
Charcoal Production in Davao, Mindanao, Philippines: Introducing Yoshimura and Iwate Kilns

ARECOP Team



Charcoal is widely used in the Philippines, especially in the Southern region. Most charcoal producers in the Mindanao islands use the traditional ground-pit method of production. This

method involves filling a large pit with wood, igniting it, and covering the pit with soil. Two small pipes are inserted to allow smoke to escape.

Many other methods of charcoal

production exist which are able to produce higher quality charcoal products than the traditional ground-pit method. Above-ground kilns allow for greater control of the temperature and



Constructing the chimney

carbonization process, and can be used to produce commercial-grade charcoal products and wood vinegar. Wood vinegar is a by-product of charcoal production, and can provide additional income for the charcoal producer. Based on the potential for increased charcoal commercialization in Mindanao and the need for higher quality charcoal products, Approtech Asia and ARECOP decided to introduce several styles of above-ground kilns in the city of Davao, Mindanao.

Two types of Japanese kilns have been used successfully throughout Asia to produce high-quality charcoal: the Iwate kiln and the Yoshimura kiln. These kilns were introduced in Southeast Asia in 1991 by Japanese charcoal experts at the first high-quality charcoal training workshop in Pontianak, West Kalimantan, Indonesia, organized by ARECOP and Yayasan Dian Tama (local host). Since then, these kilns have been adapted and used in Bhutan, Cambodia, Indonesia, and Thailand. Based on the success of

the kilns in these areas, Approtech and ARECOP decided to build them in Davao.

The constructions of the kilns in Davao served multiple purposes:

1. As a technology transfer within the ARECOP network
2. As preparation for other regional high-quality charcoal production
3. As a production center
4. As a training center for high-quality charcoal production
5. As a facility for further research and development of high-quality charcoal in the Philippines

Approtech and Yayasan Dian Tama provided the necessary space and materials, as well as helping hands during the construction of the two kilns. ARECOP provided a kiln production expert to design the kilns and guide their construction.

The Yoshimura Kiln

The Yoshimura kiln was designed with a chamber measuring 2m in diameter and 1m high. The kiln's capacity was 3.5m³ of wood, with an expected output of 350 kg of charcoal. Four chimneys attached to the kiln allowed for wood vinegar collection.

The fire chamber was designed with a small size to avoid adding too much height to the kiln. Dry



The Iwate kiln mouth

wood was used for fuel to maximize the kiln's efficiency during the early stages of firing.

The inner and outer walls of the kiln were constructed using a mold. The space between the walls was filled with a mixture of red clay, sand, coral sand, and crumbled material from previous building structures. Shrinkage caused by the red clay as it dried was amended by refilling the mixture from the top.

The kiln floor was made of concrete. The chimney was constructed of red bricks, with sand and coral applied around the chimney body.

A metal kiln cover was made in a local metal workshop. Convincing the workshop owner to make the kiln cover was rather difficult and required a great deal of discussion. The kiln cover was completed in the last hour of the last day of the training workshop. Luckily, it was well made and fit perfectly with the kiln construction. The cover was then painted to prevent it from rusting.

During operation, the kiln lid must be covered with 15 cm of rice husk ash. The ash functions to insulate the kiln and maintain the high heat.

The Yoshimura kiln can be operated directly after construction



Bamboo staves are arranging into the Iwate kiln



Adjusting the air flow at the mouth of horizontal drum kiln

is completed, as it does not need curing time. As soon as the wood and the person in charge of operating the kiln are ready, charcoal production may begin.

To protect the kiln from wind and rain, a good shelter was constructed with enough space to store the charcoal stock.

Some additional construction may still be needed to make the kiln functional. For example, a ladder or ramp may be needed for moving wood to the top of the kiln and retrieving the charcoal produced.

The Yoshimura kiln produces high-quality charcoal with a shorter carbonization time than other kiln models. Each charcoal batch takes around 100 hours to complete.

The Iwate Kiln

The Iwate kiln was designed with a 1.6 m² inner diameter, with a capacity of 2.6 m³ of wood. It has an expected charcoal output of 300 kg per operation. Each operation takes around 12 days: six days to complete carbonization and five to six days for cooling. Despite the length of the carbonization process, the charcoal produced is of ideal quality. High-quality wood

vinegar can also be collected from the chimney.

The kiln floor was made of stone sheets. This material functions to maintain a high degree of heat evenly distributed throughout the kiln. The inner wall was lined with stones 15 to 20 cm in diameter, and stabilized by coral sand, a heat-keeping agent. The outer wall was constructed with hollow concrete blocks to strengthen the structure of the kiln. The space between the walls was filled with a mixture of red soil and crumbled material from previous structures, which provided heat insulation.

The chimney was made of red bricks, with small stones and coral sand applied around the chimney body. Below the chimney a water tank was constructed to catch water overflow from the kiln.

The dome of the Iwate kiln is the most critical part of the kiln construction. Although the best material to use is castable cement, it was not locally available and is very expensive to import. For that reason, alternative materials were sought and tested. A suitable mixture was developed consisting of 60% local yellow clay, 30% fine sand, 10% cement, and additional



Horizontal drum kiln

rice husk ash. To minimize the risk of the kiln dome losing shape during the curing process, a 20 cm x 20 cm grid frame was constructed to support the dome, made from 10 mm iron bars.

The Iwate kiln takes more time to operate, but produces higher quality charcoal and wood vinegar than most kiln models.

Other Alternatives: Smoke Charcoal, Vertical Drum Kilns, and Horizontal Kilns

Although the kiln construction was greatly appreciated by the local participants, many were concerned that the quantity of charcoal production may be limited. In response, the production expert provided instructions for several other types of above-ground kilns to help supplement charcoal production:

1. Smoke charcoal technique: Usually used to carbonized fine materials such as rice husks or saw dust. Made from GI pipe or hollow bamboo pipe.
2. Vertical drum kiln: Used to produce charcoal from dry biomass waste.
3. Horizontal drum kiln: Used to produce charcoal from wood. Produces better quality charcoal compared to traditional methods.

Participants learned the basic principles of carbonization using these techniques. All of the above kilns were completed in 10 days and were only possible because of the hard work of the coordinator from Approtech Asia, along with ARECOP staff and local workers.

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Paidi Family

Charcoal Producer From The Foot of Mount Merapi

Edwin Sujarwo - ARECOP

The day was still early, at about five o'clock in the morning, when Paidi family was unloading charcoal from a soil pit kiln. The soil on the top surface was first removed, followed by the removal of soil on the sides of the kiln. Charcoal was uncovered from underneath the soil. The charcoal was unloaded a little at a time. Water was splashed to extinguish the glowing charcoal. There were four kilns which emitted thin white smoke from the surface layer of straw and soil.

"We failed this time" Mrs. Paidi exclaimed, as she pointed to the stack of wood which had just been unloaded from the kiln yesterday. About half of the charcoal, was still made up of mostly wood. "This happened if we forget to control the fire" added Mr. Paidi. He was slightly disappointed. However he quickly gathered all the leftover and added more fresh wood - a preparation for the next firing.

Since 1965

Rows of neatly stacked wood were seen as we entered the front yard of Paidi's house. The wood pieces have been chopped into uniform lengths and stacked up to one meter in high.

We proceeded to the back yard, an area of modest size where there were operating pit kilns, releasing thin smokes from cracks on the outer soil surface. Mr. Paidi started selling firewood from more than 40 years ago. At that time, he was still young; he with his assistants purchased trees, cut and chopped them into sizes, which was then sold. Trees were purchased from the surrounding villages. "In the past, there were still a lot of trees. I chopped the wood and sold it as firewood'. He was telling us story from the past.

He still remembered that in 1965,



Mr. Paidi



Arranging the wood for making charcoal

there were several food stalls which place charcoal order to him. He then started to produce charcoal as a side job, to fulfill his customers' demands. He started to try to produce charcoal at the back yard of his house. He self taught himself on charcoal production, through watching charcoal production in the neighbouring villages. The method is as follows - wood pieces are stacked on the ground surface, it was then fired from the bottom using smaller wood pieces and rice straw, after that, it is then covered with soil. The process was then left for 3-4 days. During that time, charcoal was not used widely since people still preferred firewood which was cheaper. He then stopped producing charcoal and concentrated on his firewood business.

Efforts to improve charcoal quality

By 2001, Mr. Paidi observed the rapid growth of charcoal utilization in food stalls in Yogyakarta. He thought that, the time was right to produce charcoal, since its usage was growing. However, he considered that the quality of charcoal he used to produce was not good enough. His ambition to improve the quality of his charcoal brought him to Temanggung, in Central Java, which was known as the production center of good

quality charcoal. Mr. Paidi decided to hire a charcoal producer from Temanggung to produce charcoal at this place for a month. The technique used by the Temanggung producer was different from what he had known previously. Initially, a ground was excavated, with the length of the pit based on the length of the wood to be processed, while the depth of the pit is based on the stacking height of the wood. Wood is then stacked inside the pit and firing was conducted from the bottom. When sufficient temperature has been obtained, the top surface of the stack is covered with rice straw and then is covered by a layer of soil. The process is left for 3-4 days and the wood has been converted to charcoal. The completion of the process is indicated by the drop on the level of the top most surface by 15-20 cm and the appearance of thin and small quantity of smoke from the cracks on the surface on the kiln's surface. The kiln can then be dug and the charcoal harvested.

According to Mr. Paidi's observation, higher quality but lesser quantity charcoal is produced using the technique. The smaller yield was due to the production of higher amount of ash. Using the old technique, 6 big sacks of charcoal can be produced compared to the 5 produced using



Covering the wood with straw and soil



Initial firing started from the bottom

the newer technique. Since consumers paid the same price for charcoal of different qualities, hence the new technique does not bring about economic improvement. Besides the economic issue, according to Mr. Paidi, the new technique is also more complicated, firing is more difficult, and the need for more frequent control since fire often goes off.

Not thoroughly satisfied with the charcoal production method from Temanggung, Mr. Paidi explored further this brought him to Wonosari, which is still in Yogyakarta province. He again hired a Wonosari's producer to produce charcoal at his place for 1 month. The charcoal production technique from Wonosari was not very different from what he had practiced in the past. Initially, wood pieces, the size of adults' thigh and 1m long were stacked on the ground. At the bottom of the stack, 3 smaller wood pieces were placed 30 cm apart to create openings at the bottom, needed for firing. The first stack consists of the biggest wood pieces, approximately 20 cm diameter; followed by middle sized wood pieces, which are placed above; then, by small wood pieces on top of the stack. The height of the stack is approximately 1.2 meter. Gaps in between wood pieces need

to be minimized in the stacking. There are altogether 4 openings at the bottom, measuring 25 cm wide and 8 cm high, wherein firing is done.

The wood stack is then blanketed with dry rice straw with a thickness of about 20 cm. The sides are filled with soil, the front and back sides are not covered, since firing is done in those openings. Small wood branches and dry leaves are used to start a fire. When fire has gained sufficient intensity, the holes are then covered with soil and fire is controlled regularly. The same procedure is repeated for the hole located at the back.

Control of the fire is usually done in the evening. The whole process is usually completed in three days. According to Mr. Paidi, the method he learnt from Wonosari was basically the same with what he had practiced initially. However the producer from Wonosari provided him with important tips on wood stacking, on the control of fire and on smoke observation.

Complaint from customers

The demand for wood charcoal in Yogyakarta has been growing along with the increase of the population in the city. To meet the demand, Mr. Paidi also distributed charcoal from other producers. He stopped distributing charcoal from other producers when he received complaints about the unstable quality of the charcoal he distributed. He realized that he was not able to control the quality of charcoal from other producers. Now that he had stopped distributing charcoal from other producers, he was happy that he no longer received complaints - despite the limited income from the sales of the charcoal he



Packaging the charcoal into the sacks

produced.

He realized that to keep his customers, he needs to maintain the quality of charcoal he produced. "A good charcoal is hard, it does not smoke when lighted and it does not finish quickly when burnt", Mr. Paidi said. "To get good quality charcoal, hard wood must be used", he added. "I used wood such as rosewood, acacia, tamarind tree and mango tree. He also thought that it is getting more difficult to get wood nowadays. When he restarted the charcoal production in 2001, he only needed to go to the neighboring villages to obtain raw materials, now he must go further. The price has also been increasing. He and his three assistants had to make daily

trips in search of wood for charcoal and firewood. While charcoal production was taken care of by his wife and a relative. According to Mr. Paidi, more income could be made from the sales of charcoal.

He further explained, "For the production of charcoal, I only need to pay once for transportation, from the location where wood was purchased to my place. Charcoal buyers will conduct the purchase at my place and transport it themselves. However, I need to transport the firewood twice, from the location where wood was purchased to my place, then from my place to the location of firewood buyers".

"I'm grateful that I'm still healthy at this old age. If in the future there is no more tree, I have to do something else to earn a living", Mr. Paidi expressed. His two sons had no interest to continue the charcoal production business and had gone to the urban area to work. When asked how long he will continue to carry out the charcoal and firewood business, he said, "as long as there are still demands for them" he replied with a big smile.



The Paidi family

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Charcoal Production in Davao:

What is New in this Traditional Practice?

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Charcoal and its Uses

The burning of wood by controlling oxygen which slows down the combustion process produces a black substance commonly known as charcoal. Charcoal is a carbon residue which has been used to produce heat energy by humans perhaps since the beginning of civilization. Generally, charcoal is used for industrial production and as a home fuel. Its specific uses may differ from time to time, person to person, place to place or depending on the status of the people using it.

Today, charcoal is one of the cheapest sources of commercial energy in the Philippines and maybe in other countries where trees are abundant. It is now one of the best alternative sources of home fuel considering the present economic crisis. Although many others use charcoal because it is hotter and cleaner, less hazard and produce aroma in food satisfying to the feeling. People who have attained higher financial status use charcoal only for outdoor activities such as backyard grilling (i.e. barbeque, fish). But more people



Traditional charcoal making in Philippines

use it as a main energy source in the household.

In the Davao region, until the late 1990's, the main producers of charcoal were coconut farmers. Their main raw materials for producing charcoal were coconut shells. They supplied fuel both for home and industrial use. Coconut charcoal is one of the best fuels because it can stand longer. With

increasing demand for coconut charcoal for industrial use here and abroad, the price already soared high which is no longer cost-effective to use for cooking nowadays.

At the beginning of the 21st century, other non-coconut farmers are seeing the opportunities and starting to produce charcoal from wood trees.

There are two tree species that farmers find convenient to carbonize due to their high energy-efficiency: these are locally known as “Giant Ipil-Ipil” and “Madre de Cacao” trees. These species are both easy to grow, fast growing, fast regenerating and widely available in the Philippines.

There are now several forms of charcoal on the market for home use. At supermarkets, briquettes are available (processed charcoal pre-formed into blocks) and coconut charcoal cleaned from residual dust. At public markets, repacked natural wood charcoal and coconut charcoal are available in different sized packages. The packages range from enough charcoal for one cooking session to enough for use over three days. Wood charcoal is, however, much cheaper than coconut charcoal. The price of wood charcoal is almost 50% lower than the price of coconut charcoal.

For the Davao Region, the biggest volume of wood charcoal is sold at variety stores and other retailers in the community using recycled rice sacks as one package. The average price of wood charcoal now ranges from \$1.60 - \$1.70 US per bag with weight

ranging from 11-18 kgs per bag. Other big consumers of wood charcoals are those selling roasted chicken that are proliferating almost everywhere these days.

Practices in Charcoal Making

Charcoal production practices in Davao Region are basically traditional in nature. Wood is converted to charcoal through the partial combustion process. Under this system, heavy fumes are released to the environment during

carbonization. The process is simple but critical. If burning is done by a non-expert, all of the fuel wood might be turned into ashes.

In charcoal making, poor control during the combustion process can result in a low recovery rate and poor quality of the charcoal produced. During the burning period, oxygen must be properly distributed in the chamber but managed in such a way that it is of very minimal supply.

There are various stages before charcoal is produced. The first stage is the heating of the chamber until it can sustain the burning process; the second is the drying of raw wood materials; third is the burning where gases are released as heavy fumes visibly come out of the chamber; fourth charcoal is produced.

Quality charcoal can be produced if the production process is properly prepared and managed. Selection of good fuel wood as raw materials also contributes to good quality. Old cut wood already

infested with insects and fungi can no longer produce good quality charcoal.

Charcoal producers in Davao use different methods and techniques. The most common methods are the use of oil drums as furnaces and the earth-pit method. Many of the producers using coconut shells as raw materials use drums to produce charcoal. While those who use wood as raw materials mostly use the earth-pit method. Although, they excavate earth pit of different dimensions and forms. Some use galvanized iron sheets and flattened drums to cover the kiln with soil on the top. While others also use green grasses or banana leaves and pulp to cover the chamber with soil on the top.

Charcoal production in this part of the country is still on a subsistence level. But with the significant number of farmer-producers participating in the industry, it was able to substantially produce volume enough to cushion the impact of skyrocketing prices of



The raw materials for coconut charcoal



Vertical drum kilns were used for coconut charcoal making

fossil fuels (i.e.: LPG, kerosene, etc.) and electricity.

Increasing Demand

When the financial crisis erupted in the late 1990's, more people seemingly shifted, or partly, used traditional fuel in cooking their food. There was a tremendous increase in demand for charcoal as fuel. The unprecedented increase of LPG, kerosene and electricity make charcoal the best alternative fuel because it does not produce soot on cooking utensils, it is easily available, easy to manage and cheaper than LPG, kerosene, and electricity.

Filipino cuisine also influences the demand for use of charcoal. Filipinos love to eat "Bulalo" (chopped cow or carabao legs cooked slowly until very soft and the bone marrow is released as fat), "Balbacua" (cow or carabao epidermis cooked until very soft), barbecue, grilled fish, grilled pork, roasted chicken, roasted pig, etc. All these dishes are best or most efficiently cooked using charcoal.

[The average population growth rate in Davao region is 3% per

annum. Therefore it is also expected that the demand is assured of increase every year considering only the growth of population. It excludes yet the introduction to the market of improved charcoal fueled stoves with energy-efficiency comparable to electricity or LPG fueled stove.]

Blessing in Disguise?

While more sectors suffer the impact of high prices of energy fuel, ironically it also created remarkable opportunities to; 1. the Farmer-Producers who find charcoal making as another livelihood activity that can generate revenue 2. the Labor sector for another job opportunity 3. the Small-Scale and Community-based businesspersons who engage in repacking of charcoal to a more affordable sizes and retailing 4. Business sector who provide trucking services and capital in transporting charcoal from production area to nearer to the consumer. More so that used bags of rice are also reutilized giving it additional market value.

The situation also created the charcoal stove makers to produce more and improve their products to suit market needs. The flourishing of different improved stoves sold in the market is a real manifestation that charcoal industry had soared high for the past few years.

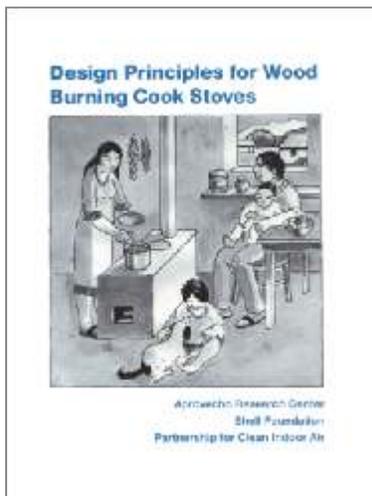
Several of these improved stoves now available in the market are designed either as survival mechanism against the currency turmoil or as a cooking gadget with performance efficiency and convenience comparable to electric, LPG and kerosene stoves.

Turning Threats to Opportunities

The use of fuel wood in cooking food has been the lifeblood of the poor. But the practice of converting wood to charcoal or using firewood both produce fumes maybe harmful to the environment and human beings. Perhaps the use of charcoal in cooking food attempts to eliminate harmful effects to the household. However, charcoal production is expected to cut more trees as the most sufficient source of raw materials. Certainly, it will create more pressure to the environment and most particularly to our dwindling forest.

However, these threats posed to the environment are challenges that can be turned into opportunities. Like if the charcoal-producers are given enough information, they will be able to appreciate the importance of planting more trees to ensure sustainable charcoal production. Policies also can be designed in such a way that other carbonaceous materials from agricultural wastes can be utilized as raw materials for charcoal production. *glow*

RESOURCES



Design Principles for Wood Burning Cook Stoves

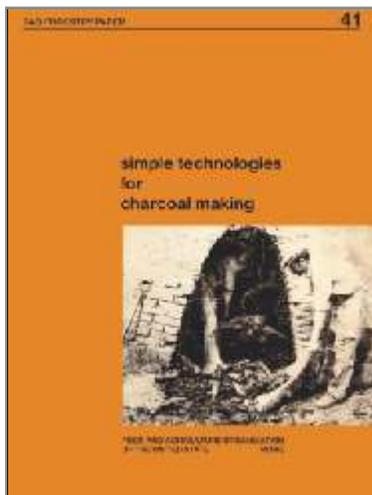
Aprovecho Research Center

Shell Foundation

Partnership for Clean Indoor Air

This booklet provides concise information on the thermodynamics of cookstoves and tactics for improved stove design. As a practical guide for stove designers, it outlines the work of leading researchers, explains the basic theory behind stove improvement, and offers technical details of the central principles for design.

The final chapter provides designers with an in-field method for measuring the performance of stove prototypes. A water-boiling test provides reliable information about the performance of a stove without requiring a computer or complicated calculations for data analysis.

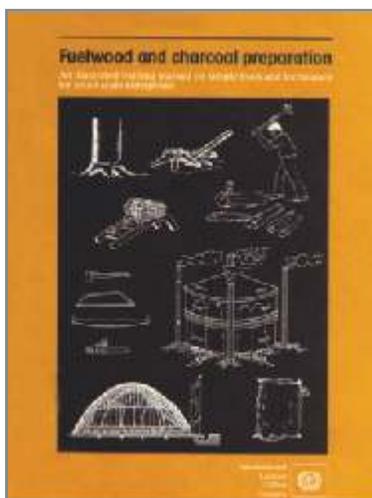


Fuelwood and Charcoal Preparation: An illustrated training manual on tools and techniques for small-scale enterprises

International Labour Office Geneva

Fuelwood and charcoal are major sources of energy in developing countries throughout the world. In countries which face an acute energy shortage, efficient methods of fuel production are of vital importance. In order to make the most efficient use of natural resources and ease fuel shortages, wasteful methods of fuelwood and charcoal production must be avoided.

This training manual is a revised and enlarged version of an earlier manual on charcoal preparation. It presents step-by-step directions for preparing fuelwood, along with detailed illustrations.



Simple Technologies for Charcoal Making

Food and Agriculture Organization of the United Nations Rome

This comprehensive manual presents techniques for making charcoal using simple technologies. Its main purpose is to inform and orient government agencies and industries in developing countries concerned with improving production and distribution of charcoal.

This manual represents the collective wisdom of charcoal makers from many countries. It is offered with the hope of increasing charcoal production, while also conserving forest resources by curbing wasteful methods of production.