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Transitioning to Low-Carbon Agricultural-Technology Solutions

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Key messages

- This project examines how agricultural MSMEs can promote the adoption of low-carbon agricultural technologies among youth and women smallholder farmers in Kenya. The focus is on solar water irrigation pumps, which can reduce dependence on rain-fed farming, strengthen resilience to climate shocks, and improve agricultural productivity.
- Despite policy commitments to climate-smart agriculture, uptake of low-carbon technologies remains low. MSMEs face weak market linkages, and households—particularly those led by women and youth—confront barriers of awareness, affordability, and access to finance. To address these gaps, the study tests whether targeted information campaigns and training can stimulate adoption and empowerment. By comparing standard marketing with an enhanced approach that uses testimonials from existing adopters, the project will assess whether exposure to peer experiences shifts intentions to adopt.
- Findings will inform county and national policies, including the draft Green Fiscal Incentives Policy Framework (2023), and support MSMEs such as SunCulture to expand their outreach. The study ultimately seeks to generate actionable evidence on how inclusive transitions to low-carbon agriculture can empower vulnerable groups while contributing to Kenya's broader climate and development goals.

Anticipated Policy and Practice Relevance

This project is informed by four frameworks: (1.) A draft Green Fiscal Incentives Policy Framework (2023) which is still at the draft stage, (2.) National Climate Change Action Plan (NCCAP)-2018-2022, (3.) National Agriculture and Food Security Investment Plan (NAFSIP), and (4.) Kenya Climate Smart Agriculture Strategy (KCSAS).

The National Treasury and the 6 county governments corresponding to the locations of the study are likely to use this study's findings in aligning the draft Green Fiscal Incentives Policy Framework (2023). By raising awareness on low-carbon content ag-tech energy solutions and existing policies, this study bridges the information gap. A key hindrance to the effective transmission of government policy has been limited awareness of existing policies, and limited awareness of whom to go to with respect to smallholder farmer households' specific needs covered by the policies.

The second beneficiary is SunCulture, our implementing MSME partner. By raising awareness of SunCulture's solar water irrigation pumps, this study directly bridges the gap arising from limited information among women- and youth-led smallholder farmer households. These households are also the most likely consumers of ag-tech energy solutions once they are made aware of their availability and usefulness.

The third beneficiary is the Ministry of Youth and Enterprise Development which has been looking for evidence on what could be done to empower young people via climate smart agriculture within the Bottom-Up Economic Transformation Agenda (BETA).

One of the barriers to youth involvement in agriculture has been limited awareness of available ag-tech energy solutions. Thus, awareness campaigns will not only help smallholder farmer households to realize climate resilient agriculture but also meet the government half-way in realizing its youth empowerment targets.

We anticipate that, once awareness is widespread, financing access will be a matter of attracting state and non-state development financiers such as GIZ and EnDev alongside private capital investors/ lenders to smallholder farmer households, e.g., commercial banks' mkulima (farmer) loans who offer financing assistance for ag-tech energy solutions.

Co-creation and Stakeholder Engagement

The design of this intervention was shaped through a participatory process with MSMEs, policymakers, and researchers to ensure both contextual relevance and policy alignment.

In April 2024, the project research team organized a virtual workshop, convening two MSMEs (SunCulture and SolarNow) as well as government actors, including the Ministry of Co-operatives and MSME Development, the State Department for Planning and SDGs, and the State Department for Gender and Affirmative Action. Together, stakeholders assessed alternative intervention models—such as commission systems, targeted financing, and rent-to-own approaches—and agreed that targeted information campaigns were the most feasible and scalable solution. This decision anchored the intervention to be within project's theory of change, which identifies information and awareness as key barriers to adoption.

Subsequent engagements refined the approach. Policy partners were updated individually to maintain alignment with sector priorities, while collaboration with SunCulture's marketing and finance teams integrated testimonial-based marketing into the intervention. This marked a significant shift in SunCulture's strategy,

embedding business-training content within its outreach.

Local-level consultations further strengthened the design. County governments, where the intervention is being implemented, validated the approach and ensured recruitment strategies were inclusive of women and youth smallholder farmers. These inputs shaped the sampling frame and aligned the intervention with local agricultural priorities.

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Through this co-creation process, the intervention design reflects farmer realities, MSME capacities, and government policy objectives. It also secured early buy-in from key actors, positioning the findings for direct uptake in national frameworks such as the draft Green Fiscal Incentives Policy Framework (2023) and in county-level agricultural programs.



Solar Energy Irrigation System

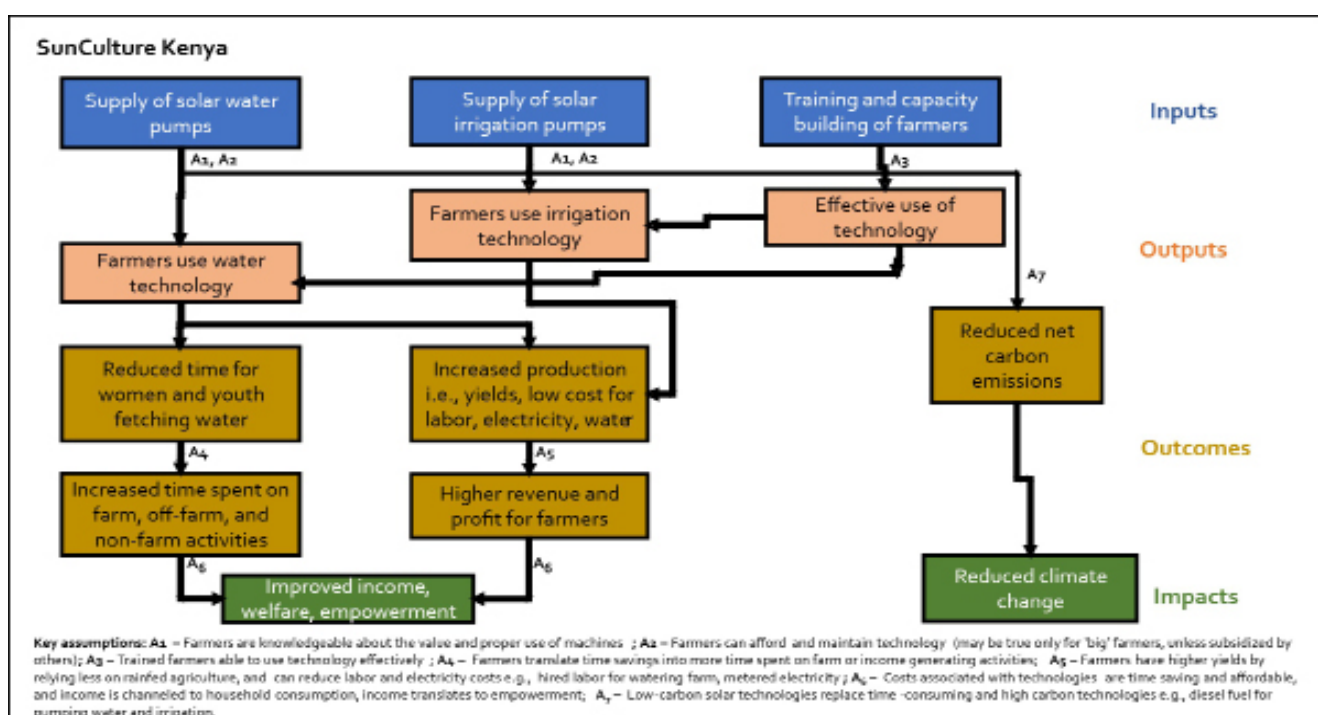
Intervention Design

This study tests two hypotheses: (1.) targeted informational awareness campaigns raise the intention to adopt low-carbon solar water irrigation pumps among youth and women smallholder farmers, and (2.) training and capacity building improve the welfare and empowerment of youth and women smallholder farmers who will later use solar water irrigation pumps.

To test the first hypothesis, we employ a quasi-experimental design whereby 400 yet-to-be-adopter smallholder farmer households are exposed to an enhanced marketing campaign, which we call “marketing +,” and; another 400 yet-to-be-adopter smallholder farmer households in our sample only receive “standard marketing”. In identifying the first 400 households, we first mapped out 399 households that are already using solar water irrigation pumps across six counties from SunCulture. We then identified, for each household, another household which closely resembles the already-adopters in terms of locality, gender of the household head, household's asset index, household size, and number of women and youth in the household. Since women and youth were underrepresented in this initial household survey we augmented it by including another 400 households which captured more women and youth.

Standard marketing is a door-to-door approach which SunCulture typically uses, and does not involve the use of testimonials from past consumers of its products. In the enhanced marketing +, we augment standard approach with pre-recorded 3–5-minute videos capturing experiences and testimonials of the existing already adopters of solar water irrigation pumps. These videos will be shown to 400 yet-to-be adopters on a smartphone or tablet at their homes as well as projected on a white board during focus group discussions. We believe that exposure to these experiences/ testimonials could shape decisions to adopt and use the technology among the yet-to-be adopters.

From various discussions and stakeholder engagements, we developed the theory of change applicable for SunCulture. These stakeholders included government officials and policymakers, SunCulture's senior leadership, select non-State actors, and scientific mentors from PEP. From the engagements, it was anticipated that agricultural-technology energy solutions adoption will have a positive impact such as increasing incomes, improving welfare, empowerment of farmers (especially women and youth), and reduced impacts of climate change. Using these impacts as described in the theory of change, suitable interventions that are consistent with the theory of change were co-designed.



Theory of change - SunCulture

Baseline Insights

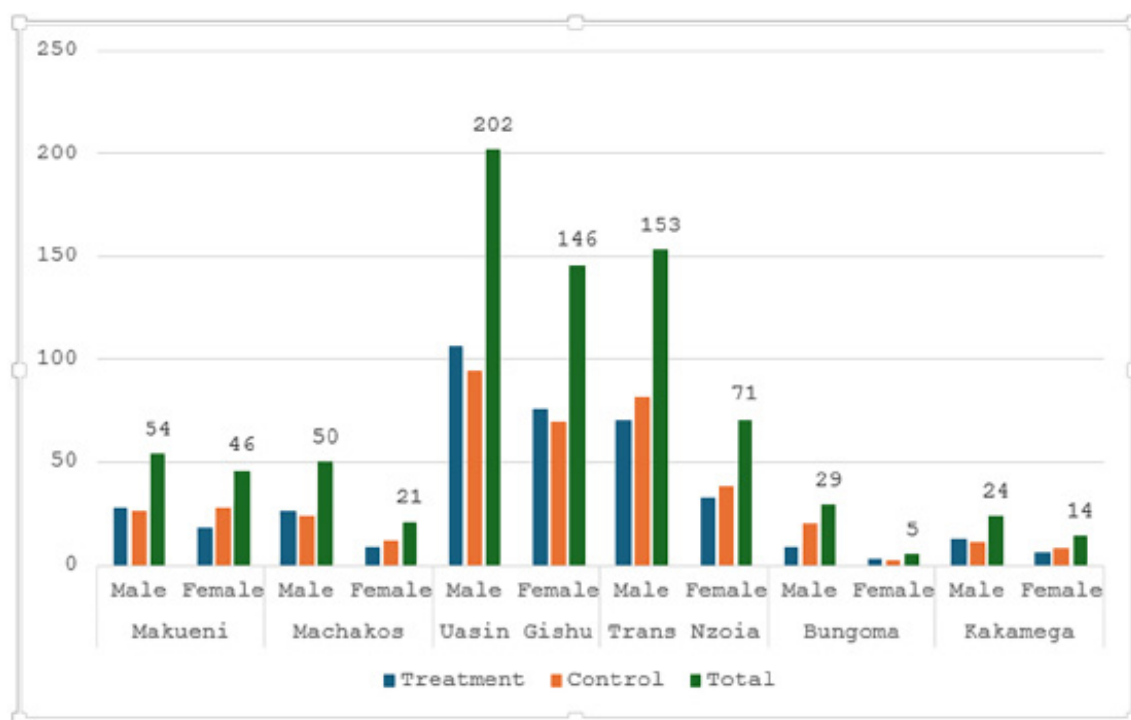
The baseline survey covered 815 smallholder farming households across six counties, including 399 that had already adopted solar water irrigation pumps and 416 that had not. The data highlight important patterns that inform the project's theory of change and the barriers to adoption of low-carbon agricultural technologies.

First, adoption is closely associated with household wealth. Adopters are significantly wealthier than non-adopters, indicating that affordability is a critical constraint. Importantly, this wealth disparity is not linked to proximity to markets, suggesting that the challenge is not primarily about physical access but about financial capacity and awareness. This finding reinforces the focus on information campaigns and highlights the need for complementary financing strategies to make technologies affordable to poorer households.

Second, gender dynamics are central. The survey was designed to capture perspectives not only from household heads but also from spouses and agricultural decision-makers. This allows for a deeper understanding of intra-household dynamics and empowerment. While the full analysis is ongoing, baseline evidence suggests that women and youth are underrepresented among early adopters, pointing to structural barriers in both access to information and decision-making power.

Third, the survey documents a low level of awareness of existing low-carbon technologies among yet-to-be adopters. Even where products such as solar water pumps are available, households are often unaware of their benefits or of financing mechanisms that could support adoption. This information gap reinforces the rationale for testing testimonial-based marketing campaigns as a way to shift perceptions and intentions.

Overall, the baseline findings suggest that adoption is constrained less by geography than by affordability, information gaps, and gendered barriers to decision-making. These insights sharpen the relevance of the intervention design: using targeted information campaigns, with explicit attention to women and youth, to test whether more inclusive and credible marketing strategies can drive uptake of low-carbon agricultural technologies.



Already-adopters and yet-to-be adopters at baseline by county and gender

Planned Outcome Evaluation

The intervention will assess adoption of solar pumps but will also have training and capacity building component using the “rainmaker parties” that will be used to demonstrate how the pumps are used. The outcome variables will be pooled but also disaggregated by gender following the adoption of SunCulture’s solar-powered irrigation systems. These outcomes will include changes in smallholder farmer household revenues, crop yields, time use allocation, and perceptions of climate risk and vulnerability.

Additional disaggregation will entail whether the decisionmaker on key spending within the household differs from the head; whether the household head is youth, woman, or both; whether each household member has control over a separate piece of agricultural land; and whether the land is owned or rented.

These findings will inform policymakers on ways to overcome barriers to adoption, that can be generalized to other technologies and interventions. We anticipate that smallholder farmer households will also learn about other interventions, e.g., e-voucher subsidy program under the National Agriculture and Food Security Investment Plan, and existing financing plans which SunCulture extends to its customers. As a result, awareness of existing technologies will be reinforced by knowledge on financing options which farmers can leverage in order to adopt low-carbon content ag-tech energy solutions. We further anticipate that our findings will inform the Green Fiscal Incentives Policy Framework (2023) which is still a draft. These findings will be instrumental in aligning this framework towards realizing the dual goal of empowering women and youth in agriculture at the county and national level, and contributing towards low-carbon content agriculture in Kenya.



solar energy powered waterwheel aerator

Next Steps

The team has finalized the testimonial-based video clip—developed jointly with SunCulture—featuring model farmers from two counties. This video will be used as part of the intervention.

The evaluation will now be implemented with a sample of approximately 800 participants allocated to three groups: (i) a pure control group receiving no treatment; (ii) a group exposed only to the enhanced marketing approach (“rainmaker parties”); and (iii) a group exposed to both the enhanced marketing and the video clip.

Due to the ongoing rainy season in Kenya, the rollout is planned for the second week of January, when field conditions will allow for proper implementation.



Solar Energy Water Pump

This document presents progress and preliminary analytical insights from the project Leveraging Renewable Energy MSMEs for Sustainable Agriculture in Sub-Saharan Africa and Southeast Asia (SSA and SEA). The authors acknowledge the valuable guidance of CEDCA Scientific Advisors — Marc Jeuland, Martine Visser, Amin Karimu, Brais Álvarez Pereira, Gallina Vysotskaya, Francesca Marchetta, and Jorge Dávalos — and extend special thanks to Bipasha Baruah (IDRC) for her continued support.

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