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Mimosa Caesalpinifolia a new alternative for charcoal production

Haiti is a country located on the western side of Hispaniola Island in the Caribbean; with rough topography, where about two-thirds of the total land area is above 1,600 feet (490 meters) in elevation and is subject to periodic seismic activity. Its surface is 27,750 km² from which 38.82% according to the World Bank is arable land (World Bank, 2016). Its population is 11,067,777 (CIA, 2020), and is the poorest country in the Western Hemisphere, with a Gross Domestic Product per capita of \$756 in 2019 (World Bank, 2020) 37% made out of global remittances meaning it is the second-largest recipient of remittances in the world relative to its GDP (Batalova; Medina, 2020) and is placed in the position 169 out of 189 countries in the Human Development Index ranking of 2019 according to the World Bank which also specifies “The latest official poverty estimated (2012) suggested that over 6 million Haitians lived below the poverty line of US\$2.41 per day, and more than 2.5 million fell below the extreme poverty line of US\$1.12 per day” (World Bank, 2020). Almost 70% of rural households are considered chronically poor, against a little over 20% in cities (World Bank, 2014).

The average household is formed by 4.6 people and rural housing consists of two-room dwellings with mud walls, paneless windows along with wooden shutters and little furniture, toilets are usually a latrine dug far from the house (Britannica, 2020). In 2010 the country suffered a 7.0 Richter scale earthquake that caused between 220,000 to 300,000 deaths, 300,000 injured, initially 1.5 millions of displaced Haitians and 100,000 collapsed structures (CNN, 2020) due to the lack of an appropriate building code, construction in slopes without proper foundations, insufficient steel and no urban development planning (Watkins, 2010). Also hurricanes like Thomas (2010) and Matthew (2016), just to name a few, have contributed to homelessness and the increase of those who live in fragile tents or government camps which accounts for 2% of the Haitian population (Miami Herald, 2020). In addition to this, accessing basic needs such as education and health care is really difficult. (Britannica, 2020). According to the World Bank, “only 11% of Haitians in the countryside have access to energy compared with 63% in the cities”(World Bank, 2014), therefore kerosene lamps are used but sometimes the income is not enough to buy the fuel and depending on the sunlight is necessary (LifelineCM,2017).

Around 40% of Haiti’s rural population uses non-potable water sources like rivers or unprotected wells (World Bank, 2014) where 37% has periodic access to improved ones among the rural bottom (World Bank, 2018). Children collect water using water fountains or going straight to rivers tainted with human and other waste. Diseases such as hookworm and typhoid, which are transmitted by contaminated food and water are

common (Goldstein,2006). Coastal waters are polluted by organic waste, industrial and domestic sewage, phosphorus detergents, fertilizers, pesticides, and herbicides from denuded and irrigated agricultural lands nearby, as well as runoff after fires or logging affecting the reproductive capacity of crustaceans and fish, thus reducing the island's seafood supply and fishermen income (UNEP,2013). Biodiversity is also affected by the ambient degradation in Haiti, where 19% of all species are threatened with extinction (United Nations, 2016)

The high mountains block the majority of the precipitation carried by the Caribbean winds creating seasonal draughts in between the rainy season which are from April to June and from August to mid-November. The hardening of the soils and lack of vegetation allows the water to flow quickly without being absorbed into the soil and subsoil dragging more topsoil to the rivers and decreasing the filtering capacity of the basins while also having big amounts of soil ending up in the oceans (Bargout and Raizada, 2013). As result, we can state that “the country is more vulnerable to extreme events such as floods and the rapid depletion of rivers in periods of drought, which in turn reduce the number of crops and transform agricultural land into desert land”(UNEP,2013). This had led to the loss of up to 70% of the harvest, price increases of basic food products and lack of job opportunities in the agricultural sector. (United Nations, 2016)

Andrew Tater on his doctoral *Dissertation on Haitian farmer responses to ongoing deforestation* recalls almost every household takes advantage of the courtyard or river near to plant crops such as beans, squash or plantains and raise domesticated animals for sources of food; even absentee landowners may pay a resident, usually a relative, to grow crops for them, or raise an animal on their behalf as a favor exchange (Tarter, 2013). These in addition to mangoes, cassavas, corn, sweet potatoes, coffee and rice are planted in the average land holding, less than two acres, and are consumed at home, prepared with local spices and cooked in charcoal stoves; if possible sold in markets (Fergusson et al, 2020). Not everybody is capable of producing enough for its own consumption causing that in 2017 3.6 million Haitians were food insecure and 1.5 million severely food insecure (FAO and WFP 2017); as a matter of fact, anemia affects 59% of children between the ages of 6 months and 5 years (Blashfield, 2008). In desperate circumstances, people have turned to eat mud-cookies as they are way cheaper than a marmita (2,5 kg) of rice (ECHO, 2015) and are convinced that the clay from which they are made has minerals and is filling (Worldfocusonline, 2011). Food is the main expense of rural families accounting for 60% of their income, in the poorest groups it reaches 70% (Blashfield,2008). Although 78% of all households are involved in agricultural activities almost 25 % supplement their income by engaging also in some type of nonfarm activity as the agricultural productivity is very low due to the degradation of the soil and lack of modern agricultural practices makes them import most of their food from other countries, mainly the U.S. (Coello et al, 2014).

The charcoal value chain provides jobs for 250,000 individuals in the rural and urban population. In the South Department, approximately half of the peasants depend on it and firewood production as their primary or secondary source of income (UNEP, 2016, p. 20). On the other side, women usually cook and run food businesses around the country where their exposure to heat and smoke creates respiratory issues, eye sensibility, dehydration, amongst others; the fumes also affecting the elderly and infants. According to a study conducted in 2005 12.5% of children under the age of 5 die because of respiratory complications (Perry et al, 2005).

“Charcoal is a solid biofuel obtained from biomass by means of a chemical process known as “pyrolysis” or simply as “carbonization process”, which consists of the thermal decomposition of biomass in the absence of oxygen” (Müller et al, 2011). It is the main energy source for 72% of the Haitian population which consumes 400,000 tons yearly whereas the country is only capable of producing 70,000 sustainably (USAID, 2016). Its commerce is the second-largest agricultural value chain in Haiti representing US\$392 million, approximately 5% of their GDP (World Bank, 2018) and is the 26% of the total combined contribution of agriculture, forestry and fishing to Haiti's GDP. Also is one of the main spendings for the households as Haitians use one-third of their salary to purchase it; being the minimum salary the equivalent to US\$ 1 daily (World Bank, 2020).

This means we have several challenges at once. First of all, it is imperative to find ways to administrate the charcoal trade in the nation. Second, make the charcoal industry production sustainable and encourage the development of new initiatives to reduce or make more efficient use of it because the majority of the population will still depend on it for daily survival. Third, restore the fertility of the soils in the degraded land available, which will reduce erosion, and host other crops that can boost the economy reducing the dependence of charcoal and creating new sources of income for the smallholders.

Solution I: Regulate and Control Charcoal

Trade

It is important to recall that Haiti is not the only country whose population depends basically on charcoal as the main source of energy, specifically it was found a project financed by the Netherlands Development Organization (SNV) in Rwanda where the Charcoal Value Chain and Improved Cookstove Sector was analyzed and pointed out several challenges and recommendations regulating of its trade, based in their experience this solution was developed.

Firstly, the value chain of charcoal and its development in the country must be clear in order to address and improve aspects of said industry by understanding the process of production and acquisition for a further homogenization, implying additional research and

the collection of the already existing on the charcoal value chain and farmers, retailers and final consumers, price behavior, agronomic analyses on energy production techniques, environmental degradation and improvement, safe labor working conditions while cutting and transporting and the charcoal consumption habits. Recent innovations by farmers and the agroforestry systems should also be taken into consideration for better development in addition to an "Examination of prospects for long-term sustainability of different charcoal cultivation and harvest methods, in terms of soil nutrients and ground cover" (World Bank, 2018). Research institutions must share the knowledge of improved techniques, calorific values of the different charcoal and their benefits as they are discovered to producers and local authorities for decision making.

Producers often act without planning ahead of time, guided by increasing periods of drought or demand year round, using traditional carbonization techniques instead of proper forestry management ones resulting in low-quality charcoal and carbonization efficiency because of the type of material and dryness. Consequently, there is no standard weight, quality or appearance of the product inciting some to take advantage and divide big bags into smaller ones sold for a similar price. In the same way, the inefficiency causes the thick black dust which results from carbonization to be lost when it can be recovered to produce low-quality briquette, paint, shoe polish, insect repellent and fuel. In Kenya, The United Nations Development Program promoted the use of improved design vertical and horizontal drum kilns that reduce processing times from 2 to 3 days to 6-14 hours and increase yield from 120-180 kgs of charcoal per Ton of wood to 250 kgs (UNDP, 2016)

The government's role is crucial for long term planning to be effective if not the lack of enforcement of forest policies could negatively affect producers. For starters, prohibiting the cutting of immature trees and having to request a permit for it at all; as a requirement the trees must be fully grown and this must be checked by a local officer; if taxation is necessary it should be uniform for every province. Also, administration plans shall be set to restore provincial and national plantations where better management of resources like fertilizers or water could increase productivity. In terms of transportation having charcoal checkpoints on the road to make sure that people have temporary permits given by local authorities for transporting the material.

No bank wants to loan money to smallholders if they don't have a property title; for said reason the model developed in the Dominican Republic from 2012 to the present day could be a viable option. It consisted of a governmental initiative where the prospect farmers were organized in cooperatives and small and medium enterprises, later on provided loans to purchase planting material, equipment and improve infrastructure. At the same time, the Ministry of Agriculture provided technical services to improve yields and solve arising problems. The government agreed to loan them money as a group without using their land as collateral. (Redacción digital,2020)

Organizing the farmers and charcoal processors can reduce the transportation costs if they have collection centers and standardize the number of charcoal sacks allowed by each type of vehicle.

Solution II: Transitioning to propane gas stoves or improved charcoal stoves.

It is said by Robert Wicklein for any technology to be appropriate for communities in developing countries has to be “affordable by locals, decentralized, labor-intensive, energy-efficient, environmentally sound and locally autonomous” (Wickleid, n.d). The device should be able to stand alone and do its work without any supporting facilities or devices to aid in its function

(Jequier, 1979; Date, 1984; Ellis & Hanson, 1989), also it should provide an image of modernity as perception is very important when including a new product into the market, giving the impression that it elevates the user’s social status as well as meeting a basic human need; this is currently a problem as stoves are perceived as too expensive and most importantly it should be affordable for locals.

EnterpriseWorks, a division of Relief International in 2002 helped to establish a program in Ghana to optimize the use of charcoal stoves “This stove reduces the amount of charcoal needed for cooking by up to 50 percent” (Gyapa, s.f) while also containing ceramic liner, which is the critical element for heat absorption and retention, therefore emission reduction. They are handmade and the metal casings are from scraps in the area; usually discarded aluminum sheets, roofing, car bodies, refrigerator and air conditioner exteriors, and finally are hammered all together. The company is capable of producing over 100,000 Gyapa cookstoves every year growing into the largest local cookstoves production industry in Africa and one of the largest cookstove carbon financing programs around the world. The seed funding was from the Shell Foundation, USAID, and the U.S. EPA (Gyapa,s.f). This project has been replicated by local companies like LUTESA, EcoRocho or Jean Baptiste Enterprises who are looking for a way of producing stoves affordable enough for Haitians (USAID, 2016). Echo Rocho stoves cost US\$10.5 each. (Tavakoli-Far, 2013) By reducing the amount of charcoal bought in every household there would be 15% more of the salary to invest on food eventually leading to a decrease on malnutrition and an increase in food security that is precisely why supporting projects made by ordinary people is essential, as they are taking action towards a solution to the realities in their country, meaning hope is not lost and that the locals are starting to stand up for themselves.

Propane stoves don't produce smoke that can harm the user’s respiratory system making them cleaner and more environmentally friendly than charcoal while also cost-effective and long term solution which in comparison to the electric ones won't stop working during a power outage, very important considering that most people don't have electricity and

usually rely on sunlight. In the cooking aspect, there is more control over heat intensity and is evenly distributed to prevent injuries.

Solution III: Add *Mimosa Caesalpinifolia* as one of the species to be used for reforestation.

The *Mimosa Caesalpinifolia forma inerme* belongs to the family of the legumes endemic of the dry forest of northeastern Brazilian region, where it doesn't rain for 6 to 11 months and annual temperatures going from 22.1 to 27.2 oC. Reaches adulthood between 12 and 15 months and is very resistant to fire and if burned down can grow back in less than a year. Grows up to 10 meters tall and is used between 4 to 6 years producing 4 thousand stakes. It can be planted up to 1,200 meters of altitude and grows naturally in profound terrains even in areas really degraded where the earth has moved or the subsoil is exposed. It can provide shade over the cacao trees while fixing nitrogen on the soil that can reduce the use of fertilizer (Ramalho,2007).

Suitable for energy and coal production, it's wood is hard, compact and durable with big calorific power, elevated gravimetric performance (32.04%) and small ash content (1.71%). It has a big regenerative capacity regrowing up to 12 times. One hectare well cared can produce 40 m3 of wood for charcoal between year 4 and 6 (Silva et al, 2020).

It is melliferous producing huge amounts of pollen and abundant nectar substances that insects can, later on, turn into honey. This business has not been explored and totally developed in the nation and could serve as a new form of income for smallholders. The leaves have good forage values being palatable for cattle with a protein content of 13.48 to 17.06% (Ramalho, 2007)

Final Remarks:

Haiti is the U.S.'s 78th largest goods trading partner with \$2.4 billion in total (two way) goods trade during 2018; while total exports for 2018 were US\$1.2 billions, of which US\$1 billion (83%) were sent to the U.S. and total imports were US\$2.74B of which US\$902 B (33%) came from the U.S., resulting in U.S. goods trade surplus with Haiti was \$399 million in 2018. (OEC, 2018) Most of this trade is due to the Caribbean Basin Trade Partnership Act that provides for duty-free export of many Haitian products assembled from U.S. components or materials, the 2008 Haitian Hemispheric Opportunity Through Partnership Encouragement (HOPE II) Act and the 2010 Haiti Economic Lift Program (HELP legislation) which provides duty-free preferences for certain light-manufacturing products produced in Haiti. This trade facilitation programs give the United States great influence in Haiti.

If aid is not given to developing countries according to Matthew Rooney, head of the Bush Institute's Economic Growth Initiative, one of two things can happen. First of all, the Haitian government would not have a reason to support U.S. goals both financially and

politically due to the lack of resources to fight organized crime and improve law enforcement training and business environment. Illegal migration would be hard to control, which particularly affects the U.S. given the flow of Haitians from Haiti to the U.S. because of the exacerbation of Haiti's humanitarian crisis, losing their belongings and sometimes their lives through the illegal and dangerous routes to get to their destination. By creating more economic opportunities for Haitians, the living conditions in the country would improve and people would not feel the necessity to leave. The second situation would be looking elsewhere for resources, perhaps borrowing more money, which would further weaken their financial stability, or they may turn to another donor and step in for their interests which may or may not be aligned with the U.S.'s (Rooney, 2019).

Replicating the initiative Charcoal Value Chain and Improved Cookstove Sector Analyses Netherlands Development Organization (SNV) in Rwanda in Haiti through funding and volunteers with the support and experiences learned by USAID in similar initiatives is critical, as innovative technologies focusing on the development of high-value horticultural crops, reforestation initiatives, collaboration with the private sector to open access to markets for high-value crops, the promotion of sustainable production practices and building a local capacity to restore and protect targeted deforested landscapes is also important (USAID, 2020). For this strategy to work farmers must be convinced of the added income they will receive by not cutting the trees before they are fully developed and that they will be financially supported in the meantime. The idea is not repeating the mistakes that happened to another USAID initiative in between 1982 and 1995 when they helped to plant 65 million trees with only a 30% survival rate (Tarter, 2015).

Even though the use of propane gas or improved charcoal stoves are our goal today, most of the population will keep using charcoal; the key is to turn this into a sustainable matter and make the transition as smooth as possible for it to be a long and lasting change. Funding for these enterprises could be found through the InterAmerican Development Bank and other Non-Governmental Organizations present in Haiti.

Mimosa plants could be added to the program already established and managed by USAID, together with Chemonics NCBA CLUSA and the International Center for Tropical Agriculture (CIAT) who could include it in their budget.

The improvement of the charcoal value chain by introducing new technologies that allow efficient and sustainable production of charcoal, creating a regulatory frame, introduction of new tree species, enhance the production methods as well transportation and more efficient household use can contribute certainly to the quality of life for the communities that depend on this industry by preserving the ecosystem, reducing the emissions and creating wealth for their members.

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