Briefing Note

Key Insights from a Community-Based Solar Water Pumping System in Southern Laos

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IP 7: Farmer-Led Irrigation for Climate-Resilient Agri-Food Systems

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Synopsis

Over a period of 12 months, the National Agriculture and Forestry Research Institute (NAFRI), together with the International Water Management Institute (IWMI), carried out several visits to a community-based, multi-purpose solar water pumping (SWP) site situated in the rainfed lowlands of Southern Laos. At the time of the first visit, the system had been in operation for around four years and neither NAFRI nor IWMI had any previous knowledge of the site. This Briefing Note shares the main insights derived from engagement with the participating households into the functioning of the water supply system and the perceived benefits to the householders. It reveals how the planning processes followed by the implementing agency resulted in an inadequate system design and limited knowledge and capacity among the water users. Policy options to address these issues are proposed herein. Whilst the representativeness of any assessment based on a single site - as in this case - can always be questioned, it is also likely that most of the areas identified as requiring attention here have some relevance to similar interventions elsewhere. Therefore we consider that the successful expansion of community-based SWP in the lowlands of Laos would be aided by policy and planning improvements that overcome issues identified in this Brief.

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Context and System Design

- In early 2019, a prominent international donor tasked the local branch of the District Agriculture and Forestry Office (DAFO) to implement a community level, multi-purpose solar water pumping (SWP) system within a village in Southern Laos. DAFO had nominated the site as there was a small yet active number of small-scale vegetable producers who were facing production-related issues due to inadequate water access.

- DAFO made concerted efforts to co-design and co-develop the intervention with the community as would be anticipated of an international donor supported rural development project. During the initial community consultation DAFO engaged with 15 farming households (HHs). During the construction phase a farmer production group was established consisting of 7 of the 15 HHs. Some of the farmers chose not to join the group for two main reasons: (1) the water abstracted from the newly installed tubewell was insufficient to meet needs of all HHs; and (2) some HHs were more interested in alternative livelihood options such as the farming of cassava, sugarcane or banana, or else, working as labourers.

- The solar water pumping system was designed and installed on land owned by the head of the WUG. The household members in the group provided labour towards construction where needed (e.g. for the installation of the water distribution pipes). A basic water user group (WUG) was established to manage the system. DAFO provided training to the WUG head on how to operate the SWP system. Only the WUG head has the knowledge and skills to operate the system and thus the group is highly dependent upon its head. DAFO provided funds for the group to purchase seeds and other materials needed for vegetable farming. Training on how to apply for funds from DAFO for farming inputs was also provided.

- Technical and end-use related details about the SWP system are given in Table 1. The vegetable production group members are composed entirely women farmers from the Brao ethnic group. All members own their own land. Despite common land title arrangements, ethnicity and gender, the group is inhomogeneous in other respects. Group member ages range from 40 to 80 years. Household sizes vary from 1 to 4 people. Plot sizes used for vegetable production vary from 9 to 625 m^2 due to the availability of land and the interest or capacity of each group to pursue vegetable farming.

- Within the group, 2 members grow vegetables primarily for sale at the local market; 3 for home consumption and 2 are currently not engaged in vegetable cultivation (Figures 1 and 2). Besides irrigation, the system provides domestic water supplies for the 7 households. Only 1 household uses the water for drinking after boiling.

Table 1. Overview of the SWP system

Components	Details
Technical	• 1 tubewell (around 30 metres deep) • 2 solar panels (0.65 kW total capacity) • 1 submersible pump (0.6 kW capacity) • 2 overhead tanks (4 kL total capacity, elevated 6 metres above ground) • Water piped to each household. Most households have a small pond or 0.2 kL plastic drum to store water
End-use	• Domestic supplies for 7 households • Vegetable production group

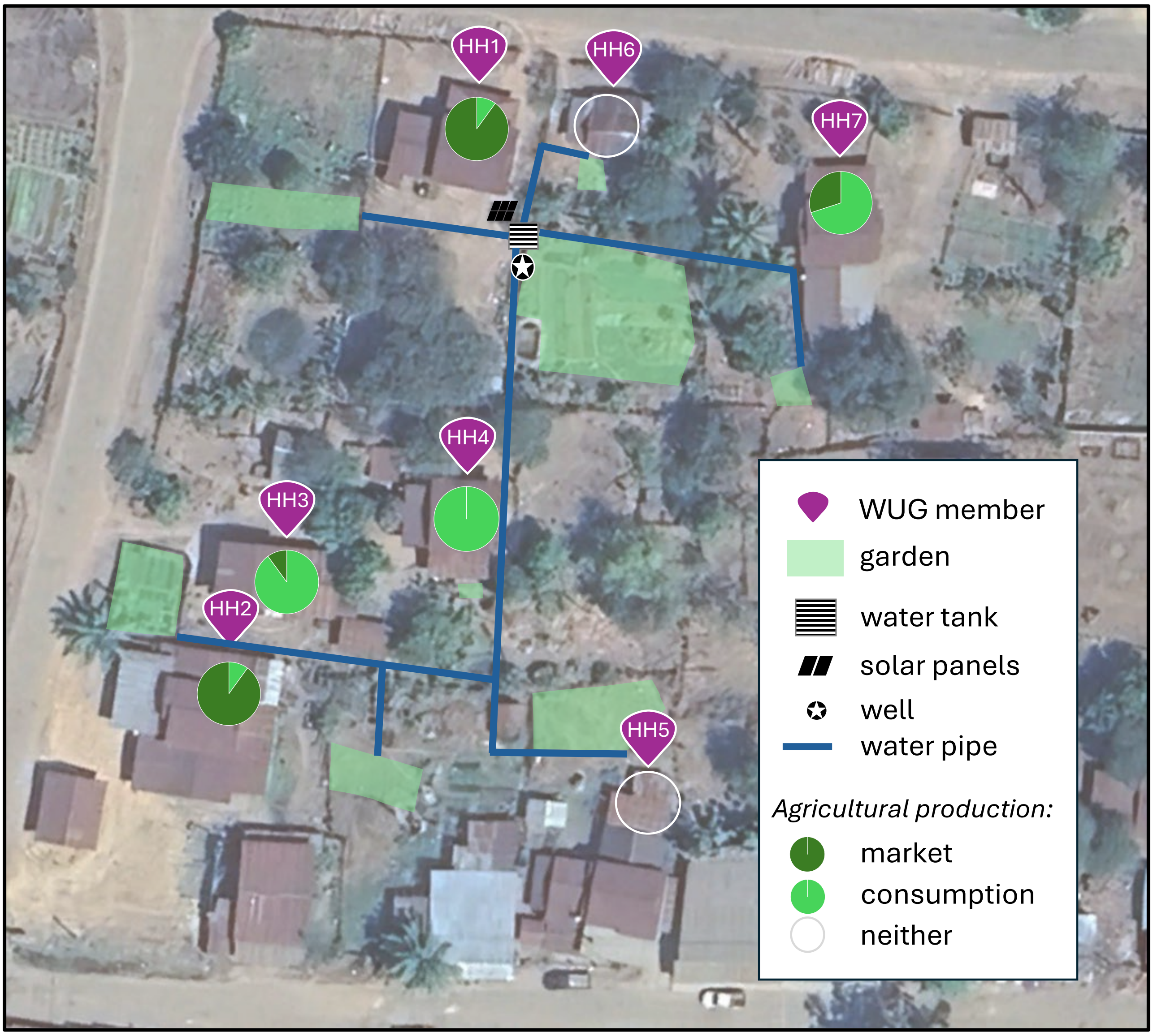

Figure 1. Layout of the SWP system (garden and water pipe locations are indicative)

Figure 2. SWP system infrastructure (left panel). WUG member irrigating vegetable plots (right panel)

System Operation

- Every morning before sunrise the WUG head switches on the system to enable water to be pumped to the elevated tanks from where it is distributed to all households within the group. The WUG head remains unsure as to whether or not she is operating the system to its full capacity. During intense rainfall or lightning strikes the system is turned off to avoid possible damage to the equipment. This creates considerable burden which could be overcome, for most part, by a level control system using a floating devise to activate the switches.
- There is no schedule in place to share water among the group members. Access to water is entirely opportunistic. No fee is charged for the water. For minor repairs of joint assets (e.g. a common tap or pipe), the group members fix it and share the costs. For the repair of an individual asset the costs are borne by the individual concerned. The WUG lack the financial resources to address major maintenance costs should they arise.
- Water discharge monitoring carried out over 3 successive days in the dry season (November 2023) showed the availability of solar radiation allowed the pump to operate for around 7 hours of productive use each day. During the monsoon when cloud cover is high, there is insufficient water pumped for irrigation and sometimes no water is delivered to the main tanks at all. During the latter part of

the dry season (March to May) the quantity of water pumped from the solar system is at its lowest for the year and is insufficient to meet the required irrigation water demand. Households limit their vegetable production or opt out of vegetable farming entirely.

- Rates of pump discharge measured during the midday peak in March 2024 of 1,200 litres per hour are around 30% lower as compared to the midday peak of 1,550 litres per hour in November 2023 when groundwater levels in the well were higher. The water pumped in March appeared cloudy due to high sediment content. This limits its suitability for domestic use and likely places strain on the mechanical pump.
- Tensions emerge within the group during times when water is inadequate. Some group members have reportedly made claims that the WUG head is withholding water solely for their use. The children of the WUG head have faced verbal harassment at school, with taunts such as, 'your mum keeps the water' common.
- Over the 4-5 year period since the SWP system was established the price for casava has risen and farmers are increasingly changing from vegetable production to growing to cassava on lands situated away from the village. As the householders have less time for vegetable farming the system isn't relied upon as much at the present time. Despite the competing demands on the group, if water availability were higher there would likely be more vegetable production.

Key Insights

(1) Technical Improvements in the Planning Phase

The SWP system struggles with capacity and reliability issues, particularly during at critical times of the year, affecting agricultural productivity and domestic water supply. Perceived inequities in water distribution have also led to social tensions within the WUG. To address these issues, the supply and demand of water need to be more closely matched. In addition, implementing automated control systems and addressing sediment issues could enhance the system's functionality and user satisfaction. Decision support tools, such as the IWMI SIP Sizing Tool, could help minimize or prevent such issues at the design stage. The tool considers factors such as water availability, solar energy availability, crop water requirements, and geographical location to determine the size and specifications of the solar-powered irrigation system needed to meet those requirements efficiently.

(2) Better Scientific Understanding and Management of Groundwater Resources

The capacity of the tubewell to supply water was not fully known before the WUG membership was decided. Local hydrogeological conditions significantly affect SWP performance. The 30-meter depth of the tubewell that provides the sole water source appears to be too shallow to maintain adequate water flow year-round. As a result, the well struggles to provide adequate water during the critical months of March to May. Other tubewells in the area are drilled to depths of up to 40 or 50 meters. The modest financial savings to the donor from drilling a shallower well have resulted in high costs borne by the WUG. Note that the cost of deepening the well would be similar to drilling a new well and is thus an uneconomic option. There is a need for a more thorough assessment of groundwater resources before system installation.

(3) Strengthen Community Engagement

A lack of understanding of the SWP system meant the expectations of the group were not always realized, especially during days with high cloud cover and critical dry season months. WUG members require greater technical knowledge. Too little effort was invested in developing capacity within the WUG. Operational rules for the system were not established at the onset, and the limited technical knowledge available was entrusted to only the WUG head. Over-reliance on a single individual for system operation is a high risk. The WUG requires access to sound technical advice from experienced professionals, inclusion in ongoing training programs to build the skills of all its members, and a more comprehensive support system to ensure the sustainability and efficiency of its operations.

(4) Factor in Emerging Economic Shifts

Market dynamics, such as rising cassava prices, significantly influence other agricultural practices like vegetable production, and in turn, the reliance on community infrastructure projects like the SWP system.

(5) Trade-offs in Community Project Locations

The siting of the project became contentious once water availability constraints emerged. Infrastructure sited on private land tends to face challenges with co-ownership among group members. In contrast, infrastructure sited on public land faces the risk of a lack of any sense of genuine ownership, leading to neglect, theft, or vandalism. While there is no perfect solution to this problem, acknowledging it and fostering open discussion within the group during the planning stage is an important step towards finding an acceptable compromise.

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The **ASEAN-CGIAR Innovate for Food and Nutrition Security Regional Program** is a research collaboration among the ASEAN Member States, ASEAN Secretariat, and CGIAR Centers, with funding support from the government of Australia and the United Kingdom. The program's vision for the next 10 years is to scale up and out bold integrated innovations that will enhance the resilience of ASEAN's agri-food systems to climate change. This ambitious endeavor aims to deliver better livelihoods for food producers and other stakeholders along the value chain. It also seeks to ensure more affordable, nutritious, and healthy food for consumers while fostering a healthier natural environment for all.

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