is essentially used for lighting.

Awareness gaps and technology preferences

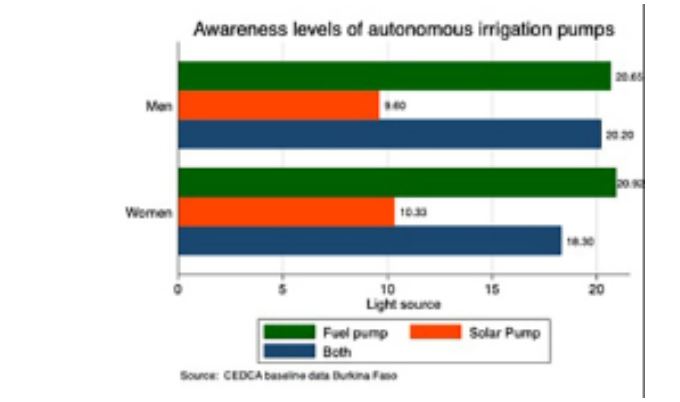
Awareness of solar pumps is strikingly low compared to fuel-powered pumps. Out of 1,104 respondents, only 9.6% of men and 10.3% of women knew about solar pumps, while over 20% were familiar with fuel-powered pumps (Figure: awareness of pumps. Yet, when farmers are aware of both technologies, preferences shift sharply toward solar: 38% of men and 43% of women preferred solar pumps, compared to just 10% of men and 3% of women preferring fuel pumps (Figure: preferences. This indicates a major information gap but also a strong latent demand for solar solutions once farmers are exposed to them, particularly among women.

Financial inclusion and savings behavior

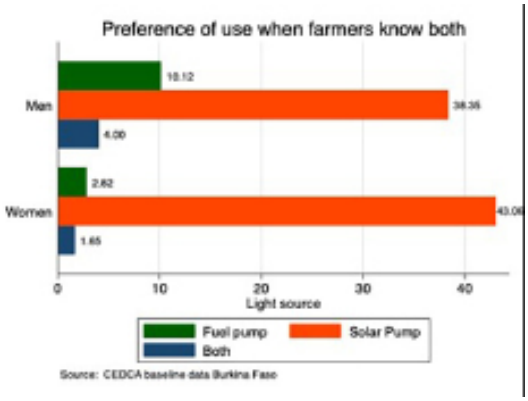
Access to finance is a critical barrier. Only 19% of surveyed farmers owned a bank or mobile money account, and men were more than twice as likely as women to do so (12% vs. 7%) (Figure: financial inclusion). Even among account holders, savings capacity was limited: only 54% reported savings, with men again more likely to save than women (Figure: savings behavior). These patterns reveal a dual challenge of widespread financial exclusion and low liquidity, especially for women. Without innovative financing mechanisms, adoption of solar technologies will remain constrained.

Implications for the intervention

The baseline validates the project's theory of change (Figure 1). Farmers face unreliable and costly irrigation, limited awareness of solar technologies, and weak financial inclusion. Yet once informed, they show a clear preference for solar solutions, with women emerging as especially receptive. These findings underscore the need for targeted information campaigns to raise awareness, complemented by tailored microfinance and cooperative-based credit schemes to overcome affordability barriers. The gender gap in financial access also highlights why explicit strategies to empower women farmers are critical for inclusive adoption.

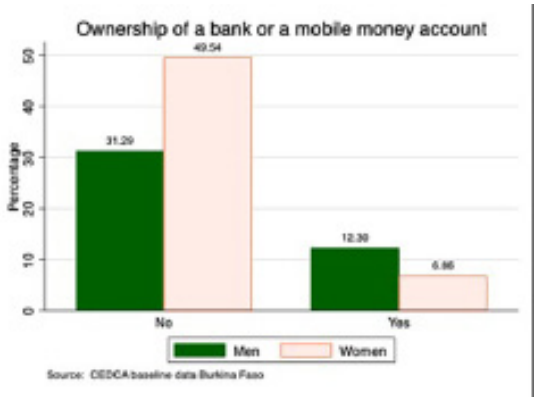


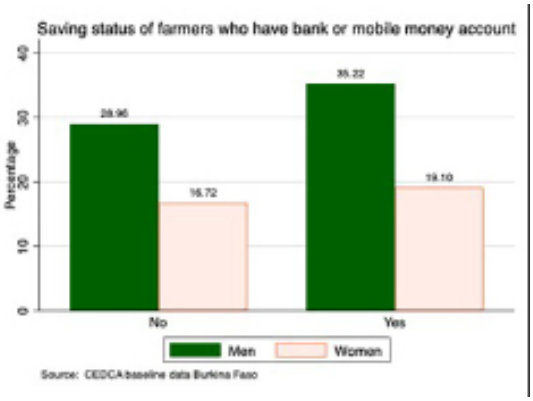
The figure summarizes farmers' awareness of solar and fuel-powered pumps, disaggregated by gender, based on a sample of 1,104 respondents (N=557 men and N=547 women). Among men, 20.65% know about fuel pumps, while 9.6% know about solar pumps. Among women, 20.92% are aware of fuel pumps and 10.33% are aware of solar pumps. Overall, awareness of fuel-powered pumps is roughly double that of solar-powered pumps for both genders. This highlights a significant information gap regarding solar irrigation technologies, suggesting the need for targeted awareness campaigns to promote solar solutions, especially if the intervention seeks to drive adoption of modern energy technologies in agriculture.



The figure presents farmers' preferences for using fuel-powered versus solar-powered pumps when they are aware of both technologies, disaggregated by gender. Out of 425 respondents (N=223 men and N=202 women), a clear preference emerges for solar pumps: 38.35% of men and 43.05% of women prefer using solar-powered pumps, compared to only 10.11% of men and 2.8% of women who prefer fuel-powered pumps. This indicates a strong latent demand for solar irrigation technologies, particularly among women, and suggests that adoption could increase significantly if barriers related to cost, access, and awareness are addressed.

Workshop with stakeholders for the theory of change





The figure summarizes farmers' ownership of bank or mobile money accounts, disaggregated by gender, from a total of 1,748 respondents (1,413 without accounts and 335 with accounts). 215 men (12.30%) own a bank or mobile money account, while 547 men (31.29%) do not. Only 120 women (6.86%) have an account, compared to 866 women (49.54%) who do not. Overall, just 335 respondents (19.15%) have access to financial services, whereas a vast majority, 1,413 respondents (80.85%), remain unbanked. This highlights a significant gender gap in financial inclusion, with men being more than twice as likely as women to own an account. Such disparities can limit women's ability to access credit or savings mechanisms, posing a potential barrier to adopting modern energy technologies like solar irrigation pumps.

The figure presents data on farmers' savings behavior, disaggregated by gender, based on a sample of 335 respondents (N=153 without savings and N=182 with savings). 118 men (35.22%) report having savings, while 97 men (28.96%) do not. 64 women (19.10%) have savings, compared to 56 women (16.72%) who do not. Overall, 182 respondents (54.33%) reported having savings, while 153 respondents (45.67%) do not. These results suggest a moderately positive savings culture among both men and women, with men more likely to save than women. This represents a potential financial barrier to investing in modern energy technologies like solar irrigation pumps, highlighting the need for innovative financing mechanisms to support adoption.

Planned Outcome Evaluation

The project will measure key outcomes to assess the impact of information campaigns and technological transfer on the adoption of solar-powered irrigation pumps. Primary outcomes include intent-to-adopt solar pumps (binary), knowledge of solar pump benefits (binary and composite index, 0-5), willingness-to-pay (continuous, in FCFA), and area farmed (hectares). Secondary outcomes encompass agricultural productivity (yield per hectare), net farm income, and women's knowledge on solar technologies to evaluate gender-specific effects.

Data were collected at both baseline (Primary and secondary outcome) and midline (Primary outcome except area farmed), and will be collected at endline (Primary and secondary outcome) using structured household surveys administered digitally, ensuring secure storage and quality assurance through daily monitoring and automated consistency checks. The study employs a stratified cluster-randomized controlled trial (RCT) with randomization at the cooperative level to minimize spillover bias, while stratification by geography, cooperative size, and gender composition enhances balance and precision.

Subgroup analyses will explore heterogeneous impacts, particularly across gender, cooperative type and region, enabling insights into barriers faced by women and less-productive farmers. The analytical framework relies on Intent-to-Treat (ITT) estimates to identify causal impacts. This rigorous design ensures credible, policy-relevant findings to inform strategies for sustainable solar pump adoption.

Next Steps

The project is moving into its next phase. Following the successful rollout of the training sessions completed in May 2025, we conducted the midline survey in July 2025. The team will prepare the survey instruments for the endline data collection in October 2025. The enumerators' training will be held in December 2025. Endline data collection is scheduled to begin in January 2026. This will allow us to rigorously assess changes in farmers' knowledge, willingness to adopt, and early adoption behaviors.

In parallel, engagements with policymakers are planned at both local and national levels to share preliminary findings and align them with ongoing government priorities, particularly the national push for irrigated agriculture and women's empowerment in farming. Cooperative leaders, AES, and Graine will continue to be involved to facilitate uptake, as farmers are expected to contact them if they are interested in purchasing a solar water pump.

Workshop with stakeholders for the theory of change

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