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LINKING AGRICULTURE AND ENERGY IN CAMBODIA

This series of case studies is part of a project to emphasise the energy-agriculture nexus in smallholder and small-scale commercial farming.

SMALL-SCALE COMMERCIAL VEGETABLE FARMER

Province: Takeo

Farmers' ID card

Number of farms: 3
Name: Mrs. Sophea, Mrs. Khat Saem, and Mrs. Seng Sarang
Access to grid electricity: since 2016
Total land owned: 0.5 to 0.9 ha each
Main source of income: vegetable production
Industry segment: cucumber
Production capacity: 6-8 tonnes/cycle
Production cycles per year: 4 cycles
Duration of each cycle: 2.5 months

The three women, Mrs. Sophea, Mrs. Khat Saem and Mrs. Seng Sarang started to grow vegetables in 2015, which soon became their main source of income. They sell more than 90% of their production to Lors Thmey, an iDE-established social enterprise and keep less than 10% for their own consumption.

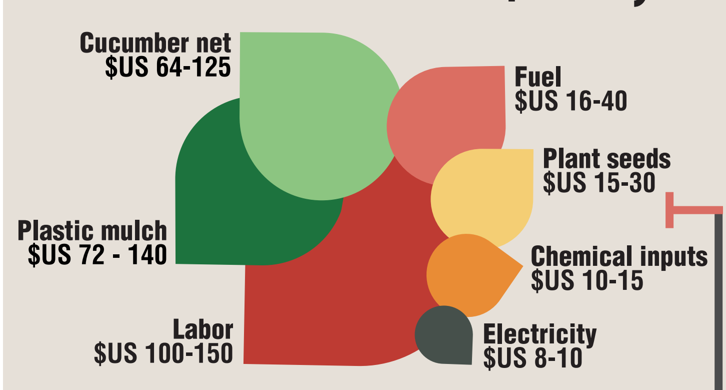
Context

Cucumbers are one of 13 priority crops in Cambodia. In Takeo, the cucumbers are easy to produce and can be harvested 4 times per year with each cycle lasting 2 to 2.5 months. In rural areas of Cambodia, firewood, charcoal and fuel-based energy are the main sources of energy for most households. Sustainable alternatives to traditional cooking energy sources, chemical fertilisers and irrigation systems including biodigesters and solar water pumps are presented in this case study.

Earnings & expenses

By production cycle, each farmer can produce 6 to 8 tonnes of cucumber, which they sell at $US 0.30 per kilogram. They earn up to $US 2,200 net profit each production cycle, and $US 8,800 annually, using renewable energy technologies, biodigesters and solar pumps with drip irrigation system. Cucumbers require consistent watering, fertilisers application, sunlight and good soil conditions. Expenses are thus related to the irrigation practices, crops' protection, agricultural inputs (fertilisers, pesticides), labor cost during the harvesting period and fuel used on and off-farm.

The farmers' expenses splitting (per cycle)



Today, the three farmers' biggest expense is on the wages of their workforce. Before switching to renewable energy, chemical fertilisers accounted for one of the biggest part of their operating expenses, representing between $US 60 to $US 135 per cycle depending on their use and land size.

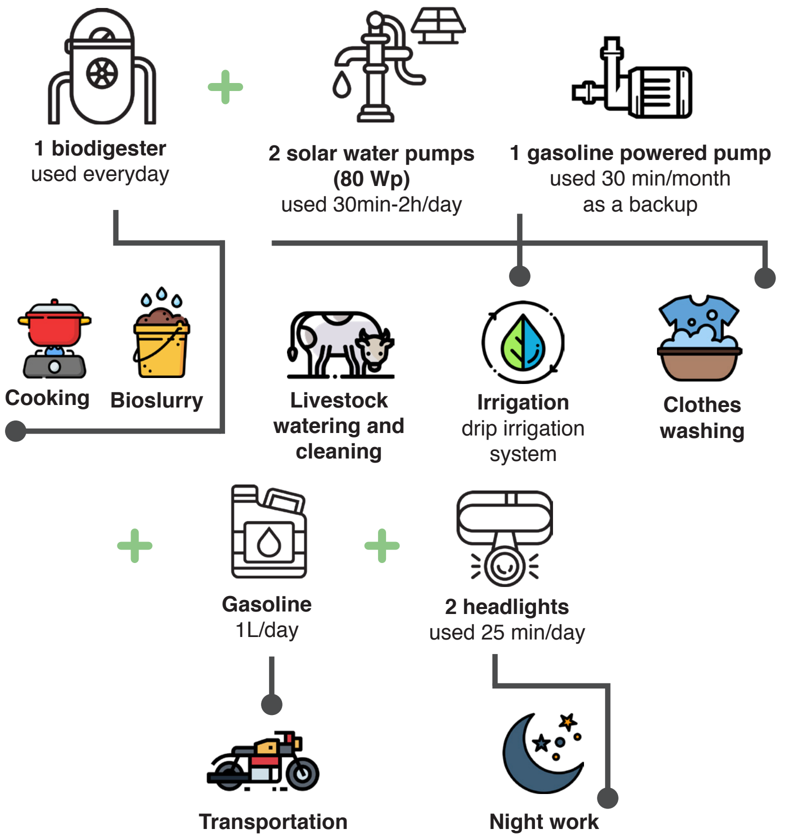
≈ $US 160 per year

energy-related expenses for vegetable farming

**The maintenance cost and initial investment of all energy equipment are not included in the calculations, nor are the domestic expenses.*

Zoom in: Three farmers' energy profile

Mrs. Sophea, Mrs. Khat Saem and Seng Sarang are uncommonly well-equipped with renewable energy-based technologies. They each have one biodigester, and two solar pumps driving drip irrigation system. Their main expenses are transportation to buy fertiliser and pesticides, electricity and gasoline for their backup water pump. They keep using it a few times per month, when there is not enough sun or when cultivated land needs to be drained in rainy season.



"In the future, I see myself increasing my land to produce more vegetables. I will also have a better life with more money."

Mrs. Sophea

"With the progress done within my farm, I hope my children will be able to study, increase the size of my farm and build a new house."

Mrs. Sarang

"The savings that I will get using renewable energy will be used for my kids. I will support them until they finish university. We could also build a new house, increase our land and have a chicken farm."

Mrs. Saem

Farmers' challenges for adoption

Adoption of renewable energies by farmers in Cambodia is still limited due to 3 main factors:

Lack of awareness: low levels of knowledge and understanding of renewable energy technologies

High upfront cost: it accounts between 6% and 8% of yearly revenue

Lack of financing solutions: limited access to the existing solutions:
- End-user financing from company
- Loans from MFIs
- Innovative financing solutions (*e.g.* CERF from Nexus for Development)
- Loans from NGOs

Even if some financing solutions exist, they are not largely spread and access to them is difficult and limited for farmers that lack collateral and present solvability risks.

& long-term usage of renewable energies

Cambodia faces substantial inadequacies in after-sales service for renewable technologies. According to some farmers' testimonies the main challenges related are:

- No contact number of technical support
- Difficulty to get technical repair on faulty systems

For long-term usage these techologies need to come with customer training, hotline, and reliable maintenance and repair system. For example, ATEC offers a 2-year warranty for their biodigester, after-sales service and guarantee a 25 year life span.

Zoom in: The biodigester

Since 2006, the National Biodigester Programme (NBP) in collaboration with SNV has promoted more than 24,000 small biodigester systems. Since then, other actors (e.g. ATEC) have emerged and are selling more advanced version of this technology. Cow dung put within the biodigester is partly converted into biogas, a clean renewable cooking and lighting fuel and the remainder, a bio slurry, is used as an organic fertiliser for the vegetables (cucumber, morning glory and watermelon). Among the three farmers, Sophea has benefited from NBP in 2006 and decided to start using an 4 m³ underground biodigester while the two others, after seeing the success from neighboring farms, decided to try the ATEC open-air biodigester systems (2 to 4 m³).

Shifting to the biodigester

BEFORE Traditional practice	AFTER Biodigester
Firewood 3-8 kg (free) + Liquefied petroleum gas (LPG) 0.2lb ($5/month) OR Kerosene and car battery ($5.5/month)	Cow dung 12-24 kg per day (ATEC's system) 30-40 kg per day (NPB's) (free)
=	=
Gas & heat used for cooking & boiling	Biogas & bioslurry used for cooking, boiling & as fertiliser
5 - 6h to cook everyday	1 - 3h to cook everyday
$US 60 of initial investment	$US 600 of initial investment
	Return on investment (ROI): 1.5 to 2 years (ATEC)

"The main advantage of using the ATEC biodigester is the money we save, it's safer to cook and we get a good quality of fertiliser."

Mrs. Seng Sarang

- Health preservation from not burning firewood
- Permanent switch to organic manure
- CO_2 eq. emission reduction

3-5h saved on cooking everyday by switching to improved cooking systems

≈$US 500 savings per year with the biogas & bioslurry

- High upfront cost
- Tiresome and time-consuming process of collecting dung

Small biodigester model examples

NBP	ATEC
	
	+ Easy to install, off-the-shelf and flood resistant system

Zoom in:
The solar water pump & drip irrigation system

Cucumbers need to be watered on a regular basis with an appropriate irrigation system. Traditionally, the three farmers were using gasoline powered water pumps with a traditional irrigation system and spending US$ 60 on fuel per cycle for a similar investment cost. The switch to solar pump systems with drip irrigation system results in a saving of $US 50 per cycle, which helps recover the initial investment cost after three years. However, the three farmers still rely on gasoline powered pumps as a back-up solution to fertilise, apply pesticides and drain the cultivation land (3L per month vs 2L/day before).

BEFORE

Traditional pump + traditional irrigation system

$US 60-100
of initial investment

Used 30 min - 1h/day

AFTER

Solar pump + drip irrigation system

$US 600
of initial investment

Used 30 min - 2h /day

Return on investment (ROI):
3 years

and the gasoline powered pump now used as a back-up 30 min/month

The three farmers are using two solar pumps, one from FuturePump (India) of a capacity of 900L/h, a solar panel's wattage of 80W and another one from EcoSun (Cambodia) of similar capacity. Micro-irrigation systems (drip systems) have been introduced to the farmers in order to bring an improvement in irrigation water use efficiency. The farmers are quite satisfied with the solar pumps but face some issues with operation during rainy season and maintenance.

$US 50
savings per cycle by reducing gasoline expenses

CO2 emission reduction

10%
Improved yield due to drip irrigation system

Reduction of water use

Which opportunities for the farmers?

Promoting solar-powered irrigation systems (SPIS) coupled with better market information, micro-irrigation systems (sprinkler, drip system) and the use of a water tank would represent a high-potential renewable-based technology for irrigation. For high-value crops that require a lot of water and for niche markets, the SPIS would bring enough added-value compared to a fuel powered irrigation system. Providing energy supply security (with a storage solution), access to credit and further capacity-building training are however critical to convince the farmers to adopt the technology and change their irrigation practices.

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