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ECHO Asia Notes

A Regional Supplement to
ECHO Development Notes

PLAYING WITH WATER WHEELS

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ECHO Asia Thailand Foundation

For further resources, including networking with other agricultural and community development practitioners, please visit our website: www.ECHOcommunity.org. ECHO's general information website can be found at: www.echonet.org.

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Playing with Water Wheels: Exploring Low-Cost Methods for Pumping Irrigation Water

by Thomas Singer[1]

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(1) Editor's Note: The Raintree Foundation is a small grass-roots organization in Northern Thailand, dedicated to helping underprivileged children and communities. In addition to hosting children's homes, foster programs, and several small-scale social enterprises, Raintree is confronted with basic needs such as access to clean water, and seeks to find appropriate solutions to them.

Initial Attempts

As we began looking into sustainable and alternative solutions for pumping water, our team began 'playing around' with the idea of water wheels for the supply of irrigation water to low elevation farmland. We initially began with research and testing of a pump called a Sling Pump, but gave up after testing several prototypes. Challenges included difficulty with DIY assembly, cost, specialized parts, and ultimately its efficiency.

Knowing that every pumping solution has its place and application, we decided to go another route and began looking into water wheel pumps. With the many design approaches out there, we decided to define our goals, and agreed that an appropriate design would feature affordability, easy assembly, low maintenance, and quick setup for people with access to flowing water. The overall objective was to help farmers with proximity to a river or small stream to irrigate their crops without the need for electric or gasoline powered pumps, as well as the reduction of manual labor.

Figure 1. Using a water wheel in a nearby river (left) to pump water uphill for irrigation of tree crops in northern Thailand (right). Elevation: ~6m; Distance ~50m.

To avoid starting from scratch we looked to the local hardware shop and decided to get a small 1 inch piston pump (Figure 2) off the shelf for around 2,400 THB (75 USD), along with a set of spare seals, bands, and piston for 260 THB (8 USD).

Figure 2. 1 inch piston pump off the shelf for around 2,400 THB (75 USD).

The next step was to design a wheel capable of driving the piston pump, solely by the flow of a small stream. Our first prototype featured an old bicycle wheel, which we had laying around, fixed with 14 used conveyor buckets attached (Figure 1). Attached to the outlet was a garden hose, while the inlet fed directly into the stream. Initially, this set-up enabled air into the pump inlet, so we used a strainer and a bucket with holes to provide a stable water level (Figure 1). The flow rate of the stream in this instance was approximately 0.6 to 0.8 m/s, so not too slow and not too fast. The elevation gain from the pump to the water storage tank uphill was approximately 6 meters, with a distance of approximately 50 meters. We calculated a roughly 3 liter per minute flow rate, more than adequate considering this pump would run 24 hours a day (~4,500 liters per day). In terms of cost, it certainly depends on availability of materials, but we calculated our set-up at 4,000 THB (125 USD).

Improving the Design

While our original prototype worked well overall, we felt that we could improve upon the buckets driving the wheel. We decided to modify the wheel using a simple hose reel used for ¼ inch chemical pipe. The reel itself cost 500 THB (15 USD) and already had the bearings, a basic frame, and a turn handle. To make the wheel spin by the flow of water from the stream we welded steel plates (roughly 2 mm thick) between the sides where the hose would typically sit (Figure 3).

Figure 3. Improving on the original design, using a hose reel frame and welded paddles.

We added a ½ inch PE (polyethylene) pipe to the pump and were able to start watering cashew trees 100 m away from the water source. The elevation was similar to the first site (~6 m in elevation gain) and the flow rate of the stream was similar as well. It quickly became apparent that the required distance was stretch for the pump, putting pressure on the piston pump, and sometimes caused it to stop entirely. The same would happen when raising the pipeline to higher elevations. With no control over the stream flow rate, we were limited in our ability to improve the work rate, but we have been successful in getting enough water to our trees each day for irrigation. Overall, this model was cheaper, and its larger surface area enabled longer pipelines capable of pumping water to greater elevations.

Additional Observations

It should be pointed out that the situating of the water wheel and pump in the water was one significant challenge that had to be overcome. It was challenging because the pump itself can't be submerged totally due to its design, but the paddles need deep enough water to keep turning efficiently. After playing around for quite some time, we were able to find the right balance.

In addition, since our streams don't flow particularly fast, we had to create a small canal to funnel the water. This helped to create a regular flow rate and a safe spot to run the pump (Figure 4). Finally, we found that in these areas where irrigation water is needed, these pumps can easily be placed into the stream by one individual, making them very convenient to use.

Figure 4. Water diversion and wheel set-up in a slow-moving river.

Taking a Different Approach

Since we had already purchased a piston pump we wanted to look into some kind of plug and play system. This time we explored the possibility of using a floating raft system (Figure 5). The cost of our next approach

was much higher since the raft we used was not locally available. Because shrimp farming is not widely practiced in this area, the raft had to be shipped from the southern part of the country. Costs for the raft, frame, wheels, and bearings were about 12,000 THB (375 USD).

To adapt the system, we added a sprocket onto the paddle axle and connected it with a bigger sprocket to the belt axle. If I recall right we had a 50mm diameter sprocket at the pump shaft and a 150mm diameter sprocket at the raft axle.

Figure 5. The floating raft model, adapted from an aerator used on shrimp farms.

This system was tested at another site, in another stream, during the rainy season. We estimated the water flow at this site was at least 1.2–1.5 m/sec. The major issue we encountered was the challenge of fixing the floating raft so it would stay in the middle of the stream. Unfortunately, fixing a steel cable along the side of the riverbank still allowed for the raft to move from side to side and outside of the stream's flow. Another downside of the original shrimp farm aerator paddles were that they had holes for better aeration, but not helpful when attempting to harness the full power of the flowing water. In the end, we had trouble keeping the raft in place, while the stronger current made the nosedive in the front.

Figure 6. Combatting the challenge of keeping the floating raft within the river's direct current.

Conclusion

Despite our mediocre attempts, I am confident that we can find affordable solutions to meet the irrigation needs of farmers with proximity to flowing water. ❷

❷ To read more on this subject, including more research from Raintree on Ram Pumps, go to ECHOcommunity.org and search the collection on **"Water Drilling & Pumping"**

A 'Successful Failure': Introducing SALT[1] Technology in Northern Thailand

lessons from David Crist[1]

[1]*World Challenge/CHE Chiang Mai, Thailand*

Dave had come to Thailand two years prior exactly for the opportunity that he was now presented with. Ethnic minority hillside farmers had been experiencing lower crop yields even with their efforts in using more chemical fertilizer.

Even to Dave, who had no formal agriculture education, the cause of the problem was apparent. Erosion had removed their top soil and left them with poor soil void of organic matter, minerals, and micro-nutrients.

Fortunately, Dave was mentored by a local agriculture missionary who had learned 'Sloping Agriculture Land Technology' (SALT) from the creators of this methodology in the Philippines. Hands-on experience was included in Dave's mentorship so he got to know the system well.

Furthermore, the Thai government provided free seeds in their support and promotion of conservation practices among hillside farmers in northern Thailand. So Dave was equipped with the know-how and the seeds needed in providing the solution these farmers needed.

Since Dave's Thai language skills were not proficient to conduct trainings, he hired a northern Thai farmer, Shua, who had a relationship with these farmers. He grasped SALT quickly, was confident, a good communicator, and cared for these marginalized farmers.

Surely, with such a simple, proven technology, free seeds, free equipment, free assistance, and the prospect of increased crop yields, Dave anticipated not only immediate adoption and implementation in the coming growing season but wide spread adoption once other farmers in the area witnessed these increased yields.

Naturally, Dave was quite confused and disappointed when only 1 out of 35 farmers who attended the SALT workshop implemented SALT on one of his parcels of land. Shua experienced successive years of increased yields. To his delight, each year yielded more than the previous one. With the profits he was able to re-roof his house as well as buy a motorcycle and a truck.

Additionally, even though the smallholder farmers raising crops close to Shua's land saw the increase productivity, none of them even tried SALT. This puzzled Dave even more. He wondered . . . 'What did I do wrong?'; "Why did so many turn away from what could have increased their income and raised their standard of living?" These questions began a long and ongoing journey of seeking to understand community

[1] To read more about SALT, go to the collection on **ECHOcommunity.org**

Figure 1. Sloping Agriculture Land Technology (SALT) demonstrated by the Upland Holistic Development Project (UHDP) in northern Thailand around the same time.

development and the tools available for empowering communities.

Dave actually began to gain insights into factors and dynamics he had never considered when he attended a CDE (Community Development Education) training and implemented a CDE program. This included insights into such things as:

- Fear,
- Risk Perception,
- 'The Adoption Bell Curve',
- Social Approval,
- Poverty Mentality,
- Unfair Market Influences,
- Resistance to Change,
- Anticipated Jealousies,
- Respect of Tradition,
- False Assumptions,
- Mistrust,
- Importance of Relationship Building and Ownership,
- Time-Line Realities, and more...

To learn of these and other valuable insights gained through this experience, please consider signing up for Dave's auto responder series (Discoveries in Effective Community Development) in which he explains the simple but essential principles that he has taught to hundreds of development workers for the past 17 years after he had the experience above.

Virtual Training Opportunities Available NOW

The ECHO Asia team has developed a number of virtual trainings to serve the whole Southeast Asia region! Subjects currently available include:

Intro to Biochar Production

Intro to Black Soldier Fly Production

Intro to System of Rice Intensification

Seed Saving Fundamentals

Materials for virtual trainings include video lecture and on-farm demonstration, promotional materials, teaser video, transcript of lecture (for translation other other purposes), resources links to ECHOcommunity.org, and pre and post "tests" to help with participant active participation. In addition we can arrange a live ZOOM call with your team/ participants.

To learn more email us at echoasia@echocommunity.org

Upcoming Events echocommunity.org/events/region/Asia

Virtual Events

Friday 22 April 2022

Register NOW at: http://edn.link/asia-conference

On-Farm In-Person Events

Friday 18 March 2022

Biosand Water Filtration Workshop

Learn how to build a low-cost 300 Liter per day water treatment system using locally available materials.

Friday 8 April 2022

On-Farm Feeds Workshop

Learn about animal feed needs and make animal feed using materials on the ECHO Asia farm

Register NOW at: echoasia@echocommunity.org

In Case You Missed it...

...Click the links below to read other recent Asia Note Articles

ASIA NOTE #47

Establishing a Scaled-Up Black Soldier Fly System

An Innovative 'Do-All' Biochar Burner Design

ASIA NOTE #46

African Swine Fever Virus:
Overview and Prevention on the Small Farm

Small Farm Biosecurity Plan for the Prevention of African Swine Fever

I Suspect ASFV On My Farm
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Stingless Beekeeping (Meliponiculture) on Java

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The Martinez Airlift Pump: Lifting Water with Air

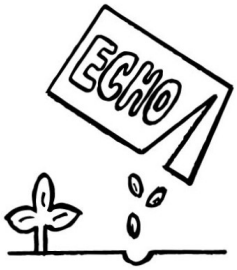
Do All parts of the Chaya Plant Contain Cyanide?

Cyantesmo Paper for Detecting Cyanide

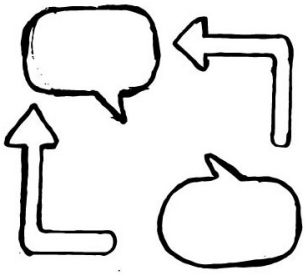
Ways to Stay Connected...

...and Contribute!

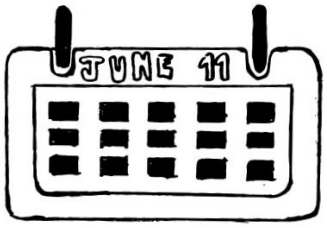
Please do remember that a "Development Worker" membership entitles you to 10 free trial packets of seed per year! If you would like more seed packets or larger quantities of some seeds (especially green manure/ cover crops), we do have additional seed packets and bulk seeds for sale, and our seed bank catalog is available online.



Please also know that besides being written in English, our *ECHO Asia Notes* are translated and available for free download in Thai, Khmer, Burmese, Mandarin, Bahasa Indonesia, Vietnamese, and Hindi languages.



If you have never joined us for an event, please consider doing so- when we have events, we would love for you to join! Please go to the events page of ECHOcommunity.org to learn more.



We encourage you to share success stories, lessons learned, insights, Facebook posts, etc. with us to keep us abreast about what you are trying and what is working in your context.

Additionally, if you have any ideas or would like to write an article for an upcoming *ECHO Asia Note,* we invite you to do so! Thank you for reading, and please do stay in touch!

Email us at echoasia@echocommunity.org!