Charcoal and fuel-wood are not the principal causes of deforestation in Haiti.

Charcoal and fuel-wood contribute 70% of Haiti's energy supply.

Embracing charcoal will lead to investment, improved production and use, and will support one of Haiti's largest and most important agricultural industries: charcoal.

Reforestation can be achieved within ten years with little cost to the State.

John Dale "Zach" Lea, Ph.D., Agricultural Economist, Catholic Relief Services, May 2017

We've passed the "tipping point"[1] in society's estimation of charcoal. Henceforth, it will become more and more acceptable to assert that charcoal is not the cause of deforestation in Haiti. Pushing the turning tide of sentiment are recent studies and events. In September 2016, the United Nations Environmental Program (UNEP) published what was perhaps the first positive study of the impact of charcoal in Haiti, describing sustainable charcoal production in southwest Haiti.[2] Following on a World Bank study of charcoal and fuel-wood use in Sub-Sahelian Africa,[3] Kenya has reversed years of policy and legalized the production and marketing of charcoal.[4] In April, it was announced that the first export from Cuba to the US in over fifty years would be charcoal.[5] The May 8/9 issue of Haiti's La Nouvelliste newspaper carried the headline: *Le charbon de bois n'est pas la principale cause du déboisement d'Haiti*[6] *(Charcoal is not the principle cause of Haitian deforestation.)*

So, what has been the cause of deforestation? A quick history would include the following. When the Europeans arrived they did what was considered normal for the times: they took everything of value that they could find. The gold went first. Then, the natural resources. They say that the Artibonite River flowed with old-growth mahogany and campeche logs.[7] Later on the Europeans used trees to process sugar---the white gold of the Pearl of the Antillies. They cleared the forests to plant coffee. More recently, in 1941, under President Lescot, the Haitian and American governments formed a company, Société Haïtiano-Américaine pour le Développement Agricole (SHADA), for agricultural development.[8] The company was owned 100% by the Haitian government and was funded by a $5 million loan from the US Export-Import Bank. One of SHADA's activities was to grant concessions to private companies to

[1] Gladwell, Malcolm, The Tipping Point: How Little Things Can Make a Big Difference,
[2] Haiti South Department Forest Energy Supply Chains. UNEP Haiti, September 2016.
[3] Sander, Klas; Haider, Syed Waqar; Hyseni, Besnik. 2011. Wood-based biomass energy development for Sub-Saharan Africa : issues and approaches. Energy Sector Management Assistance Program (ESMAP). Washington DC : World Bank.
[4] http://www.businessdailyafrica.com/New-laws-legalise-sustainable-charcoal-trade-to-save-forests/539546-1071772-11mhqw9/index.html
[5] http://www.reuters.com/article/us-cuba-usa-export-idUSKBN14Q0DB
[6] http://www.lenouvelliste.com/article/170838/le-charbon-de-bois-nest-pas-la-principale-cause-du-deboisement-dhaiti#sthash.c6cZ6wDj.dpuf
[7] Campeche is logwood or bloodwood in English (Haematoxylum campechianum). It was harvested and sent to Europe where the wood was used to make a red dye.
[8] Casimir, Jean. La Conception de SHADA, http://islandluminous.fiu.edu/french/part09-slide09.html

continue mining the forests. One concession was to log the Ile de Gonave, once covered with old-growth mahogany and campeche. Another SHADA project was to "scientifically" exploit one of Haiti's last remaining forest: the Forêt des Pins, the great old-growth pine forest running from behind PauP to the DR border.[9] After Duvalier became president, he "...continued to grant "juicy contracts" to individual Haitians to exploit Haitian lands for lumber and charcoal and called for the complete deforestation of areas in the Artibonite valley to deny hiding places as protection against his opponents."[10]

The Haitian people, led by Haitian presidents Lescot and Duvalier were apparently so alarmed about deforestation they promulgated a series of laws to regulate the use of the land and the forests. The law we remember best is the Rural Code of Dr. François Duvalier which requires a permit from a forest officer to harvest a tree. This set the tone for what we have today: a strong social norm against tree harvest and uncertainty about the idea of tree farming. In the late 1990s, Joanas Gue and I worked with USAID's Productive Land Use Systems project (PLUS). We thought about planting a small forest for sustainable charcoal production. We discarded the idea due to the uncertainty of its treatment under Haitian law and due to concern as to the unfavorable press it might bring to our international organizations.

In the modern era, people have continued to be alarmed about deforestation and have generally blamed charcoal. This is the common error of confusing correlation with causation. Deforestation is correlated with charcoal production but deforestation is not caused by charcoal. Deforestation in the modern era is caused by agriculture and its aftermath. Remember what the Pilgrims did when they landed in America? They cleared the forests so they could farm. And in the years afterwards, New England and much of the eastern US was cleared for farming. But after wars and better economic opportunities drew the people off the land, the forests returned. Vermont was 35 percent woods in 1850 and is 80 percent today, and even Massachusetts, Connecticut, and Rhode Island have seen woodlands rebound to the point where they cover nearly three fifths of southern New England.[11] The southeastern US is a giant pine forest that has been repeatedly cut and regrown. In the aftermath of tree harvest in the US, the trees are replanted or are simply allowed to regrow.

In Haiti, the trees are often prevented from re-growing on agricultural land. It is culturally acceptable to allow cows and goats to enter an agricultural field, after the crop has been harvested, to clean-up any remaining crop residues.[12] Any plant, tree, or grass, is eaten. This is as the farmer desires because the land is kept clear of non-crop plants and the farming cycle can begin with re-tilling the soil. If the land is under a crop or under the multiple crops of agroforestry, cattle and goat owners respect the crops and do not allow their animals to graze the gardens. I have a personal experience with this cultural practice. Within the USAID PLUS project, Junior Paul and I worked with José Sylvain, one of the leading exporters of mango, to establish a small plantation of mango as a test of cooperation between farmers and exporters. The farmers granted the exporter the right to plant his trees on their gardens. We thought we had agreements and cooperation from everyone involved. We worked with the exporter and the farmers to plant the trees. We congratulated each other, took our pictures, and went home. The

[9] FAO : http://www.fao.org/docrep/003/X6768F/X6768F07.htm
[10] Gilbert, Myrtha. Haïti : La catastrophe n'était pas naturelle. AlterPresse. Nov/1/2008. http://reliefweb.int/report/haiti/ha%C3%AFti-la-catastrophe-n%C3%A9tait-pas-naturelle
[11] The Atlantic Magazine, April, 1995. https://www.theatlantic.com/magazine/archive/1995/04/an-explosion-of-green/305864/
[12] Shannon, Dennis, Auburn University, personal communication, and introduction to Haiti, 1993.

following nights, cows ate all of the mango samplings! We had not established agreements with the local cattle owners who continued to follow local tradition and lead their cows onto the "fallow" gardens. The animal owners did not recognize the trees as a crop.

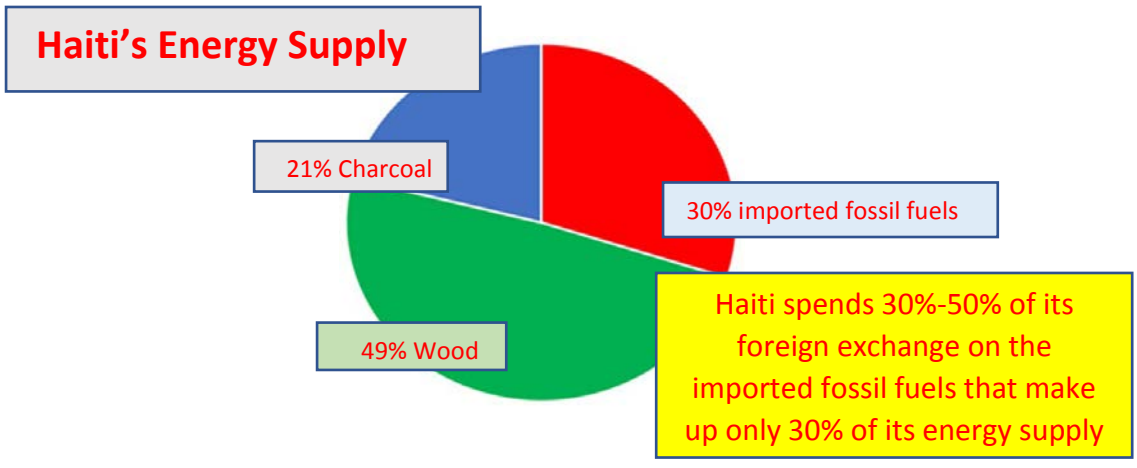
Where farmers use a agroforestry system, the land remains partially or totally covered by trees and long-cycle crops, interspaced with short-cycle crops. The land is never fully cleared. The pictures below illustrate the two agricultural systems: agroforestry and cleared-field agriculture. The pictures illustrate why deforestation has occurred in Haiti over the recent past. Deforestation in modern Haiti is caused by cleared-field agriculture, not the production of charcoal.

On one side of the same road: a garden protected by agroforestry[13]

On the other side of the road: a corn and bean garden kept clear of trees and long-cycle crops

Charcoal and fuel-wood make enormous contributions to Haitian society and economy

Charcoal and wood provide 70%-75% of Haiti's energy supply.[14] Haiti spends 30%-55% of its foreign



[13] Sipple, Elizabeth, Mercy Corps Vie, Tè, Enèji Project, Personal communication, 2013.

[14] World Bank, Haiti: Strategy to Alleviate the Pressure of Fuel Demand on National Woodfuel Resources, ESMAP Technical Paper 112/07, Energy Sector Management Assistance Program (ESMAP), 2007, Page XV.

exchange to purchase the 30% of its energy supplied by imported fossil fuels.[15] [16] The graph above represents the situation. To replace charcoal and wood with imported fossil fuels, Haiti would need nearly 4 times as much foreign exchange as it has now.

Until solar, wind, bio-gas, or other renewable energies take over,

Charcoal and fuel-wood will continue to be the major component of Haiti's energy supply

Charcoal and Wood Contribute to Disaster Relief and Recovery

Charcoal and lumber are components of rural Haitians' savings banks. When emergencies arise, when large expenditures arise, when school fees have to be paid; rural Haitians often harvest one or more trees. If the trees are large enough, Haitians saw them into planks or heavy wooden pieces for house construction. If the trees are small, they are sold as posts. The smaller pieces are made into charcoal or used directly as fuel for cooking. Forward-looking Haitians cultivate trees for these purposes.

Hurricane Matthew struck southwestern Haiti in early October 2016 at the beginning of the cacao harvest season. Most of the cacao crop was lost. Some 40% of the cacao trees were destroyed. The breadfruit crop was destroyed. The yam crop was destroyed. Many homes were destroyed along with the corn and bean seed being kept for planting during the regular planting season in October/November.

The only items of value the farm families had to sell were their surviving animals, charcoal and lumber made from the many trees destroyed by the hurricane.

Thanks to the existence of a well-developed charcoal industry, charcoal was easy to sell in large quantities.

Without the charcoal value chain, these relief funds would not have reached Haitians in the Hurricane zone.

This picture of trucks loaded with charcoal was taken on a secondary road near the main highway leading to Jeremie. December 2016.

[15] UNEP, Haiti, Haiti South Department Forest Energy Supply Chains, September 2016, page 14.

[16] "The petroleum products subsector, which represents only 20-25% of the national energy supply, uses more than 35-50% of external receipts of the country." Ministry for Public Works, Transportation and Communications, Bureau of Mines and Energy, Electricity of Haiti, Haiti Energy Sector Development Plan, 2007 – 2017, page 4.

Charcoal and planks awaiting sale at a coffee cooperative (damaged by the storm) near Pestel, Grand'Anse. December 21, 2016.

Charcoal at the roadside near a farm house in the Grand'Anse, awaiting sale. December 21, 2016.

Picture from main highway between Jeremie and Beaumont. December 21, 2016

Charcoal's Contribution to Jobs and Value Added:

Annual value of Charcoal in PauP: $150 million[17]

Compare with Annual value of Cacao exports: $8 million

Employment in Charcoal Value Chain: >150 thousand[18]

Employment in Cacao Value Chain: <30 thousand

Charcoal's Dependence on Fast-Growing, Coppicing Trees

Sustainable charcoal production in Haiti depends on trees that regrow (coppice) after being cut down. Charcoal producers "manage" their energy gardens. They cut the trees for charcoal, wait 4-6 years until the trees grow back, and cut them down again. This is the pattern of commercial forests in many parts of the world. The Haitian charcoal industry's dependence on coppicing trees has largely escaped attention. For example, In 1976, the United Nations reported that "...the charcoal industry in Haiti would only be able to satisfy the demand [for] fuel needs for ten years."[19] In the late 1970s, USAID had a reforestation project near Jean Rabel. Here's an excerpt from a report made at that time.

[17] "ESMAP Study:" Haiti: Strategy to Alleviate the Pressure of Fuel Demand on National Woodfuel Resources, Energy Sector Management Assistance Program (ESMAP), 2007, Page 15.

[18] Ministry for Public Works, Transportation and Communications, Bureau of Mines and Energy, Electricity of Haiti, Haiti Energy Sector Development Plan, 2007 – 2017, Page 3

[19] Moeller, Roger, Renewable Energy Plantations for Charcoal Production, quoted in:

> "Each week an estimated 12,000 sacks of charcoal leave the Jean Rabel region for the Port-au-Prince area... The deforestation of the Jean Rabel region is proceeding at a rate of 288 ha/week or 14,024 ha/yr, based on Earl's estimated growth rate of 10m^3 wood/ha/yr. Earl calculates that approximately 1 million ha/yr of the total forest cut naturally regenerates.... While 2,000 ha of trees are being planted through the USAID/DARNDR LAD Project, charcoal producers will be busily cutting down some 53,000 hectares of trees. The rate of deforestation will exceed reforestation by a factor of 25. "Frightening?""[20]

Given what we know about forest cover in Haiti today, it is obvious the dire predictions of the past have not been realized. Obviously, the trees are re-growing and Haitian forests may no longer fit the traditional definition applied to old-growth forests. Modern Haitian forests may only be a few feet high.

The best charcoal examples in Haiti are mesquite (*Prosopis juliflora*) and neem (*Azadirachta indica*). The Haitian word for mesquite is *Bayawonn*. In the picture below, I am standing on an enormous stack of mesquite being prepared for conversion to charcoal near Cape Haitian. In the background, you can see the large mesquite forest from which this wood was taken.

Neem, which was introduced into Haiti from Senegal in 1967, is another of Haiti's mini forests. The

RENEWABLE ENERGY AND CHARCOAL PRODUCTION, Michael D. Benge, Agro-forestation Advisor, Agency for International Development, October 1978, page 1.

[20] Moeller, Roger, op.cit., page 5

tree was planted along Highways 1 & 2, running north and south from Port-au-Prince. As most observers know, the tree has colonized large areas of land that have been abandoned by farmers. The pictures below show the current neem "forest" growing along the southern highway and being exploited for fuel-wood and charcoal.

A rack of neem sticks awaiting sale along Hwy 2 just south of Carrefour Dufour. Such racks are seen in several places along this road.

Scene showing the extent of the colonization of the hills in the area by neem.

The United Nations Environment Program report, Haiti South Department Forest Energy Supply Chains. UNEP Haiti, September 2016 discusses the sustainable charcoal and pole-wood "industry" in the Commune of Maniche, near Les Cayes. There, the fast-growing tree is *Acacia mangium*, introduced into Haiti from Southeast Asia and promoted by USAID's Productive Land Use System Project (PLUS) in the late 1990s and early 2000s.

Acacia mangium was also established by the USAID/PLUS near Acul des Pins and Perches in the North-East Department. The pictures below were taken this year from that area. Acacia gardens near Acul des Pins have been cut for charcoal more than once and are now re-growing for the next cutting.

Piles of Acacia poles with the Acacia garden in the background

Acacia garden near Perches, NE Dept.

Eucalyptus is another fast-growing, recent emigrant to the new world and to Haiti. As are Haitians, most of Haiti's important trees, breadfruit, mango, cacao, and coffee are emigrants to this land. *Eucalyptus grandis* could play a major role in Haiti's charcoal industry and its

future forest industry as it is currently doing in Uruguay. Uruguay has planted a 25,000ha forest of *E. grandis* and are exporting the sawn wood as a substitute for mahogany, under the brand name Red Grandis. The wood sells in US specialty wood shops at $7 per board foot. The Uruguay industry harvests the wood on a 12 year cycle. See http://www.urufor.com.uy/.

Red Grandis Eucalyptus Plantation in Uruguay

Many people mistakenly believe that Eucalyptus "dries the land" and kills most plants around it. However, this appears to be an urban myth as the following pictures demonstrate. Also, the cover of Bwa Yo: Important Trees of Haiti shows a 12-year-old eucalyptus near St. Michel de l'Attaye.

> According to the FAO: "*Eucalyptus* is an efficient biomass producer, it can produce more biomass than many other tree species. It also consumes less water per unit biomass produced than many other species of trees; but as a result of its fast growth and high biomass production *Eucalyptus* species consume more water than other, less productive species. Growing *Eucalyptus* in low rainfall areas may cause adverse environmental impacts due to competition for water with other species and an increased incidence of allelopathy. Generally, the areas which receive an annual rainfall of less than about 400 mm are less suitable for *Eucalyptus* wood production purposes due to this reason...The Allelopathic effects of *Eucalyptus* are more prominent in areas with low rainfall (less than 400 mm annually)Allelopathic effects may have implications when other species are grown near *Eucalyptus* trees. This is important especially in agro-forestry systems.[21]

Eucalyptus growing on lawn near other trees near Leogane.

[21] http://www.fao.org/docrep/005/ac777e/ac777e0a.htm

Eucalyptus in freshly planted corn and bean garden, Boutilie Mar 2017

Eucalyptus lining bean garden, road to Jacmel May 2017

Eucalyptus in banana garden near Leogane Jan 2017

Reforesting Haiti can be achieved within ten years

In collaboration with the ministries of Tourism, Agriculture, and Environment encourage friends and citizens of Haiti to plant trees. A "Fast Forest" program, in collaboration with Phillippe Mathieu's 4 by 5 project, would help them use fast-growing trees that can be planted easily from seed to cover the land quickly then plant fruit trees inside the forest once protection against grazing animals is assured. Use thick borders of fast-growing trees to form living fences around interior gardens. In fast-growing forests on flat land or gently-sloping hillsides, maintain alleyways for annual crops. If the fast-growing trees are nitrogen-fixing, use their leaves for fertilization. Intersperse fruit and lumber trees in gardens of fast-growing trees on flat or sloping land. A "Giant Trees" program would promote use of *E. grandis* for borders and windbreaks, topping the trees at 12-14 feet for wind-breaking strength and for production of planks, using the toppings for charcoal and fuel-wood.

Embracing charcoal will lead to improved utilization of charcoal and wood

As long as charcoal and fuel-wood are the objects of negative public policy, they will continue to remain in the background of Haitian society...the "elephant in the conference hall" no one wants to recognize...the "elephant" many people wrongly wish would go away. But, if charcoal and fuel-wood were recognized for their contributions to society and their potential for increased contributions, the private and public sectors would invest in R&D and scale-up useful techniques and devices. This is the sentiment expressed by a Kenya Forest Service (FFS) official on announcing

the legalization of charcoal in Kenya.

> "The forestry service seeks to regulate the charcoal industry and promote it as a viable business. What has happened over time is that there has been no incentive for investments in the industry and technology because you cannot invest in an industry without clear policy? You cannot be sure of tomorrow," said Emilio Mugo, senior deputy director, KFS, in a recent interview with the Business Daily.[15] Copyright ©2017 ::Kenya Forest Service

Kenya Forest Service officials seize charcoal before the lifting of a ban on charcoal-burning and sale. The new Forest Act will provide for charcoal-burning on a sustainable basis to stop forest destruction and ensure constant supply of fuel to families that cannot afford alternative fuels. Photo/LABAN WALLOGA.

Modern Charcoal Production Techniques Capture Some of the 60% of Wood Energy Currently Lost by Traditional Charcoal-Cooking Practices.

Current charcoal-cooking practices in Haiti are quite efficient---for Haitian socio-economic conditions, namely, charcoal's pariah status and very little investment. Haitian charcoal makers cook their charcoal with the natural resources they find at hand. They don't build or transport retorts. They often sell the charcoal "sur place." They arrive at the charcoaling site with little other than a manchet and a shovel and they leave the site with nothing more, perhaps, than a little money.

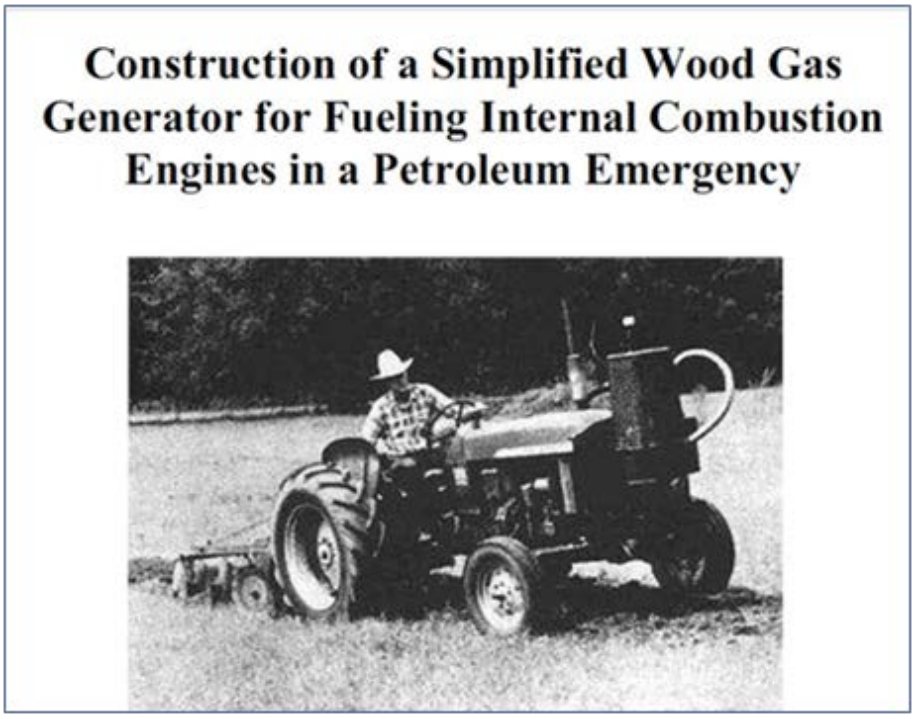
The picture below shows a charcoal maker tending his traditional charcoal kiln. This picture was taken in the Grand'Anse, near Beaumont, following the hurricane. Notice the large plumes of smoke escaping from the kiln. This smoke initially contains large amounts of water vapor being driven out of the wood being converted to charcoal. Later, the escaping gas is a mixture of methane and other flammable gases. Wood is converted to charcoal when it is heated in a reduced-oxygen environment. To produce the charcoal, the charcoaler lights the wood on fire and then manages the amount of oxygen reaching the fire by adding or removing the earth and leaves covering the pile. During this process, more than 60% of the energy in the wood escapes to the atmosphere.

Remember that charcoal supplies some 20%-25% of Haiti's energy. Imported fossil fuel supplies 30%.

Note: If 60% of the energy in Haiti's wood is lost during conversion to charcoal, Haiti is losing an amount of energy almost equal to its imports of fossil fuel. To maintain Haiti's relative energy independence (70% home-grown), more of this lost energy should be captured and used.

Even without this extra effort, Haiti is one of the leading countries of the world---in terms of its dependence on renewable energy. While Germany is struggling to increase its reliance on renewable fuels to 25%,---- Haiti is already at 70% reliance on renewable energy.

Modern charcoal-making retorts can capture some of that lost energy in the form of wood-gas. Using retorts to capture and use wood-gas is an old, well-understood process as the following picture illustrates.



In 1986, the Federal Emergency Management Agency (FEMA) published this pamphlet explaining how to build a device to produce wood-gas from wood. The pamphlet showed how to direct the gas into the carburetor of an internal combustion engine to power the engine. Here a man is using the wood-gas to power a tractor tilling agricultural land.

While this technology has languished in the backwaters of Western society, it has been further developed by environmentally-conscience tinkerers in the West and publicly-funded scientists in other countries have made substantial improvements in the devices to produce and use

wood-gas. The HUSK company of India has developed small-scale electricity production units powered with agricultural byproducts for small villages. Agricultural engineers in the Philippines are using rice hulls to generate electricity, mill rice, or pump water into irrigation systems.

A retort can be compared to a household pressure cooker. A pressure cooker is a heavy pot with a heavy lid that locks onto the pot. There is a small aperture in the lid used to control the pressure built up by steam on the inside of the pot. Charcoal can be made in a pressure cooker. Place some wood into the pot, seal the lid on and heat the pot on a stove. The gas escaping the pressure cooker through the small aperture can be set on fire or channeled into some other use such as powering an internal combustion engine. Inside the pressure cooker, the wood will have been converted to charcoal.

Retorts convert wood into charcoal and channel the wood-gas to other uses

Google: Charcoal retort

The adjacent picture shows a home-made retort. It is a small barrel inside a larger barrel. The wood to be made into charcoal is placed in the small barrel and the lid replaced. A fire is built in the space around the small barrel. In the picture the wood-gas escaping from the small barrel has been set on fire.

This photo suggests that a small retort could be used to cook food while simultaneously producing charcoal. It inspires the invention of a retort made from materials found in rural Haitian family homes that would allow the family to cook food with small sticks and pieces of wood taken from their energy garden while simultaneously producing charcoal, a marketable product.

Changing attitudes and embracing sustainable charcoal will:

- **Encourage more efficient production and use of charcoal and fuel-wood**
- **Support reforestation and one of Haiti's largest and most important agricultural industries,**
- **Save foreign exchange,**
- **Contribute to the effort to control global warming, and**
- **Help address the question: "Do smoke-free stoves really save lives?"**
  See http://www.bbc.com/news/magazine-38160671