

SECTOR BRIEF · AGRICULTURE, FISHERIES AND ENERGY

Where Solar Pays

Energy costs and solar entry points across 15 agri-fisheries value chains in Cambodia's Tonle Sap region

2020 baseline · lessons from 12 programmes

Prepared by Sevea under SWITCH to Solar, implemented by People in Need and funded by the European Union and the Czech Development Agency.

Most of the value leaves Cambodia before it is added

The question for a programme is not "where can we install panels?" but "which step of which chain stays abroad, or is lost, because energy is too expensive or unreliable at farm and village level?" This brief answers it chain by chain.

Raw

exported for most crops

Value is added in Thailand and Vietnam

For most crops, Cambodia exports raw or semi-processed products. Drying, sorting, processing and packing happen across the border. This holds for rice, cassava, cashew and mango, and the informal cross-border channels are often better organised than the formal ones.

15–20%

of rice processing costs go to energy

Energy weighs exactly where value is added

Processing, drying, storage and cold chain are the energy-intensive steps. Where farmers and small processors cannot afford reliable energy, they sell unprocessed.

25–40%

of vegetables damaged after harvest

What is not processed or stored is lost

Without drying and cold storage close to farms, part of the harvest never reaches a buyer.

The case for solar

Solar is a way to keep value at home, not only a cheaper kilowatt-hour: it brings drying, storage and processing within reach of farms and villages.



Cooking on a wood fire. Most rural households still rely on traditional biomass for energy.

Who this brief is for: designers of agriculture, energy and climate programmes, development partners, agri-processing companies and the financial institutions that lend to them.

Where solar fits in 15 value chains

Solar entry points at each stage. Supply and trade are left out: across all 15 chains, the energy used there is mostly transport fuel, where solar was not a relevant option in 2020.

Value chain	Production	Collection and storage	Processing
CROPS			
Rice	Solar water pumping for dry-season irrigation	**Solar drying** of paddy at village level	Milling (energy 15–20% of processing costs)
Cassava	—	**Solar drying** of fresh cassava and chips	Chopping, **drying**, grinding; waste management
Cashew	—	**Solar drying** of in-shell nuts	Drying, shelling, peeling, grading (mostly done in Vietnam)
Corn	Solar water pumping, against drought	**Solar drying**, against losses and aflatoxins	Threshing, feed processing
Mango	Solar water pumping	—	Hot water and vapour heat treatment for export
Vegetables	Solar pumping, greenhouses, hydroponics	Solar cold storage, evaporative cooling	—
Melon	Solar pumping for drip irrigation	—	—
Rubber	—	—	**Solar dryers** for smokehouses and air-drying
FISHERIES AND AQUACULTURE			
Fish catch	—	Solar cold storage at landing sites	**Solar drying** and smoking
Fish farming	Solar aerators and pumps	Solar cold storage	**Solar drying** and smoking
Frog	—	Solar cold storage	**Solar drying**
Crocodile	—	—	Skin removal (technology still immature)
LIVESTOCK			
Poultry	Solar egg incubators	Solar cold storage for meat and vaccines	**Solar drying** of meat
Cattle	Solar feed grinders	Solar cold storage for meat and vaccines	**Solar drying** of meat
Pig	Solar feed grinders; piglet breeding	Solar cold storage for meat and vaccines	**Solar drying** of meat

11 of 15
chains where drying is a solar entry point

7 of 15
where cold storage is one, mostly fish, meat and horticulture

Dry season
when irrigation pumping matters most for crops

Crops

Rice: the largest chain, where drying and milling decide competitiveness

IN FIGURES

8.1 Mt

of paddy in Cambodia on about 3.5 million ha (2017)

~1/3

of national production from the Tonle Sap provinces: 2.6 Mt on 1.2 million ha

2.2 / 3.25 t/ha

wet and dry season yields, national averages

- Most farms are 0.5 to 1.5 ha and hire tractors and harvesting services.



Rice mill, Battambang, 2022

How the chain works

Smallholders sell paddy to village collectors and traders, who supply small, medium and commercial mills. Fragrant rice is exported to the EU, China and ASEAN countries. Much of the paddy also leaves informally for Thailand and Vietnam, where the value is added. Women are key actors at every stage, from transplanting and harvesting to trading and managing mill finances.

Where energy weighs

- **Milling and processing:** energy is 15–20% of processing costs.
- **Irrigation:** on average about 6% of the total cost of rice.
- **Drying and storage:** few dryers and little storage at village level, so quality is lost before milling.

Where solar fits

- Solar drying of paddy at village level, to preserve quality before milling. → **Solar dryer**
- Solar water pumping for dry-season irrigation. → **Solar water pump; case study on irrigation companies**

What solar does not solve

Dependence on rainfed farming, access to quality seed, weak links between producers, cooperatives and millers, no warehouse receipt system to use stock as collateral, and working capital for millers. A programme that adds solar without working on these constraints will not move the chain.

Sources: NIS Commune Database 2017; SWITCH to Solar value chain identification (Sevea, 2020). Figures are a 2020 baseline.

Crops

Cassava: a large export crop, sold before it is processed

IN FIGURES

515,000 ha
of cassava in Cambodia (2014)

2.8 Mt
from about 197,000 ha in the Tonle Sap provinces (2017)

1.8 Mt
from Battambang alone

- Planted February to April, harvested 6 to 12 months later depending on the land.



Cassava field, Kampot

How the chain works

Farmers and plantations sell fresh or chopped and dried cassava to collection centres, traders and middlemen. Processing firms turn it into dry chips, pellets and starch. Most of the crop is exported, formally to China and informally to Thailand and Vietnam, whose agro-industry is far more advanced. Women prepare planting material and play a large part in trading and in managing the businesses.

Where energy weighs

- Chopping, drying, peeling, grinding, washing and dewatering, done with small machinery and sun-drying on open floors.

Where solar fits

- Solar drying of fresh cassava and chips, to preserve quality before processing. → **Solar dryer**
- Energy for small-scale processing, where processing exists in Cambodia.
- Waste and effluent management, a recognised environmental problem of cassava processing.

What solar does not solve

Soil depletion and unsustainable practices, the absence of research and extension for cassava farmers, the lack of price information, and competition from Thai and Vietnamese processors. The value stays abroad until there is a processing industry in Cambodia, and that depends on more than energy.

Sources: NIS Commune Database 2017; SWITCH to Solar value chain identification (Sevea, 2020). Figures are a 2020 baseline.

Crops

Cashew: three quarters exported raw

IN FIGURES

200,000 t

in shell from about 154,000 ha in Cambodia (2017)

116,000 t

from about 42,000 ha in the Tonle Sap provinces (2017)

~3/4

of production exported raw, mostly to Vietnam

- Almost all Tonle Sap cashew is in Kampong Thom (about 37,000 ha).
- First crop after 3 to 4 years, full production at 7; harvest February to April.



A dryer being built by a local manufacturer, visited for SWITCH to Solar, 2021

How the chain works

Smallholders with 1 to 2 ha of orchard sell in-shell nuts to middlemen and traders. About three quarters of the production is exported raw to factories, mostly in Vietnam. The rest is dried, which lets it be sold at any time of year. Cashew kernels, the high-value product, are processed abroad.

Where energy weighs

- Drying of in-shell nuts.
- Processing (drying, steaming, shelling, peeling, grading, roasting), mostly done in Vietnam.

Where solar fits

- Solar drying of in-shell nuts at collection level, to preserve quality, protect from pests and extend shelf life. → **Solar dryer**
- Energy for processing, if processing is brought into Cambodia.

What solar does not solve

A long, poorly organised chain with many collectors, little research and extension, a lack of skilled workers for processing, price volatility and a lack of market data. Bringing kernel processing home needs factories with quality systems; energy is one input among many.

Sources: NIS Commune Database 2017; SWITCH to Solar value chain identification (Sevea, 2020). Figures are a 2020 baseline.

Crops

Mango: a known variety, sold below its value

IN FIGURES

116,000 ha

cultivated in Cambodia, 47,000 ha harvested (2017)

60,000 t

from about 18,000 ha in the Tonle Sap provinces (2017)

58,000–139,000 t

exported in 2019: official figure and estimate including informal trade

- Keo Romeat is 90% of production.
- About 15% is sold on the domestic market.



Portable solar water pump, Battambang, 2022

How the chain works

Farmers often lease their trees to contractors, who manage production, flower induction and harvest on 2 to 5 farms each. Collectors and traders sell most of the crop to Vietnam and Thailand, from where it is re-exported at a higher price. In 2020, only one facility in Cambodia had the vapour heat and hot water treatment needed to export to China and Korea.

Where energy weighs

- Heat treatment for export compliance.
- Processing into dried, frozen or juice products.
- Irrigation.

Where solar fits

- Solar water pumping for irrigation, including off-season production. → **Solar water pump**
- Hot water treatment, assessed as a medium-maturity technology already present in Cambodia.

What solar does not solve

Excessive use of chemicals that blocks phytosanitary compliance, incomplete knowledge of off-season flower induction, poorly organised formal export chains, and no Cambodian brand for Keo Romeat. The step that would change the price is quality treatment and packing for strict markets, which needs investment and certification as much as energy.

Sources: NIS Commune Database 2017; SWITCH to Solar value chain identification (Sevea, 2020). Figures are a 2020 baseline.

Crops

Vegetables: high losses, a domestic market still supplied by imports

IN FIGURES

530,000 t

from about 58,000 ha in Cambodia (2019)

~1/3

of the vegetable area in the Tonle Sap region (2013 census)

25–40%

of vegetables damaged after harvest

- The Tonle Sap region grows 69% of the country's tomatoes, 56% of its lettuce and 48% of its pumpkins.
- 99% is sold in Cambodia; imports still cover about a third of consumption.



Hydroponic vegetable production

How the chain works

Mobile collectors buy in villages, fixed collectors in markets, and both sell to wholesalers and retailers. Most farmers work at subsistence level, a few at commercial scale. Women do much of the field work and most of the selling. The government actively supports domestic production to reduce imports, and an organic standard and logo were introduced in May 2020.

Where energy weighs

- Irrigation, particularly in the dry season.
- Storage to reduce post-harvest losses.

Where solar fits

- Solar water pumping for irrigation. → **Solar water pump**
- Solar cold storage at collection and distribution points, which can extend freshness from about 2 to 21 days. → **Solar cold storage**
- Solar greenhouses and hydroponics for controlled, year-round production. → **Solar hydroponics**

What solar does not solve

Small farm size, access to quality seed, weak knowledge of the quality standards buyers expect, and limited use of market information. Cold storage only pays where volumes are aggregated, which requires organised collection.

Sources: Census of Agriculture 2013; SWITCH to Solar value chain identification (Sevea, 2020). Figures are a 2020 baseline.

Fisheries

Fish catch and processing: a large resource under pressure

IN FIGURES

625,000 t

captured in Cambodia (2014), five sixths of the country's fish production

75%

of the inland catch from the Tonle Sap river and lake (2015)

80%

of women in the sector work in buying, selling, processing and marketing

- Commercial fishing lots were abolished in 2012 and replaced by community-managed fishing areas.



Fish drying, Siem Reap province, 2021

How the chain works

Large, middle and small-scale fishers sell to landing site operators, collectors and processors. Much of the catch is sold fresh; the rest is dried, smoked or fermented into fish paste (prahok), mostly for the domestic market. Small-scale processing is largely run by women.

Where energy weighs

- Drying, smoking and fermenting, done with small machinery and the sun.
- Keeping fish fresh between landing and market.

Where solar fits

- Solar fish drying and smoking kilns, which also free processors from the limited space available for sun-drying. → **Solar dryer**
- Solar cold storage at landing sites, where the quality of the catch deteriorates quickly. → **Solar cold storage**

What solar does not solve, and what it could make worse

Fish abundance has fallen with the open-access regime, illegal fishing, dams and habitat loss. Cheaper processing can increase pressure on a declining resource. Programmes should check that solar processing reduces losses and improves hygiene, including the use of insecticides in small-scale drying, without raising catch.

Sources: SWITCH to Solar value chain identification (Sevea, 2020), from FAO and Fisheries Administration data. Figures are a 2020 baseline.

Aquaculture

Fish farming: fast growth, still dependent on imports

IN FIGURES

260,000 t

of freshwater aquaculture (2018), up from about 39,000 t in 2010

6,400 / 2,700

ponds and cages in the Tonle Sap provinces (2014)

120,000 t

of fish imported from Vietnam and Thailand (2017)



Equipment on a fish pond, 2021

How the chain works

Smallholder low-input ponds, semi-intensive ponds run by small businesses, and floating cages (pangasius, snakehead) supply collectors, processors and retailers. Commercial fish farming depends on feed, seed and veterinary supplies imported from Vietnam and Thailand. Women are most of the retailers and collectors, but are under-represented in leadership and policy.

Where energy weighs

- Maintaining water quality and oxygen in ponds, and pumping.
- Post-harvest drying and storage.

Where solar fits

- Solar aerators and air-blowers for ponds, hatcheries and nurseries, to raise productivity and reduce mortality. → **Solar water aerator**
- Solar water pumping for ponds. → **Solar water pump**
- Solar cold storage and drying after harvest. → **Solar cold storage; Solar dryer**

What solar does not solve

Dependence on imported inputs, disease (epizootic ulcerative syndrome), access to credit to dig ponds and buy seed, the absence of producer organisations, and competition from Vietnam on low-cost species. Demand for local, safe fish is the opportunity; aeration is a productivity tool, not a market strategy.

Sources: SWITCH to Solar value chain identification (Sevea, 2020), from Fisheries Administration and NIS data. Figures are a 2020 baseline.

Livestock

Poultry: smallholders, high losses, a clear solar case for incubation

IN FIGURES

16.3 M

chickens raised for sale in Cambodia (2017)

27%

of them in the Tonle Sap provinces: 4.5 M chickens, plus 2.2 M ducks

~13 months

payback of a solar egg incubator, for smallholder and commercial farmers

- Smallholders account for more than 85% of production (2015); local chicken is 20–30% of sales.



Cricket farming at the Agri-House demo site, SWITCH to Solar

How the chain works

Smallholders keep from a few hens to a few hundred broilers; semi-commercial and commercial farms raise hybrid breeds with concentrated feed. Village collectors and provincial wholesalers supply markets, restaurants and processors. Ducks are raised mostly for eggs, often alongside rice.

Where energy weighs

- Incubation of chicks and ducklings.
- Slaughter, and storage of meat and vaccines.
- Transport, where losses are high.

Where solar fits

- Solar egg incubators, to reduce energy costs and mortality. → **Solar egg incubator**
- Solar cold storage for meat and vaccines. → **Solar cold storage**
- Solar drying of processed meat.
- Adjacent opportunity: a solar cricket incubator, with a payback of 1 to 2 years. → **Solar cricket incubator**

What solar does not solve

Poor-quality feed, disease, the lack of contracts that leaves producers without bargaining power, price instability and losses during transport.

Sources: NIS Commune Database 2017; SWITCH to Solar value chain identification (Sevea, 2020) and technology brief (2021). Figures are a 2020 baseline.

Thirty solar applications assessed, ten retained

16
Production
Irrigation, mobile pump, PV and water heaters on ponds, greenhouse, grow room, aerators, floating farm, grinder, hydroponics, egg and cricket incubators, feeders, ventilation

4
Harvest
Crop cutter, fish-head cutting machine, skin removal, cricket catcher

3
Post-harvest
Cold storage, evaporative cooling, hot water dip

7
Processing
Crop dryer, fish smoking kiln, fish dryer, sugarcane juicer, oil press, coconut scraper, maize thresher

Each was rated on maturity, presence in Cambodia, price, complexity and fit with the needs of the value chains, then scored against criteria agreed with experts from ministries, solar companies and similar projects: affordability, ease of use, time and labour saved, payback against lifespan, maintenance, local availability of parts, use by women, environmental impact and scalability, among others.

15 value chains → 30 technologies → Scoring with experts → 10 in-depth analyses

The ten retained for in-depth analysis

Technology	Main value chains	In our public studies
Solar water pump	Rice, vegetables, fruit, aquaculture, pig	Two-page sheet available
Solar dryer	Horticulture, cattle and pig, aquaculture	Two-page sheet available
Solar cold storage	Horticulture, fish, meat	Two-page sheet available
Solar cooling system (evaporative)	Livestock, horticulture	—
Solar egg incubator	Poultry	Two-page sheet available
Solar cricket incubator	Insects	Two-page sheet available
Solar grinder	Livestock feed	Two-page sheet available
Solar water aerator	Hatcheries, nurseries, fish ponds	Two-page sheet available
Solar hydroponics	Horticulture	Two-page sheet available
Solar smart farm appliances	Horticulture, rice	—


Diesel pump, Siem Reap province, 2021

Sources: SWITCH to Solar rapid assessment (Sevea, 2020) and technology brief (2021).

Six lessons for anyone designing a programme today

Before designing SWITCH to Solar, we reviewed twelve agriculture and fisheries programmes in Cambodia: PADEE, ASPIRE, AIMS, S-RET, Harvest II, CHAIN, CAPAC 1 and 2, CAPFish Capture and CAPFish Aquaculture, TSTD and TSSD.

1 **Adoption happens in groups, over at least two production cycles.**

Technologies were adopted when farmers practised them together, with a technician, and refined them with demonstration farmers before scaling.

2 **Farmers learn by seeing other farmers.**

Demonstrations work when combined with face-to-face support and a mix of media; mobile phones proved effective for sharing information.

3 **Service centres need a revenue model.**

Extension and service centres with no business plan and no income beyond their operating costs did not last. Those located where there was real demand did better.

4 **Link farmers, traders and finance from the start.**

Most programmes worked on one link of the chain; the absence of linkages between farmers, traders and financial institutions limited scaling.

5 **Build gender, climate and environment in from the outset.**

Not as add-ons. Plan also for the varying capacity and limited time of local authorities.

6 **Energy was the missing piece.**

Almost none of the programmes considered the role of solar and renewable energy in agri-fisheries technology and value chains.



Participatory workshop on energy

6 · DESIGN CHECKLIST

Before you fund or design a productive-use solar programme

Gender

- Understand land tenure, gender roles, and which crops and steps women control.
- Favour technologies that save time and labour, cost less, and do not require land ownership.
- Expect adoption to be gendered: monitor use, make promotion groups inclusive, involve women in maintenance.
- Men are often the gatekeepers of women's access: show the household what it gains in money and time.

Batteries

- Check battery capacity and life cycle against the actual use, for business or household.
- Plan collection and recycling at end of life.
- Optimise self-consumption of the system's energy.

Resilience and environment

- Check that solar actually reduces the use of biomass and forest resources.
- Check that it does not increase pressure on water or other natural resources.
- Monitor use after adoption, not only installation.

7 · ABOUT THIS WORK

This brief draws on the market analysis Sevea carried out in 2020 for SWITCH to Solar (2020–2024), a 2.6 million USD programme implemented by People in Need and funded by the European Union and the Czech Development Agency. The analysis followed four steps: identifying 15 agri-fisheries value chains around the Tonle Sap; rapidly assessing 30 solar technologies against them; scoring them with experts and stakeholders; and analysing the 10 most promising in depth.

Sevea has worked on Cambodia's transitions since 2011, with governments, development partners and businesses, in agriculture, energy, water, finance and climate.

To go further: our SWITCH to Solar technology sheets and case studies, and our sector, market and value chain studies.
Talk to us: contact@seveaconsulting.com · www.seveaconsulting.com