



ECHO Asia Notes

A Regional Supplement to ECHO Development Notes

ECHO Asia Notes

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*Reducing Hunger,
Improving Lives
Worldwide*

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Charcoal Production in 200-Liter Horizontal Drum Kilns

By Rick Burnette
Director, ECHO Asia Regional Office

Editor: Due to the length of this article, only a portion is included in ECHO Asia Notes. The full article, including illustrated steps related to the assembly of 200-liter drum kilns as well as charcoal and wood vinegar production, can be accessed via the web link included below.



Until recently, firewood was taken for granted in northern Thailand. With vast forests full of many types of trees, upland households could afford to be choosy concerning the wood they used for cooking.

However, in recent years, more and more communities are facing restricted

access to forest products due to the establishment of national parks.

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In many areas, deforestation caused by agricultural activities, such as the encroachment of large plantations, is also resulting in declining access to firewood.

In upland communities, commercial types of cooking fuel like propane are not readily accessible or affordable. With limited options, communities and development organizations have begun considering alternative fuels.

The [Upland Holistic Development Project](#) the Thailand affiliate of [Plant with Purpose](#) has been exploring alternative cooking fuels. Biogas and gasifier stoves hold promise, but UHDP staff members have observed that many of their focus communities are not ready to adopt these specific approaches, partially due to the cost of materials and equipment.

Charcoal is the third alternative cooking fuel being evaluated. The potential switch to charcoal is not too drastic, since local families are already very aware of the fuel. Small "bucket" cooking stoves favored by hilltribe families are generally affordable and can accommodate both firewood and charcoal. These stoves average 300 baht (the current exchange is 29 baht Thai to \$1.00 US).



The Charcoal Option

But how does the heating value of charcoal stack up against firewood? According to a 1987 article by J.D. Keita, FAO Regional Forestry Officer, the heating value of wood is generally around 3500 Kcal/kg for green wood and 4500 to 4770 Kcal/kg for dry wood. Charcoal, however, has a heating value near 7500 Kcal/kg. Keita states further that, "Although carbonization causes a loss of energy, the charcoal produced gives a higher yield in use than wood. Thus, the thermal energy yield of wood is, on average, 8 percent and can even go as low

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as 5 percent with the popular three-stone African stove. Charcoal has a thermal energy yield of about 28 percent (Unasyuva, No. 157-158)."

Energy from biomass (biological or renewable sources) includes direct wood fuel such as firewood and charcoal and plays an important role throughout the developing world. Almost two-thirds of Asia-Pacific's population is rural, and among them, traditional biomass remains the most important source of energy (Gumartini, p.16). Although projections through 2020 show an overall declining trend for wood fuel consumption in the region, an increasing trend is expected for charcoal. According to Gumartini, the growing use of charcoal is due to increased income and urbanization (p. 19).

Kittichai Sumpansinkor, UHDP technician responsible for field research and development, states that for charcoal to be readily accepted by families in the project's focus area, it must be available, inexpensive, easy to use and of good quality. In Thailand's north, although the consumption of composite charcoal (made from carbonized, compressed wood aggregates) is growing, traditional lump charcoal is still common, produced from the wood of culled litchie (*Litchi chinensis*) and longan (*Dimocarpus longan*) trees as well as select forest species.

The cost of good quality lump charcoal currently averages 13 baht per kg. UHDP's Co-Director, Jamlong Pawkham, estimates that the expense breaks down to approximately 4.40 Thai baht for the preparation of each household meal. This cost potentially adds up to 400 baht per month. With monthly household incomes in UHDP's focus area rarely exceeding 4000 baht (\$138 US), such expense for cooking fuel exceeds what most families are willing to pay. Sufficient quantities of charcoal are also difficult to transport into remote upland communities.

**For the full article and references, please click here to
download the pdf file from the ECHO Asia website:
[Charcoal Production in 200-Liter Horizontal Drum
Kilns](#)**

An Introduction to Wood Vinegar

By Rick Burnette

Director, ECHO Asia Regional Office

Prakrit Khamduangdao was looking for an alternative to agricultural chemicals to control pests in his vegetable farm. However, he was not completely satisfied with various botanical pest control measures being promoted in northern Thailand. He reports that even though certain natural insect repellents were beneficial, their effects were too limited. Additionally, finding adequate amounts of necessary raw plant materials and processing them into sprays was laborious and time consuming.

When Mr. Prakrit first heard about wood vinegar in 2000 he was intrigued. Compelled by the idea of a natural by-product of charcoal production that can control pests and diseases of crops, he bought his first bottle. Having used the product, Mr. Prakrit was pleased with the ease of mixing and application. Ultimately, after observing much fewer insect pests and fungal diseases on his crops, he became convinced of the effectiveness of wood vinegar.



Not long afterwards, Mr. Prakrit became self sufficient in producing both charcoal and wood vinegar with a 200-liter horizontal drum kiln. He has been an advocate of wood vinegar ever since.

Wood vinegar (pyroligneous liquor) is rapidly gaining acceptance as an essential Asian natural farming input. Reported agricultural use as a fertilizer and growth-promoting agent goes back to the 1930s, making the product a relatively new innovation.

Uses of Wood Vinegar

According to Thailand's Department of Agriculture, wood vinegar has the following broad benefits:

- Improvement of soil quality
- Elimination of pests
- Plant growth control; being able to accelerate the development of roots, stems, tubers, leaves, flowers, and fruit
- Used to increase amounts of fruit produced in orchards

Dr. Arnat Tancho at Mae Jo University also reports that wood vinegar can be applied to the soil surface to help increase the population of beneficial microbes and to promote plant root growth. Additionally, the product can help boost crop defenses against disease.

Wood Vinegar Production

Wood vinegar is produced when smoke from charcoal production is cooled by outside air while passing through a chimney or flue pipe. The cooling effect causes condensation of pyroligneous liquor, particularly when the temperature of smoke produced by carbonization ranges between 80 and 180°C/176 and 356°F (Nikhom). This temperature is reached at the carbonization stage of exothermic decomposition (see previous article about charcoal production) and is indicated by the production of yellowish, acrid smoke.

The following is a summary of key wood vinegar production steps:

- Arrange dry wood in the 200-liter drum kiln (see related article), close and cover every hole with clay before burning. Stop feeding the fire when smoke exiting the flue is very thick and white.
- Approximately 30 minutes to 1 hour after having stopped feeding fuel into the kiln, if the smoke is yellowish and acrid, close off most of the outer vent.
- Extend a hollow green bamboo pole (far end elevated to 45°)

from the flue pipe. **Wood vinegar** can be collected with containers fastened underneath one to two holes, approximately 2 cm (3/4 in.) wide, drilled into the bamboo pole roughly 30 cm (11.8 in.) from the connection with the flue pipe.

- Thailand's Department of Agriculture reports that if wood is burned for 12 to 15 hours (or less, depending on the type and size of wood) in a 200-liter oil drum kiln, it should produce 2 to 7 liters of raw wood vinegar. Leave the raw wood vinegar sealed in a bottle for approximately three months to allow sediments to settle.

Nikhom Laemsak at Kasetsart University recommends refining raw wood vinegar by a simple standing method. The brown liquid collected during charcoal production is left sealed in a bottle for two to four months, during which time the components will settle into four distinct layers. The first and second layers at the bottom of the container will be black, containing wood tar and tar pitch. The third layer (located beneath the top strata of liquid) is the usable portion of wood vinegar. This component will be light yellow to reddish brown. The fourth (top) layer is classified as light oil and will have a skim of wood tar at the top.

Wood vinegar producers, such as Boonsong Thansrithong, an agriculturalist with Partners Thailand, recommends that the useable layer of wood vinegar (second from the top) can be harvested with a syringe or siphon after first sucking out the light oil layer on top. Refined wood vinegar does not perish quickly. Prakrit Khamduangdao is confident that the product can be stored in bottles at least five years.

One does not have to be a charcoal producer to access wood vinegar. Refined wood vinegar is available in many agricultural stores in Thailand with one liter bottles generally selling for 50 baht (\$1.72 US).

Composition and Characteristics of Wood Vinegar

Nikhom reports that wood vinegar yield per metric ton (2200 lbs.) of air dry wood is 314 kg (690.8 lbs.). The product contains

approximately 200 components. These include:

- Alcohol (methanol, butanol, amylalcohol)
- Acid (acetic, formic, propiionic, valeric)
- Neutral substances such as formaldehyde, acetone, furfural, valerolactone
- Phenols (syringol, cresol, phenol)
- Basic substances such as ammonia, methyl amine, pyridine

He also describes quality wood vinegar as having the following characteristics (most of which may require special laboratory instruments or methodology to determine):

- pH of approximately 3.0
- Specific gravity between 1.005-1.050
- Color ranging from pale yellow to bright brown to reddish brown
- Transparent
- Smoky odor
- Dissolved tar content: less than 3 percent
- Ignition residue: less than 0.2 percent by weight

Small Farm Uses of Wood Vinegar

Wood vinegar has some industrial applications; it is used as an ingredient in cosmetics, and for odor removal. De Guzman shares that a number of potential agricultural applications are also reported in which wood vinegar is blended with water in ratios ranging between 1:50 (1 liter wood vinegar and 50 liters water) to 1:800.

For improved plant production, the solution can be sprayed over plant shoots. Wood vinegar, like hormones, will be absorbed into twigs, trunks, or leaves, resulting in stronger plants and leaves that are greener and more resistant to pests and diseases (de Guzman).

Specific Farm Uses for Wood Vinegar

The Appropriate Technology Association of Thailand recommends the following wood vinegar/water solution rates for various farm uses

(ATA, p. 27-28). Note that, in some cases, no details were given regarding the specific identity of pests:

- **Repel nematodes** - Tomatoes, 1:500 (apply to the base of plants); strawberries, 1:200 (apply to the base of plants); and black pepper vines, 1:1500 (apply in place of water).
- **Repel insect pests** - Cabbage and Chinese cabbage, 1:1500 (apply in place of water); corn 1:300 (spray onto leaves).
- **Control of fungal diseases** - Tomato and cucumber, 1:200 (spray onto leaves).
- **Control of root rot** - Tomato and cucumber, 1:200 (apply to the base of plants).
- **Reduce incidence of chili pepper flowers aborting** - 1:300 (spray onto leaves).
- **Improve flavor of sweet fruits and stimulate development of crops.** Mix solution rates of 1:500 to 1:1000. Wood vinegar prevents excessive nitrogen levels, improves plant metabolism and contributes to higher fruit sugar levels.
- **Stimulate compost production.** A solution rate of 1:100 will help increase the biological activity of various beneficial microbes and can decrease composting times.
- **Combat bad odor.** A wood vinegar solution of 1:50 will diminish the production of odor-causing ammonia in animal pens.
- **Supplement for livestock feed.** Mixed with livestock feed at rates of between 1:200 and 1:300, wood vinegar can adjust bacterial levels in the animal digestive tract which improve the absorption of nutrients from feed.
- **Enrich garden soil.** Use a strong solution of 1:30 to apply to the garden soil surface at a rate of 6 liters of solution per 1m² to enrich the soil prior to planting crops. To control soil-based plant pathogens, use an even stronger rate of 1:5 to 1:10.
- **Repel houseflies.** Dilute wood vinegar at a rate of 1:100 and apply to affected areas.

Sombat Chalermliamthong, also with Partners Thailand, reports that

28, 2010.

de Guzman, C.B. 6 January 2009. "Exploring the beneficial uses of wood vinegar." BAR online, Republic of the Philippines Department of Agriculture, Bureau of Agricultural Research, accessed September 25, 2010, <http://blog.agriculture.ph/exploring-the-beneficial-uses-of-wood-vinegar.html>

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Prakrit Khamduangdao, phone conversation with author, October 18, 2010.

Sombat Chalermliamthong, phone conversation with author, October 18, 2010.

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<http://groups.google.com/group/echo-asia-forum>

Registration deadline: December 1, 2010

**2011 ECHO Asia/Partners Thailand Tropical
Agriculture Workshop
January 19-21, 2011
7:45 AM - 5:00 PM**

The [ECHO Asia Regional Office](#) and [Partners Thailand](#) will co-host a three-day workshop to be held at the Partner's farm on the outskirts of Chiang Mai. Divided into six half-day sessions, the Tropical Agriculture Workshop will offer 20 participants a chance to engage in hands on practice related to:

- Moringa (*Moringa oleifera*) propagation, production and processing of products.
- Basic fruit tree grafting and propagation.
- Soap making for development.
- Natural farming for pig and compost production
- Backyard mushroom production.
- Introduction to vermiculture (to be held at Mae Jo University).

Workshop Cost

- **3200 Thai baht (about US\$110)**, includes:
 - three days of training, including six morning and afternoon sessions
 - lunch and transportation between the ECHO Asia office and Partners Farm/Mae Jo University

• **Or 700 Thai baht per workshop session *(about US\$24)**

**Those not participating in the entire day's event must handle their own transportation to/from Partners Farm/Mae Jo University*

Note: If the event is overbooked, preference will be given to those interested in attending the entire workshop (six sessions).

- Workshop participants *will be responsible for their own lodging and non-workshop related meals and transportation.*
- Please note that this workshop will be held during Chiang Mai's high season for tourism. It is recommended that participants register and make their own lodging reservations as soon as possible prior to January.

Workshop Registration

To inquire and register for the Tropical Agriculture Workshop, contact the ECHO Asia Regional Office at echoasia@echonet.org.

Registration deadline: December 1, 2010

Workshop Sessions

January 19

Moringa (*Moringa oleifera*) propagation, production and processing of products - The Partners Thailand team will introduce participants to the basics of establishing and managing plantings of moringa trees for the mass production of leaf shoots. Additionally, participants will be able to engage in key steps related to harvesting and processing moringa leaf shoots for the production of leaf powder to be used to supplement food rations and overall nutrition.

Basic fruit tree grafting and propagation - Betsy Langford, a previous ECHO intern with recent international development experience, and Boonsong Thansrithong of Partners will lead participants through the basics of fruit tree grafting and propagation. Techniques will include the production of root stock as well as making grafts. Propagation by air layering as well as stem cuttings will also be covered.

January 20

Soap Making for Development - The Partners Thailand team will introduce the basics of home soap production for possible application in community development work. Various types of soap making techniques and materials will be introduced. Products will include not

only simple soap for basic sanitation and hygiene but also valued-added soaps made from botanical materials.

Natural farming for pig and compost production - Partners Thailand and ECHO Asia staff will introduce participants to various natural farming techniques including the use of natural bedding (e.g, rice husks, leaves) for pigs which can be later used as natural fertilizer. The production of low-cost fermented livestock feed, made from local materials such as banana stalk, molasses and rice bran will also be covered.

January 21

Backyard mushroom production - Covering the basics of backyard mushroom production, Partners Thailand staff member, Sombat Chalermliamthong, will lead participants through key steps in raising straw mushrooms (*Volvariella volvacea*) using both baskets and frame beds. Mushroom production issues such as seasonal management, sources of spawn, production site preparation and problem solving will also be discussed.

Introduction to vermiculture at Mae Jo University - Dr. Arnat Tancho and coworkers will offer an introduction to Thai-style earthworm production at the Mae Jo University vermiculture facility. The workshop will include an introduction to indigenous types of earthworms and an overview of various approaches related to small- and large-scale production of vermicompost and vermicompost-tea.

Resource persons

Boonsong Thansrithong - Partners Thailand

Sombat Chalermliamthong - Partners Thailand

Rick Burnette - ECHO Asia Regional Office

Betsy Langford SAIWAM (Chiang Mai University)

Dr. Arnat Tancho - Mae Jo University

ANNOUNCING

3rd ECHO Asia Agricultural and Community Development Conference

October 3-7, 2011
Chiang Mai, Thailand

Details Coming Soon

Google Groups

ECHO Asia Forum

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