



Conquistadors, cannibals, and climate change A brief history of biochar

From Conquistadors to soil scientists, the evolution of *terra preta* into biochar is a bizarre and intriguing story. Research from the past decades is leading to this very exciting opportunity in the fight against global warming.

Here be dragons

On 5 August 1495 Christopher Columbus received a rather peculiar letter from Royal Cosmographer Jaume Ferrer de Blanes. Ferrer was writing to inform Columbus of his discoveries in the Cape Verde Islands, and the apparent correlation between “great and valuable things” and “hot regions inhabited by darker-skinned peoples.” Ferrer continued “and therefore, in my judgment, until Your Lordship meets such peoples, You shall fail to find an abundance of such things.”

Seduced by the prospect of treasure, on his next voyage across the Atlantic Columbus turned sharply towards the equator, reaching South America. The consequences of Ferrer’s flawed logic would transform the face of the world.



Francisco de Orellana

Fifty years later, European explorers (now approaching South America from the west coast) were just as hungry for silver, gold, and cinnamon. Conquistador Gonzalo Pizarro’s expedition into the unexplored territory east of Quito, Ecuador, was an attempt to find the mythical Eldorado and its treasures. As part of this venture, Pizarro ordered his Lieutenant, Francisco de Orellana, to depart with a brigade of fifty men to establish where the Coca and Napo Rivers joined. They reached the site on 26 December 1541, but rather than turning back, the brigade’s lust for riches drove them to threaten mutiny if they did not continue. Orellana had no choice but to embark with his men on a new and dangerous voyage.

During the next eight months, traveling in two boats that they had built, the crew became the first Europeans to navigate the Rio Negro and, eventually, to reach the Amazon River. From the very beginning of their voyage, they encountered large indigenous settlements. Friar Caspar de Carbajal, the expedition’s diarist, reported, “there could be seen some very large cities that glistened in white and besides this a land as good, as fertile, and as normal in appearance as our Spain”.

Though the knowledge that humans could sustain themselves in the region was good news for our starving voyagers, it also meant danger, as the natives did not take kindly to foreigners pilfering their food supplies and their poisoned arrows proved deadly.

Nothing, however, could have prepared them for the wrath of the Amazons. This female fighting force, with hair down to the floor and adorned with gold jewellery, ruled over large swathes of the region and reportedly regarded men as an unimportant annoyance required for reproduction only.

Upon joining the fray to protect their lands, the Amazons allegedly did “as much fighting as ten Indian men” and could shoot arrows in such quick succession that within minutes “our brigantines looked like porcupines.” When the Amazons were present, even the native men fought more aggressively as the women would instantly club to death anyone who tried to turn back.



Orellana's boat building

The Spaniards were forced to flee to the Province of the Black Men (Provincia de Los Negros), where they endured heavy attacks from exceptionally tall, brightly dressed men who clipped their hair very short and stained themselves black. Although his crew wished to rest there to regain their strength, Orellana refused to stop until they had entered a less populated area - which proved to be a good call, as he learned later that these Black Men ‘ate human flesh. Recounting his adventure to the Spanish Court, Orellana described the natives’ advanced agricultural system, high population density and mixture of walled villages and isolated farms.

Focusing on the wealth of the Amerindians and eager to establish the origin of the precious metals worn by this indigenous population, the Court granted Orellana funding for a second expedition along a different route. It was, however, an utter failure. Men and ships were lost on the passage and Orellana himself drowned when his boat capsized near the mouth of the Amazon. There were no subsequent voyages up the Amazon River until 1637 when Captain Pedro de Teixeira saw no trace of what Orellana had reported. He found no significant villages, let alone entire civilizations. Either Orellana was a liar, or millions of people and an entire way of life had been erased in less than a century. The astonishing world of the Amazonians was relegated to myth.

Unravelling the mystery

Years passed and nothing happened. The Amazon River basin was disregarded as a site of little wealth or interest. And then, something mundane but brilliant occurred. In 1870, James Orton, a little-known American geologist, and explorer noticed that alongside the typically grey, acidic soils of the basin there existed large patches of ‘black and very fertile soil. Though most would deem this remark insignificant, it is what soil scientists dream of.

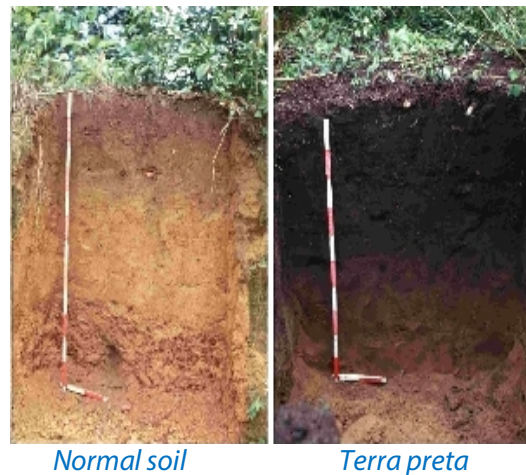
Researchers flocked to investigate the mysterious dark earth or *terra preta* as it is known locally. In 1879, naturalist Herbert H. Smith’s concluded that ‘the bluff-land owes its richness to the refuge of a thousand kitchens for maybe a thousand years.

Innovation towards sustainable development

These findings, reinforced by geologist William Katzer's early-twentieth-century analysis of the soil composition - a blend of mineral residuum, charred plant materials, and decomposed organics - started turning heads. Was this earth modified by human settlers? Had Orellana been telling the truth?

For many, this was a ridiculous idea. Betty J. Meggers, the renowned Smithsonian archaeologist, repeatedly argued that despite the river basin's rich flora, the Amazon's weak soils could not possibly retain the necessary nutrients necessary for the agricultural requirements of a complex society. She asserted that any village containing more than 1000 inhabitants would have collapsed. However, similarly thin, acidic soil can be found in the savannah grasslands of Bolivia's Mojos Plains (Llanos de Mojos). Though few people live there as crops are so difficult to grow, William Denevan noted in the 1960s that the landscape was crossed with unnaturally straight lines: evidence of pre-historic large-scale cultivation. Additionally, when working with some indigenous Amerindian farmers who still inhabit the Plains, Clark Erickson and William Balée discovered linguistic clues to the lost civilization: 'They have words for domestic plants from 2000 years ago, says Balée.

The objections raised by Meggers have largely been discounted. Archaeological surveys have confirmed the correlation between *terra preta* sites and the civilizations Orellana described back in the 16th Century. Furthermore, the presence of pottery shards and food and animal waste in these soils demonstrates that they are anthropogenic. Through careful cultivation over many centuries, we accept today that the people of the Amazon were able to compensate for the limitations of their natural environment, creating a sustainable agricultural system capable of supporting possibly millions of inhabitants.



Based on linguistic and ceramic evidence, Donald Lathrop hypothesized in the 1960s that the confluence of the Amazon, Negro, and Madeira River formed the centre of a vast and advanced civilization spanning from Brazil to the Caribbean. Its rapid decline has been predominately explained by the devastation caused by Old-World diseases brought over by the Spanish, to which the Amerindians had no immunity.

A closer look at soil science

The rediscovery of this lost civilization is fascinating. Perhaps more surprisingly, so is *terra preta* itself: even chemical fertilizers cannot maintain crop yields into a third consecutive growing season, yet these dark earth has retained their fertility for centuries. A crop planted on *terra preta* can produce a yield up to four times greater than one planted on soil from a similar parent material.

The charcoal-like materials found in *terra preta* are most likely to originate from fireplaces used for cooking and firing clay pots: indeed, the patches with the highest carbon concentrations appear to be those situated by village refuse sites. Today we understand, and over 18,000 studies confirm, that high-carbon char changes the biological and chemical behaviour of the soil, facilitating its retention of nutrients such as calcium, thereby improving growing conditions.

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Today we know that *terra preta* plots range from just a few m² to 900 acres, with the oldest site dating from 8000 BC.

Aside from increased crop productivity, *terra preta* offers a second significant benefit. As described in Sombroek's 1992 publication, 'Biomass and carbon storage in the Amazonian ecosystems' has the potential to sequester carbon.

Researchers, prominent amongst them Johannes Lehmann of Cornell University, began to explore the possibility of enhancing soil fertility and storing carbon with newly produced char. The materials they used have come to be referred to as 'biochar'.

A real green revolution

Biochar is formed by charring agricultural waste using a technology called pyrolysis, which heats biomass in an oxygen-free environment rather than burning it. If added to the soil, around 80% of the captured carbon stays well over 100 years (and possibly thousands), while the traditional 'slash and burn' method of clearing typically releases 97 percent of the forest's carbon into the atmosphere. Biochar-improved soils also release less methane and nitrous oxide, both of which are more potent greenhouse gases than carbon dioxide.

The consecration has come when the IPCC published, in 2018 and 2019, two reports considering biochar's potential for permanent carbon removal.



Rice without biochar in Northern Senegal *With biochar yield doubled*

From Conquistadors to soil scientists, the evolution of *terra preta* into biochar is a bizarre and intriguing story. Orellana's men never did bring home the precious metals of the New World, but their accidental discovery of the rich and fertile soil has led to a powerful means of mitigating and adapting to global warming, and of better providing for the world's nutritional needs. **Besides, it would be a nice historical irony if the destroyed savage civilization ended up saving the advanced one that caused its downfall. ■**

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