



Transitioning from Diesel Dependency to Inclusive Solar Pumping Services: Transforming Livelihoods in Battambang

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Purpose:

This case study was developed as part of the Nurture Project's interim evaluation to document key achievements and lessons learned from the implementation phase.

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1. Introduction

Nurture Project Overview

Nurturing Climate Resilience in Cambodia (Nurture) is a four-year collaborative initiative among HEKS/EPER, Caritas Switzerland, the Ministry of Water Resources and Meteorology (MOWRAM), and the General Directorate of Agriculture (GDA). Co-financed by the Swiss Agency for Development and Cooperation (SDC), the project strengthens the climate resilience of smallholder farmers (SHFs)

through three interventions: local water governance; policy and planning on climate adaptation; and climate-resilient agriculture and market development. By enabling private-sector actors and farmer organizations to adopt and scale commercially viable, climate-resilient practices, Nurture facilitates improved decision-making, productivity, and market access for vulnerable rural households.

Intervention Scope

Under its local water governance framework, the Nurture project partnered with EGE (Cambodia) Energy Solutions Co., Ltd. to introduce a transformative 60 HP solar-powered irrigation system in Kdol Tahean Commune, Bavel District, Battambang Province. Departing from traditional interventions that transfer equipment ownership to farmers, who often lack the technical capacity for long-term maintenance,

the initiative pioneered a sustainable "pay-per-use" service model to ensure operational efficiency and reliable water delivery. By facilitating this private-sector partnership, Nurture is transitioning local rice production from a high-cost, weather-dependent activity into a predictable, year-round commercial enterprise that enhances productivity and climate resilience.



Floating pumping solar system in Peam village, Kdol Taken commune, Bavel district, 2023 ©EGE Cambodia

2. The Context: The "Diesel Trap" and Climate Vulnerability



Farmers competed to pump water using fuel pumping machine in Peam village, Kdol Taken commune, Bavel district, 2023
© EGE Cambodia



Farmers competed to pump water using fuel pumping machine in Prey Khpos commune, Bavel district, Bavel district, 2023
© Nurture Project

Battambang is Cambodia's rice bowl, yet smallholder productivity has historically been constrained by high operational costs and climatic variability. For the SHFs of Kdol Tahean Commune, the proximity of the Bavel River offered a perennial water source, yet access to it was a financial burden. Prior to the project interventions, farmers relied almost exclusively on diesel-powered pumps to irrigate their fields. This dependency left them vulnerable to fuel price volatility and high operational costs, with average per-hectare costs reaching USD 124 in the first season (April/May – August/September) and USD 79 in the second season (August/September – December/January).

These high costs, together with irregular rainfall and seasonal droughts, pushed many farmers into a cycle of low productivity. Most were limited to a single rice cycle per year, with modest yields, and nearly one-third of the community earned a thin profit margin of less than USD 500 in the first season. Overall, weak community-level water governance, labor-intensive irrigation practices, and increasing climate variability constrained productivity and resilience. Nurture identified this as a systemic barrier. To build true resilience, the project addressed the underlying market constraints to irrigation access by supporting more affordable, climate-resilient irrigation solutions.

Box 1: Core Challenges

- **High Costs:** Farmers relied on individual diesel pumps. Irrigation costs averaged USD 124/ha in the first season and USD 79/ha in the second.
- **Low Intensity:** Unreliable water access limited farmers to a single cycle per year, with average yields of 3.1 tonnes/ha.
- **Climate Risks:** Increasing frequency of floods (Oct–Nov) and droughts (Jun–Jul) made traditional pumping economically risky.
- **Economic Insecurity:** Approximately 30% of farmers earned less than USD 500 in the first season, with diesel price volatility often erasing profit margins.
- **Environmental Damaging:** Traditional irrigation was labour-intensive and environmentally damaging (CO2 emissions).

3. The Intervention: An Innovative "Pay-per-Use" Service Model

Through this partnership, EGE Cambodia and Nurture co-invested USD 140,932 and installed a system capable of delivering water directly to fields through a managed network. Under this model, farmers were no longer required to own, fuel, or maintain irrigation systems. Instead, they paid a predictable service fee: USD 75 per hectare in the first season and USD 37.5 in the second. This shift from an "asset-heavy" to a "service-based" approach effectively removed the financial risk for SHFs, allowing them to treat irrigation as a reliable utility.



Deep-well solar panel installation for irrigation in Peam Village, Kdol Taken Commune, Bavel District, 2023 © EGE Cambodia



Solar pumping station supplying irrigation from the mainstream to sub-canals, Peam Village, Kdol Taken Commune, Bavel District, 2023. © EGE Cambodia

Partners and Roles

EGE Cambodia designed, installed, and operated the system, while Nurture facilitated community engagement and supported governance arrangements. The community committee managed water scheduling and fee collection, with oversight from local authorities. EGE Cambodia conducts rigorous testing to ensure system compliance and deliver high-quality services.

Beyond Technology: The Role of Governance

The success of the solar pumping station depends as much on community cooperation as on photovoltaic technology. To ensure equitable water distribution, EGE and the Nurture team established a governance program that empowered a local community committee to manage water scheduling and fee collection. This structured approach resolved long-standing water governance issues and ensured that even the smallest plots received adequate irrigation. Furthermore, the governance initiative raised community awareness of the system's economic and environmental importance.

To maximise the investment, EGE Cambodia designed the system as a multifunctional energy hub. When the pumps are inactive, the solar panels generate electricity for secondary services, such as battery-charging stations and grain grinders. This diversification not only provides additional value to the community but also strengthens the business case for EGE, ensuring that the private-sector partner remains incentivised to sustain the system beyond the project's initial support.

Box 2: The Business Model

- **Partnership:** The USD 140,932 investment capital was shared (70:30) between EGE Cambodia and Nurture.
- **User Fee:** Farmers paid a significantly lower service fee than diesel costs - USD 75/ha (first season) and USD 37.5/ha (second season).
- **Governance:** Local community empowered to manage water scheduling and fee collection.
- **Asset Ownership and Management:** EGE retained ownership and responsibility for technical Operations & Maintenance (O&M) for the first nine years. Once the Return on Investment (ROI) is achieved, fees will be reduced to cover only ongoing O&M, and the community will own the system.
- **Energy Optimisation:** To maximise the energy efficiency, EGE integrated secondary services, including battery charging and grain grinding, creating additional value for the community.

4. Results and Systemic Impact



Ry Saran, a 43-year-old farmer, standing in her rice field which is now irrigated by a solar water pumping system in Peam Village, Kdol Taken Commune, Bavel District, 2024 © EGE Cambodia

The transition from diesel to solar has yielded positive results at the outcome level. Reliable access to water enabled farmers to increase their cropping intensity from one to two cycles per year. With more water available at a lower cost, 56% of farmers adopted dry-season cultivation, a practice previously considered too expensive.

The data indicate significant improvements: average yields per cycle increased from 3.16



Farmers harvest paddy rice in Peam village, Kdol Taken commune, Bavel district, 2024 © EGE Cambodia

to 3.94 tonnes per hectare. When combined with the ability to plant more frequently, total annual yields increased more than twofold, rising from 4.10 to 8.71 tonnes per hectare. For more than 40% of participating households, this translated directly into higher, more stable incomes and the ability to withstand the shocks of climate change. Thus, the transition to solar-as-a-service yielded immediate and transformative results for the participating farming households.

Table 1: Immediate and Transformative Results

Indicator	Pre-Intervention	Post-Intervention
Water Access	Unreliable & diesel dependent	84% reported reliability improvements
Cropping Intensity	1.4 cycles/year	2.21 cycles/year
Average yield (Tonnes/ha)	3.16	3.94
Annual Yield (Total; Tonnes/ha)	4.1	8.71
Irrigation Cost	Volatile	Stable

Social and Governance Gains

The intervention established a community committee to manage scheduling and fee collection. This has improved local water governance and increased women's participation in decision-making on resource allocation.

Box 3: Stakeholders' Perspectives

- "... before the project intervention, farmers relied on expensive, labor-intensive diesel pumps. The transition to solar power has not only lowered expenses but also reduced the physical burden of irrigation. It has also saved time, reduced pump noise, and lowered maintenance requirements, while creating an environmentally friendly environment." – **FWUG Representative, Bavel District.**
- ".... more importantly, women are now taking an active role in water management, ensuring a more inclusive and efficient farming environment." – **FWUG Representative, Bavel District.**

5. Lessons Learnt

The experience in Kdol Tahean has provided the Nurture project with a blueprint for scaling climate-resilient agriculture to other potential areas. The primary lesson is that technology alone is insufficient; it must be paired with robust local governance and a market-driven service model that minimises upfront risks for the poor.

While the intervention showed that high-capacity solar irrigation is a viable alternative to diesel, it also highlighted that technical innovation must be grounded in environmental governance. To mitigate the risk of overextraction and protect downstream communities, Nurture facilitated critical coordination between EGE Cambodia and the Provincial Department of Water Resources and Meteorology (PDWRAM). This ensured the system was relocated to a perennial water source

and operated in accordance with guidelines. Furthermore, the project demonstrated that private-sector partners like EGE Cambodia require more than capital; their success depends on business mentoring and strategic community facilitation. Nurture bridged the gap between EGE's technical solutions and the community's social dynamics, building the institutional trust needed to adopt a new service model.

Box 4: Key Lessons Learnt

- **Service Over Ownership:** The “Pay-per-use” model removes the barrier of high upfront costs, making solar irrigation accessible to even the most vulnerable smallholder farming households without the burden of equipment maintenance.
- **The PPP Synergy in Governance:** Bridging the private sector with Farmer Water User Communities (FWUCs) creates a more resilient management model than community-only systems. A robust FWUC must complement solar irrigation to focus on its core mandate of equitable water distribution.
- **Holistic Resource Use:** Utilizing excess solar energy for secondary purposes (e.g., battery charging, grinding) strengthens the business case for the private-sector provider, ensuring long-term commercial viability.
- **Strategic Feasibility and Environmental Compliance:** The project's willingness to relocate the system from an initial unsuitable site to a perennial water source (Bavel River) saved the investment from potential failure.
- **Private Sector Partners Need Business Support:** Beyond technical capacity, providers like EGE Cambodia require business mentoring, access to finance, and support to bridge the gap between technical solutions and community-level adoption.

6. Sustainability and Ways Forward

The pay-per-use irrigation model supports long-term commercial and environmental sustainability by stabilising irrigation costs, reducing farmers' exposure to fuel price volatility, and eliminating the carbon footprint associated with fuel use. After the ROI period, service fees are expected to decline to cover only O&M costs. To mitigate the risk of an extended ROI period, the model focuses on maximizing system utilization, including potential secondary energy uses to accelerate recovery. This financial strategy is reinforced by community-led governance through the Farmer Water User Group, which ensures long-term operational stability.

Box 5: Key Commercial and Environmental Sustainability

- **Financial Sustainability:** The fee-based structure ensures funds are available for major repairs, system upgrades, and long-term private-sector viability without further donor subsidies.
- **Institutional Synergy:** A collaborative framework between EGE Cambodia, local authorities, and the community ensures transparent cost-and-benefit sharing. This "win-win" model secures a stable market for the private sector while delivering the reliable, low-cost infrastructure necessary for long-term community economic growth.
- **Scalability:** EGE Cambodia is currently validating performance data to seek further financing for a province-wide scale-up.
- **Environmental Impact:** By replacing diesel pumps, the project significantly reduces the carbon footprint of rice production in Battambang, aligning with Cambodia's climate goals.

The Kdol Tahean Commune case serves as a demonstration site for replication. It proves that climate-resilient technology, when delivered through a market-based service model, can increase farmer incomes while building long-term environmental resilience. By aligning the incentives of private providers with the needs of SHFs, the Nurture project demonstrates that sustainable, carbon-neutral irrigation is not merely an environmental goal but a cornerstone of economic prosperity in rural Cambodia.



The solar panels installed in Peam village, Kdol Tahean commune, Bavel district ©EGE Cambodia



Sub-canal irrigation supplied by a solar pumping station in Peam Village, Kdol Tahean Commune, Bavel District, 2024 ©EGE Cambodia



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