Lao
Institute for
Renewable
Energy




Shared Pico-hydropower

Shared Pico-Hydropower in Long District, Luang Namtha Province

Report # 120510-HYDRO-FR-021

May 2012

Vientiane

Lao Institute for Renewable Energy (LIRE)

Progress Report
120510-HYDRO-FR-021

Shared Pico-Hydropower In Luang Namtha Province

Report for Norwegian Church Aid (NCA)

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10th May 2012

Vientiane, Lao PDR

About us

LIRE is a non-profit organisation dedicated to the sustainable development of a self sufficient renewable energy sector in the Lao PDR. The institute offers agronomical, technological and socio-economic research services, and works to provide a free public resource of information and advice on the use of renewable energy technologies in Laos. LIRE strives to support the development of the country by exploring commercially viable means to establish renewable energy technologies in rural parts of the country, in areas without connection to the national grid and with little access to technical expertise.

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1 Introduction

This project will see the installation of pico-hydro electricity systems in 2 – 3 villages in Long District, Luang Namtha Province, Laos. These systems will be communally owned, with village technicians responsible for operating the system, and a village committee responsible for managing the system operation and accounting. The project has 4 main phases:

1. Pre-feasibility study – briefly visiting each village in the target area to assess whether it would be possible to install pico-hydro systems.
2. Feasibility study – a more detailed look at a few selected villages to speak to the villagers about the project in depth and take all design measurements required.
3. Design and procurement – designing systems and ordering the necessary equipment.
4. Installation – putting the system into the village and training the villagers on its proper use and maintenance.


Some of the transportation used

2 Pre-feasibility visit

Between December 2011 and February 2012 a 3 person team from LIRE visited 23 villages in Long District, Luang Namtha Province, with the aim of assessing their potential for pico-hydro electricity systems. The visits were spread over two trips, each lasting eight days (including travel time) and supported by NCA staff.

When visiting the villages some characteristics were common to many of them: most had some sort of existing pico-hydro system, there were usually one of two ownership models (though sometimes a combination of the two), and most households spent a lot of money to access electricity.

Pasod (left) and Phatea Mai (right)

2.1 Existing pico systems

Recent access to cheap Chinese products has allowed villages with a small water source to install pico-hydro turbines over the last 2–4 years (though some systems have been in place for up to 10 years). Turbine sizes range from around 500–1000 W, though they often run significantly lower than their rated capacity. For example, in most villages some lights must be switched off in order to use a television.

The turbines are generally low quality and need replacing every 1–2 years. Bearings need replacing 1–8 times every 2 months (again, due to the low quality of the bearings, but also due to misalignment in the turbine). On top of this, transmission is usually though unsuitable wire and can often be over distances of 2 km or more. This results in the loss of up to 50% of the generated electricity. Since there is no voltage control, villagers must replace their light bulbs up to twice a week. All of the above results in costly and highly inefficient systems.

2.2 Ownership models

Systems are generally shared between 5–7 households, though there are some cases where only one household will be using a system, and others where around 20 households will be using a system. The systems are either communally owned, or privately owned. When systems are communally owned everyone is responsible for the capital and maintenance costs. Privately owned

systems are usually owned by one person who collects a monthly fee (usually 0.63–1 USD) from each household using electricity from the system. The owner is usually responsible for capital and maintenance costs, as well as maintenance work. These privately owned systems are almost never operated as profit making businesses (in fact most make a loss), rather, they exist to provide the owner with a small amount of money in exchange for excess electricity produced. Sometimes excess electricity is shared in exchange for support (either financial or labour) maintaining the system.

System at Aiseng (left) and canal at Chakhansene (right)

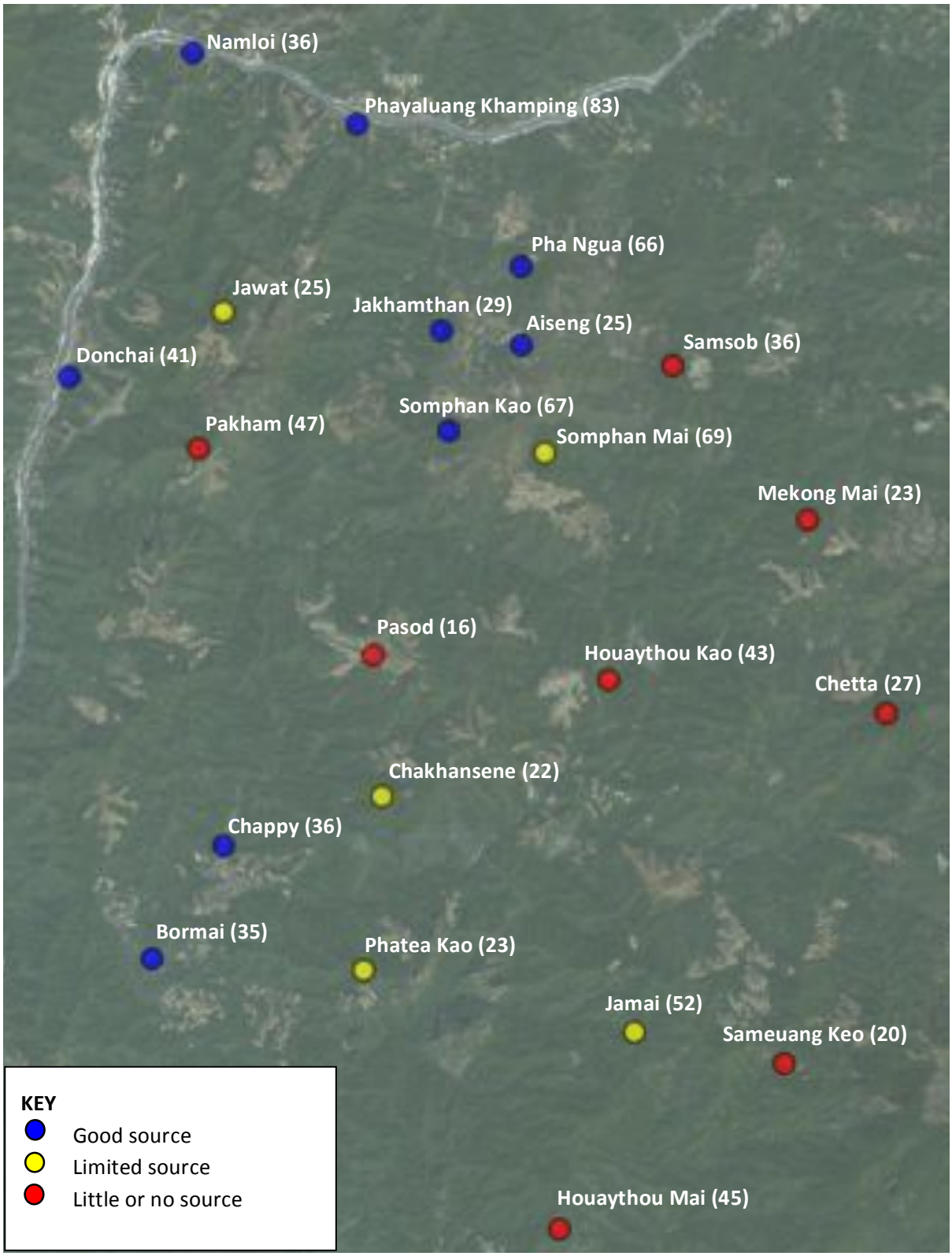
2.3 Capacity to pay

The poor quality of existing systems means households usually pay a considerable amount to use electricity. CFL light bulbs cost between 0.63–0.88 USD each, new bearings between 1.25–12.5 USD depending on quality, and pico-hydro systems between 65–125 USD. For a communally owned system shared between six households, each household could expect to pay around 40 USD each year to use low quality electricity. Furthermore, a lot of this money is exported to China rather than remaining in the hands of local traders, manufacturers, or service providers.

2.4 Outcome and selected villages

The map below outlines the suitability of the visited villages' streams for pico-hydro system installation. Out of 23 villages, 9 had streams with good enough potential for pico-hydro systems, 5 had reasonable streams, and 8 had poor potential. After the pre-feasibility visits were over, a meeting between NCA and LIRE was held to establish 4 sites for a detailed feasibility study. These sites were:

1. Bormai – this village has a large, low head, stream source.
2. Donchai – this village has easy access to construction materials.
3. Aiseng – with the potential for a high head system.
4. Subloi high school (not shown on map below) – although not strictly a village and with poor potential, this school is located near from Aiseng and even a tiny amount of electricity would benefit the students.



Map showing the location of villages (with number of households in parenthesis) and the potential for installing pico-hydro systems

3 Feasibility visit

On a third eight day trip, the team returned to the 4 selected sites in April 2011 to carry out a detailed feasibility study. This included a meeting with the villagers to ensure they would be happy with the project and were willing to help install and manage the system, as well as detailed measurements of the stream and system site. The potential system sizes are shown in the table below:

Data	**Bormai**	**Aiseng**	**Donchai**	**Subloi highschool**
Theoretical power	5.9 kW	2.85 kW	1.2 kW	0.9 kW
Deliverable power	3 kW	1.5 kW	Waiting for manufacturer	
Number of households	35	25	41	4 buildings
Power per household	85 W	60 W	Waiting for manufacturer	
Headrace length	500 m	10 m	245 m	93 m
Transmission length	1018 m	413 m	647 m	720 m

Bormai has a high flow, low head stream. This means that the required canal must be large enough to contain the flow and long enough to ensure an adequate head is achieved. As a result, this part of the system will be relatively expensive, but the achievable power relatively high. The villagers here were happy to help us install the system and were willing to operate it themselves.

Aiseng has many small streams nearby, which can all by combined through existing irrigation canals to provide adequate flow. The irrigation canals can still be used for irrigation when they are needed since there is a surplus of water during the growing season. Again, the villagers here were happy to help us install the system and were willing to operate it themselves.

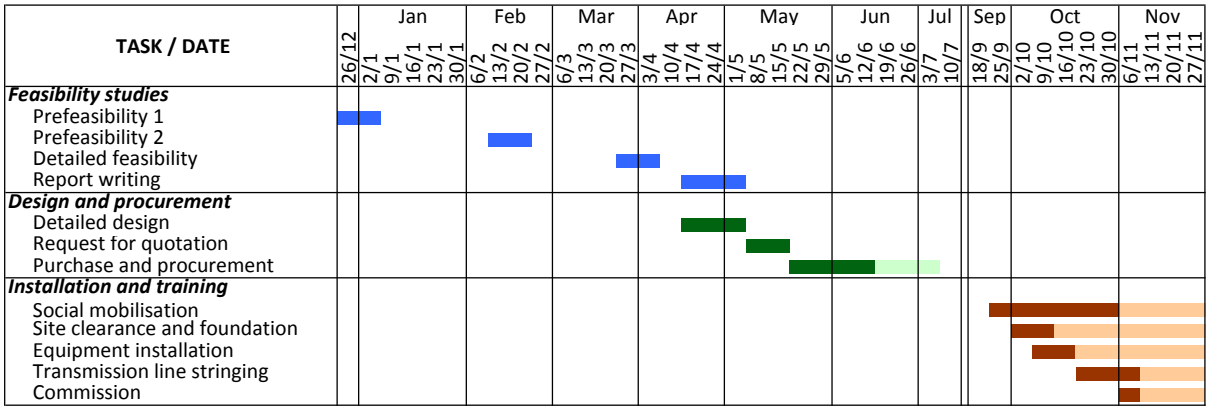
Donchai is a large village and was found to not have adequate flow during the dry season, even when two streams would be combined. A good canal was already in place and would require relatively little work to modify for this project. Construction materials are also easily transported to the villages using the Mekong River. The village is comprised of two ethnic groups that each have their own language and village head. Very little is shared between these two communities and forcing them to share a limited electricity source could be problematic

Meeting (left) and gradient measuring (right) at Donchai

Subloi highschool has a very limited source. However, since the electricity demand would only be from the school and dormitories it will be possible to provide them with enough electricity for lighting. A fairly long canal needs to be dug to take the water round the side of the hill where a larger head is available. After the water flows through this system it would join one of Aiseng's irrigation canals and eventually flow through the Aiseng system. Since the system it for a school, the students will help install the system, and it can be managed to teachers or a parents committee.

4 Current project status

The feasibility studies are now complete and the project is in the design and procurement phase. The systems are currently being designed in Vientiane and costs calculated. Once this is complete parts for the selected systems will be ordered. After the rainy season (October) installation can begin. A Gantt chart for the project is shown below:



5 Conclusion

This region has a lot of potential for improved lighting and electricity supply, and there are many reasons why such development is warranted such as the low quality of existing technologies, household expenditure on CFL light bulbs, and difficult access to other infrastructure. Based on current expenditure, there is also a capacity for villagers to pay for the use of new technologies. These pilot pico-hydro projects will give NCA a chance to see how well the systems actually perform once installed and whether the villages properly adopt the new technology. Future systems can then be planned around this information.