

Case Study
Irrigation Companies

Analysis of the energy usage and solar applicability of two irrigation companies in Kampong Thom Province.

December, 2021

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1 FWUC – Dam of Rolous

The Dam of Rolous FWUC was founded in 2014 with support from the Cambodia-Australia Agricultural Value Chain Program (CAVAC) project, funded by Australia Aid. This farmer cooperative has a licence to provide irrigation to an area of 440 hectares, 334 of which are rice paddies. However, over the years the number of members and the area irrigated by their service has been reduced to about 180 to 200 ha per season today. According to the cooperative, this decline in use is caused by the surrounding private competition, as well as by their difficulty in irrigating their entire licence area, especially in the dry season.

Table 1. Main characteristics of the FWUC.

Location	(12.6969483, 104.840912) Ou Kantor Commune, Stoeung Sen District, Kampong Thom Province
Status	Farmer cooperative
Water source	Stung Sen River
Licence surface	334 ha
Members	226 households
Product	Paddy rice (OM 54-51) – Two seasons per year
Pumping power source	Grid electricity
Employees	4 people

The main activity of the cooperative is to operate and maintain the pumping station and its irrigation canals. Water is pumped from the Stung Sen River and then conveyed to the paddy fields in the irrigation canals.



Figure 1. Cooperative building *(left)* **- Stung Sen River** *(right)*.

Pumping is carried out by 5 large electric pumps[1]; the water is pumped over 12 meters. The pumps are supplied by three-phase power supply; the pumping station is connected to the medium voltage grid and has its own transformer. The station also is equipped with a capacitor bank to compensate for the low quality of the local grid and to avoid damage to the pump motors (*correction for power factor lag and phase shift in the AC power supply).*

[1] The power of the pumps could not be collected during the interview - estimated at 10-20 hp per pump.

Initially, the pumps were automatically controlled in order to maintain a certain level of supply in the canals. Today they are controlled manually, two are used primarily for the rainy season, and three for the dry season.



Figure 2. Pumping station *(left)* - Pump outlets *(right)*.

The licence zone can be simplified as follows:



Figure 3. Overview of the licence zone.

Table 2. Licence zone characteristics (2016).

Village	# plots	Surface (ha)	# HHs	# family members
O'Kanthor Tbong	349	24.3	148	598
O'Kanthor Cheung	6	0.6	4	21
Prek Sbov	22	2.2	15	66
Boeung Lias	70	5.6	42	189
Mixed	23	1.2	17	68
Total	**470**	**33.9**	**226**	**942**

Within its licence area, the FWUC has a significant floodable reservoir. When the cooperative was set up, the CAVAC project recommended not pumping water to the reservoir, stating that evaporation and ground absorption would cause too great a loss. However, the cooperative now uses it regularly in order to store water, have an additional buffer, and reach the furthest plots. Without this, they risk running out of water regularly. In addition, some farmers utilise the surface of the reservoir to grow more rice than their land title would allow. This further complicates the work of the cooperative, which has been unable to solve this problem.

The FWUC operates two types of canals:

- **Traditional canals**, dug straight in the ground. Farmers have to pump water to their fields by their own means, usually making use of their personal diesel or gasoline pumps or connecting a pump head to their tractor.
- **Concrete canals.** More efficient and sophisticated concrete cased canals. Steel and concrete gates can be opened manually to flood surrounding plots without needing pumps[2].



Figure 4. Traditional canals *(left)* - Concrete canals *(right)*.

The tariff paid by user farmers is proportional to the surface area they irrigate. To ensure fairness among members, a premium is applied to farmers who can flood their fields via the concrete canals without having to use their personal pump.

Table 3. Tariffication of irrigation contribution.

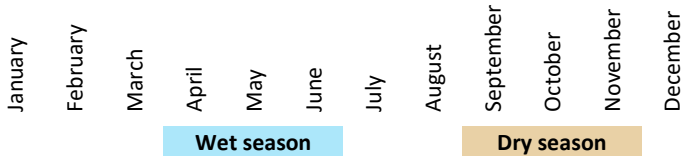
Tarif for farmers who need to pump themselves to their plot	$ 80 per hectare per season
Tarif for farmers making use of the flooding gates	$ 110 per hectare per season

[2] Farmers on the most remote plots still have to use their pumps.

The payment of contributions for each season is supposed to be made 50% before seeding the fields, and 50% after harvest. In reality, and for cash flow reasons, a majority of members prefer to pay everything at harvest time. Collection of payments can be challenging, with many households avoiding payments or paying late. The cooperative staff need to follow up and collect door to door.

Depending on their practices and on their exact location, farmers may start and end cycles at different moments. The frequency and amount of pumping required roughly follows these windows and varies depending on the weather. Overall the two seasons last 3 to 4 months and can be described as follows:

Table 4. Main rice seasons.



Farmers in this area produce OM 54-51 rice, which is sold to Vietnam. Yields average 5 tonnes of paddy rice per hectare per season. One kilogram of paddy rice is sold for 700 KHR. This means that the payment of the irrigation contribution represents close to 10% of their turnover.

The expenses of the cooperative are divided into four parts:

- **Employee incentives**: the 4 employees of the cooperative receive an allowance for their work, which varies from 290$ per season to 390$ per season depending on their position.
- **Administrative expenses**.
- **Maintenance of the pumps and the electrical system**. The cooperative has a preventive maintenance contract of $ 2,500 per season, exclusive of repair costs.
- **Electricity**. The pumps run almost continuously for 2 months each season. They consume a significant amount of energy, up to 40,000 kWh per month. The pumping station pays $ 0.165 per kWh (tariff *"Commercial, administration and other consumers connected at MV"*). The expenses per season are about $ 4,000 per month in wet season, and $ 6,000 per month in dry season.

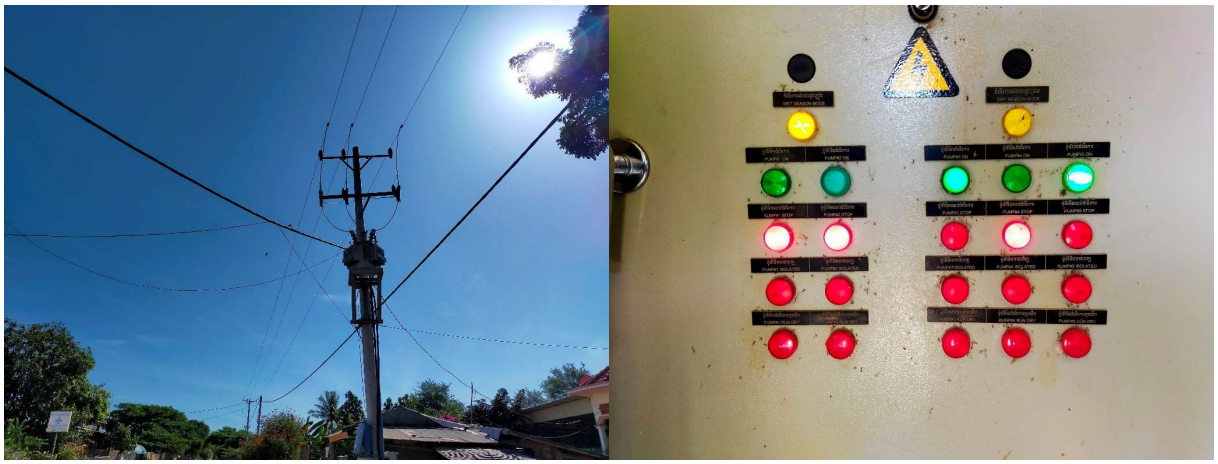


Figure 5 Transformer of the pumping station *(left)* - Main electrical panel for pumps control *(right)*.

The cooperative shared a sample cash flow report from the 2019-2020 wet season:

Table 5. Example cash flow from wet season 2019-2020[3].

Total area irrigated	202.45 ha
Area irrigated with flooding gates	*29 ha (15%)*
Area irrigated with personal pump	*172 ha (85%)*
Total # households	108
Revenue	
Total contribution collected	$ 17,059
From area irrigated with flooding gates	*$ 3,166 (18%)*
From area irrigated with personal pump	*$ 13,894 (82%)*
(Contribution still to be collected)	*$ 123*
Other income (farming, services)	$ 105
Total revenue	$ 17,041
Expense	
Cooperative management allowance	$ 2,170
Office expenses	$ 914
Electricity consumption (pumping station)	$ 6,660 *(40,279 kWh)*
Electricity consumption (office building)	$ 59 *(316 kWh)*
Total expense	$ 9,803
EBITDA	**$ 7,238**

Key highlights

- This cooperative has already been approached about ten times by STPs offering them to install grid-tied solar systems. Obstacles include the lack of space, and the difficulty of establishing an adequate financing model.
- Despite their licence granting them a monopoly over their area, the cooperative suffers heavily from competition from private irrigation companies providing irrigation services through their own canals surrounding their licence zone.
- Pumping is concentrated over 4 months a year and takes place 24 hours a day, further complexifying to pay back a grid-tied solar installation.
- Almost all farmers own and have to operate their own diesel pumps to ensure the irrigation of their plots from the cooperative's canals.
- Cooperative members seem to have difficulty with the use of the pumps, the electrical installation, as well as the planning of water needs.
- The Provincial Department of Agriculture, Forestry, and Fishery (PDAFF) can force the Cooperative to halt the pumping if they estimate there is a risk of lack of water.

[3] 1 USD = 4000 KHR assumed.

2 CWE - Prey Kuy Commune

The community water enterprise of Prey Kuy Commune was founded in 2016. This private company has a licence provided by the Commune to provide irrigation to rice paddies covering an area of 300 hectares.

Table 6. Main characteristics of the FWUC.

Location	(12.706160,104.947815) Prey Kuy Commune, Kampon Svay District, Kampong Thom Province
Status	Private company
Water source	Stung Sen River
Licence surface	300 ha
Members	200 households
Product	Paddy rice– Two seasons per year
Pumping power source	Diesel
Employees	3 people

The main activity for this CWE is to maintain and operate the pumping station. The three employees are in charge of the operations as well as monitoring the farmers' water needs.

A single 3-year-old 140 hp diesel engine is used to pump water from the Stung Sen River to the canals, some ten metres above.



Figure 6. Main building of the pumping station *(left)* **- Diesel pump** *(right)*

During the production seasons (October to December and April to May), the pump runs about 3 days out of 4 almost continuously. This leads to significant operating costs:

- 800 bidons of 30 litres of diesel per season, accounting for nearly $20,000 per season.
- Three maintenance sessions per season, where the engine is transported by truck to a local workshop, for a total cost of $ 300 to $ 500 per season.



Figure 7. The main pump engine *(left)* **- A worker clearing diesel bidons** *(right)*.

This station supplies approximately 12 km of traditional canals, which are partly owned by the station and partly by a local NGO. The CWE is in charge of maintaining the canals by making use of excavators. The 200 households in the licence area pump water to their home plots by their own means. To ensure the operation of the pumping station, a payment of **$ 90 per hectare per season** is required from the households. Payments are undertaken after harvesting.



Figure 8. A local irrigation canal.

Based on the data collected during the interview, the cash flow of a season can be estimated as follows:

Table 7. Estimated cash flow for a season of operation.

Total area irrigated	200 ha
Total # households	300
Revenue	
Total contribution collected	$ 27,000
Total revenue	$ 27,000
Expense	
Salaries *(estimate)*	$ 2,500
Engine maintenance	$ 400
Diesel consumption	$ 20,000
Total expense	$ 22,900
EBITDA	**$ 4,100**

Key highlights

- The pumping station has access to the low voltage grid. A diesel engine pump was preferred nevertheless to any electrical alternative when the station was set up.
- The pump is particularly noisy and bulky, its operation seems physical and technically challenging.
- Despite the high environmental and financial cost of a pumping station like this one operating with a high-capacity diesel engine, the potential to replace this use with solar powered electric pumps, especially with a grid-tied approach, seems particularly low. Indeed, strong constraints exist, such as (i) a necessary total replacement of the pump and the investment in a complete electrical installation (ii) the lack of access to the three-phase MV grid in order to ensure the necessary power (iii) a lack of space (iv) a difficulty to ensure a return on investment with a highly seasonal use of energy.

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