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THE MAGICAL SOILS OF EL DORADO

Karen Carmichael-Timson explores the evidence that concludes that the indigenous Amazonian people knew how to create Terra Preta, self sustaining, highly fertile 'black earth'.

In 2002, the BBC broadcast the Horizon documentary, 'In Search of El Dorado'. For most viewers it was simply another interesting Horizon programme. For those interested in sustainability and saving the rainforest it was mesmerising. The programme was about a lost great civilisation. First discovered by the Spanish Conquistador, Francisco de Orellana during his 1542 expedition along the Rio Negro in the Amazon Basin, this civilisation had disappeared within a hundred years. Early missionaries to this region found no evidence of the civilisation described by de Orellana and his stories were considered simply that – stories without foundation. Subsequent scientific investigation reached a similar conclusion. All early civilisations are associated with intensive agricultural systems but rainforest soils are unsuitable for farming, so how could a large number of people possibly have lived there? Even today, the addition of modern chemicals and techniques fail to extend crop productivity beyond a third season hence the continued destruction of pristine rainforest to create new farmland.

Modern investigations have discovered evidence of man-made structures in the form of raised mounds, causeways and canals in Bolivia's Llanos de Mojos savannah plains that can compete with the ruins of Egypt in their complexity, size and construction but this is over 2,000 kilometres away from the area explored by de Orellana. Is it really possible that a civilisation could have covered such a large area and if so what happened to it and how was it fed?

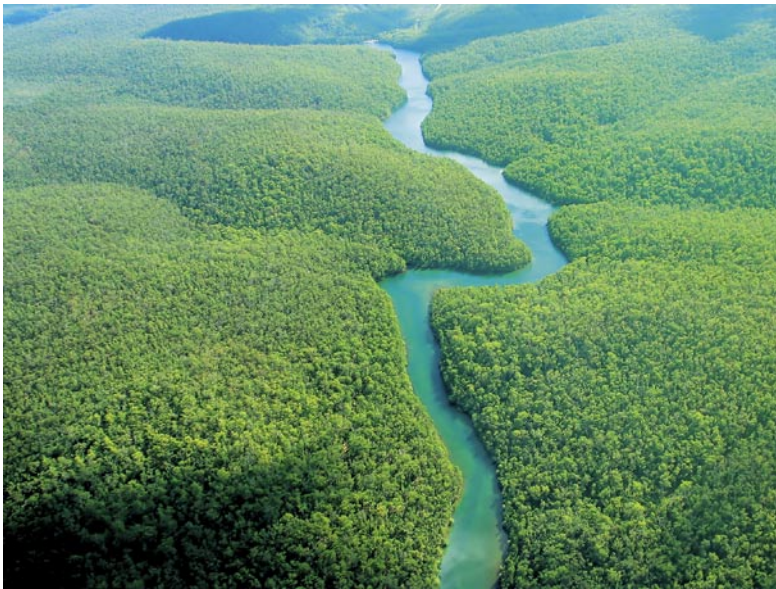
Sadly the answer to the first question is simple. The Europeans who first explored these areas brought many things with them including a wide variety of diseases that decimated the native populations. The primary building material in these regions was timber, so all traces of civilisation were rapidly consumed by nature once they were no longer maintained.

The answer to the second question is what I wish to focus on in this article. How did a civilisation of tens of thousands feed itself on soils that are

Below:
Karen Carmichael-Timson.



Steve Carmichael-Timson



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Above: It's easy to see how Terra Preta soil can lie undiscovered in the Amazon rain forest.

naturally thin, nutrient starved, subjected to intensive rainfall and contained high concentrations of aluminium? The answer is an almost magical soil called Terra Preta (de Indio). I say magical because not only are these soils extremely fertile but the fertility is maintained for hundreds of years. The aluminium levels are reduced and the heavy rains does not wash away the nutrients.

INDIAN BLACK EARTH

So what is Terra Preta? Where will you find it and how did it get there? The answer is quite simple. Terra Preta is an anthrosol (or anthropogenic) soil. These Indian Black Earth soils are found throughout Amazonia. They are man-made soils created by the indigenous Indian population and are now known to have existed for over 2,000 years.

These soils were supporting complex societies at least 1,000 years before contact with Europeans in 1542 occurred. De Orellana described native villages that stretched many miles along river bluffs with roadways linking to settlements in the interior. This is where the Terra Preta soils have been found.

The Amazonian upland soils (Terra Firme) are highly weathered and very acidic. They have few nutrients and very high aluminium concentrations. They are not suitable for productive agriculture. The várzea (flood plains) soils, although better suited to crop production, suffer from unpredictable floods.

Terra Preta is a strongly weathered soil with a thick humus layer – the dark loam is created by the addition of biological matter. The richest, blackest (Terra Preta de Indio) soils are found above former village middens or rubbish tips whilst the lighter, dark brown form Terra Mulata is believed to be the result of intensive cultivation practices – its high black carbon particle content being derived from the slash and char techniques of the native pre-European inhabitants of the area. These soils are also known to contain large quantities of pottery shards that also pre-date the European incursions.

Indian Dark Earth soils are known for their high fertility and sustainability. They contain high levels

of nutrients, soil bacteria, charcoal and arbuscular mycorrhizal fungi unique to this region. The soils were enriched with potassium, phosphorus and calcium from the food waste thrown onto the village middens – fish and animal bones, shells, manure (human or animal) etc.

The slash and char method of clearing land uses the same amount of biomass as in a slash and burn approach but the slash and char method retains approximately 50% of the biomass as black charcoal which is added to the soil. The charcoal produced by this technique is the same as any other charcoal – there is nothing special about it. However, charcoal acts as a sponge which absorbs nutrients and enables the soils to retain nutrients that would otherwise be washed out by the high rainfall levels. Furthermore, the high concentrations of aluminium are neutralised by the charcoal. The University of Bayreuth in Germany has been carrying out field trials in the Amazon basin and have found that the addition of charcoal increases soil fertility by a staggering 880%.

The heightened fertility of these soils has been recognised by indigenous inhabitants and current colonists. Original Terra Preta soil is 'mined' and sold by local farmers. It is used as a starter to generate new Terra Preta soil. We cannot yet recreate the soils from new but we know the mycorrhizal fungi play a vital part in the regeneration process. Cornell University in the USA and the University of Bayreuth lead the way in researching these soils together with their partners at the National Amazonian Institution and the Museo Goeldi in Brazil.

Chapter 4 of the United Nations World Reference Base for Soil Resources 2006 states: "Anthrosols comprise soils that have been modified profoundly through human activities, such as addition of organic

Right: Scientific equipment monitoring the carbon dioxide losses from Terra Preta de Indio near Manaus, Brazil. Experiments show the great stability of the organic matter in these Dark Earth soils.




© Johannes Lehmann



to additional stripping of emissions in the flue gas. This is a revolutionary process by which energy production can become a net sink of atmospheric carbon dioxide and provide organic matter to enrich our soils.”

So there we have it. Terra Preta soils are highly fertile and last for millennia; they could also save the rainforest, generate abundant clean energy and reduce carbon emissions.

Should we transfer Terra Preta elsewhere in the world? As shown above, anthrosol soils already exist throughout the world. It is the addition of black carbon in the form of charcoal that makes such a difference in the Amazon. We already reclaim depleted soils on brown-field sites by seeding them with bacteria and mycorrhizal fungi from a nearby natural source. We can compost all suitable wastes and add charcoal (and volcanic rock dust as found in Andosol soils) to increase fertility and nutrient levels.

It is not the soil itself that needs to be exported; it is the techniques used to create it. What the Terra Preta story really tells us is that the future of humanity and this planet could well rest on us relearning what our ancestors once knew 

Left: Johannes Lehmann (Cornell University) measuring the carbon chemistry of Dark Earth soils using X-ray technology at the National Synchrotron Light Source, USA. These measurements reveal the mechanisms causing the high fertility of Terra Preta de Indio.

materials or household wastes, irrigation and cultivation. This group includes soils otherwise known as: Plaggen soils, Paddy soils, Oasis soils, Terra Preta do Indio (Brazil), Agrozems (Russian Federation), Terrestrische anthropogene Böden (Germany), Anthrosols (Australia) and Anthrosols (China).” And: “Anthrosols are found wherever people have practised agriculture for a long time.”

Those agricultural societies that have not adopted modern unsustainable farming methods and still maintain their soils in their traditional ways are producing anthrosols with properties similar to the Indian Dark Earths. If you are making compost you are making an anthrosol.

CAN SOIL SAVE HUMANITY?

So what are the benefits? Well the most obvious one is that instead of using a slash and burn technique to destroy more and more rainforest, the slash and char technique combined with a planned cycle of resting allows the same area to be used indefinitely. Not only can large quantities of crops be grown but habitat is maintained for the benefit of all. A sensible approach to ‘mining’ this resource could spread its advantages throughout South America and possibly beyond.

Cornell University has suggested that the biomass could also be used to produce clean energy. Their Terra Preta Science Brief states: “Agricultural wastes as well as bioenergy crops can be used to produce energy by burning them in specialized power plants and yield black carbon as a by-product. The majority of the energy is converted into hydrogen. Due to favourable energetic processes, the efficiency of the energy production is very large while carbon retention is high due

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Karen Carmichael-Timson lives on a recently acquired smallholding in south west Wales with her maritime archaeologist (underwater cameraman) husband and three cats.

DO YOU KNOW SOMETHING WE DON'T KNOW?

This article was kindly submitted after a request by Pat Browne on the PM49 Letters page for more information on Terra Preta (and thanks to all the readers who wrote in with further information). Are you searching for more facts on an elusive subject that could change the world?! Please write or email in with as many details as possible and we will ask our wonderful readers all over the world for further information or contacts. *Ed*