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An Enhanced Automated Carbon Exchange (EACE)

About fifteen years ago, a land reform in Brazil distributed plots of land in the Amazon to tens of thousands of farmers. Even with Modern technologies the Amazon's soil turns out to be next to impossible to cultivate because fertilizer is washed in the deep underground during the rainy season. Those who try to farm it today generally practice slash and burn techniques, moving deeper into the jungle after two or three crops, as the soil on previous plots deteriorates. Therefore, the vast majority of the farmers who received Amazonian plots went predictably bankrupt after the third year when the land was exhausted. However, a minority had remarkably abundant crops. The secret turned out to be the soil: they had been lucky enough to receive plots with "*Terra Preta do Indio*", literally "black earth made by the Indians". When scientists examined this soil, they realized that what differentiated it was not the land itself but what people, long ago, had done to it. The history of that soil is a remarkable, tragically unsung saga

An Advanced Pre-colombian Civilization in the Amazon?

When the Spanish landed in what is now Ecuador in the 16th century, the indigenous people told them about a mythical land filled with gold deep in the thick jungle beyond the Eastern slopes of the Andes. Thus was born the legend of *Eldorado*. The Spanish sent many explorers looking for this civilization, the first being Francisco de Orellana. From 1541-42, Orellana traveled from Quito, Ecuador, all the way down the Amazon River in search of this civilization. Friar Gaspar de Carvajal, the expedition's chaplain and scribe, recorded their journey through an amazing and complex civilization lining the Amazon with large cities and temples interconnected by roads "where four horses could ride abreast". Among their many adventures, they were attacked by a group of women-warriors, similar in their mind to the Amazons of Greek mythology, an episode which gave that name to the world's longest river. It did not, however, appear to have any gold. When another expedition tried to trace back Orellana's path from the mouth of the river more than a decade later, they found only a few tribes scattered in a dense rainforest. Orellana's description was from then on dismissed as a fantasy. This conclusion was further reinforced during the 20th century on the basis of the argument that a complex civilization could never have existed there because it would require intensive and permanent agriculture to feed cities, something which was known to be impossible in the Amazon…until the rediscovery of the *Terra Preta do Indio*.

We now have proof that an ancient people with advanced pottery and other artifacts had changed the Amazonian soil from one of the poorest on the planet to one of the richest, mainly by adding charcoal produced by burning biomass at a low temperature, some of it carbon dated as early as 800 BC. This was a process Carvajal had described in his account as "local Indians burning their fields". A civilization now estimated at over a million people thrived for over 1000 years off the black earth its people created. Scientists have mapped the plots of Terra Preta and found them to line the rivers he traveled, the areas in which he described the civilization that disappeared. Lacking the stones that preserve evidence of civilization, this society seems to have been wiped out in a few years from the influenza and smallpox the Spanish brought from the Old World, leaving only a few isolated tribes in its wake. The Amazonian rainforest then erased in a few years their cities made only of earth and wood…

Terra Preta is also referred to scientifically as "anthropogenic Amazonian Dark Earths" (ADE). It is a full of organic matter and, specifically a lot of charcoal. The charcoal acts as a kind of sponge, holding nutrients near ground level instead of letting them sink. Furthermore, these particles of charcoal form a basis for very active microbial life, creating the equivalent of a living reef under ground. The resulting soil is incredibly fertile. Austrian soil-scientist Christoph Steiner - who has worked for the past four years on Terra Preta research at the Embrapa research station in Manaus, Brazil and at the Institute of Soil Science at the University of Bayreuth, Germany - has found that this charcoal combined with mineral fertilizer increases yield by some

880% from just using fertilizer, and even more compared to the usual slash and burn, in which the land would be depleted after a few harvests.

The implications of this re-discovery are vast. Companies like America's Eprida, agricultural research institutes in various countries and universities1 and Kansai Electric(one of the largest power companies in Japan)2, are working to apply the principles of the Terra Preta or ADE outside its Amazonian home to the rest of the world that badly needs to sequester carbon on a large scale to reverse the global climate change process. From biomass that is currently wasted, this process produces not only charcoal useable as fertilizer while sequestering carbon for the long-term, but also energy (in the form of hydrogen, ethanol, methanol or biodiesel) and some valuable natural oils as well. To be precise, for every 10 tons of biomass processed, 3.2 tons of biodiesel and 1.2 tons of charcoal become available! The scientific aspects of the processes involved are documented elsewhere.[3]

The Kyoto Treaty on climate change has become legally binding for 141 countries since November 2004 (Australia and the USA are the only exceptions among the developed nations). Its Clean Development Mechanism (CDM) allocates a specific amount of carbon credits to various countries and industries, but allows them to be bought and sold freely. A company that produces more green house gasses than is allocated to it needs to purchase carbon credits sold by another producer that has reduced its emissions beyond what is required in some other part of the world. International trading in carbon contracts on the basis of the CDM protocol of the Kyoto treaty has successfully started. The value of these carbon credits has rapidly increased on the European Union Greenhouse Gas Emission Trading System from a few Euros to about 25 Euros per ton of CO2, and is expected to rise to 200 Euros per ton by the end of the decade. The volume of trading is estimated at 35 to 50 Billion per year. In the US, the Chicago Climate Exchange (CCX) has also started operations, and the States of New Mexico and New York announced their intentions to participate in the carbon credit mechanism. As a consequence, corporations with manufacturing facilities on a global scale will increasingly need to purchase carbon credits in order to offset their own greenhouse gas emissions.

The exciting potential of the discoveries about the Terra Preta, and their possible applications in countries all over the world, means that small farmers anywhere would be able to sequester carbon on a large scale and thereby obtain carbon credits they can sell in the world market. Better still, we propose that these credits could become the basis of a complementary currency system that connects farmers with the companies that produce the equipment and technology they need to keep them in business during the 21st century. This complementary currency would

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[1] Active charcoal research is done by the Terra Preta Nova project involving Wenceslau Geraldes Teixeira, Gilvan Coimbra Martins and Murilo Rodrigues de Arruda and Jose Pereir da Silva at the Embrapa Amazonia Occidental in Manaus, Brazil); K.C. Das at the Bioconversion Research Center of the University of Georgia, Athens, GA; Johannes Lehman, Rondon Marco, Jacqueline Greenwood and Julie Major of the Department of Crop and Soil Science at Cornell University; Don Reicosky at the USDA Soil Conservation, Morris, MN; Matthew Realf and Ling Zhang at Georgia Institute of Technology, Atlanta, GA; and Prof. Siregar at the Forest and Nature Conservation Research and Development Center of Indonesia;

[2] Dr. Okimura from Kansai Electric is involved in projects in Australia and Thailand for utilizing charcoal additions to soil to create carbon credits. Plans include a one million hectares soil restoration project in Australia for growing cash crops, while creating carbon credits.

[3] See www.eprida.com and Bruno Glaser and William I. Woods, Eds.: *Amazonian Dark Earths: Explorations in Space and Time.* (Berlin Heidelberg New York: Springer Verlag, 2004)

be used in an Enhanced Automated Carbon Exchange (EACE) system, inspired by the automatic trading system that has successfully operated for the chemical industry called Chemconnect.

The EACE has three main objectives:

- Provide a systematic incentive for farmers and forestry managers around the world to participate in an independently verifiable and financially self-sustaining mechanism for carbon sequestration scalable to the global level, so that they can contribute to the reversal of climate change, deforestation and land degradation that is currently ongoing in much of the world;
- Maximize and stabilize the income for participating farmers, including protection against the vagaries of the purchasing power of national currencies.
- Improve the transparency of international trade, including in the trade of copyrighted or patented goods.

The EACE system would be an Internet-based information exchange system in which information about the carbon credit producers is made available to potential buyers. The information would go beyond the quantity of credits on offer, but also identify their geographical GPS location, the type of crop from which it is produced, some history about the producer(s), soil and other relevant biological information. Carbon-backed currency units are credited to farmers or biomass processors that are meeting the standards for CDM (Clean Development Mechanism) protocol of the Kyoto treaty. Verifiability of carbon sequestration being a key criterion of this protocol, the sequestration process would be independently verifiable by satellite, tracer systems, and/or soil sampling.

An algorithm forecasting the output of carbon credits for particular types of farmers and crops in specific regions makes it possible to provide credit ratings for carbon credits in advance of their production. This would enable manufacturers of goods for the farming community to sell equipment based on future carbon production. The interest-free nature of these carbon credits would be a desirable way for farmers to obtain the necessary equipment, fertilizers or supplies that would enable them to increase their production capacity, thereby further enhancing their capacity to sequester more carbon in the future and further increase their income.

Here is how it would work in practice: in China, Farmer Lu works a plot of land in the southeast. He learns about the process of carbon sequestering and uses the biomass processor from his cooperative to process the extra biomass from his land—the sheaths, the weeds, the bamboo—instead of burning it or letting it rot. The resulting charcoal he produces reinvigorates his soil, making it more productive in the future. The process also produces some valuable oils and hydrogen which could become the basis of China's future hydrogen-based economy. For now, however, it serves a different purpose. Indeed, hydrogen is the main component for ethanol, methanol or biodiesel, which he can sell in the local market, thereby a doubling or tripling his income, as the bio-energy is often even more valuable than his agricultural crop itself.

His charcoal provides him with another interesting revenue source. The entire process sequesters carbon for the long-term because the biomass takes carbon from the atmosphere. However, instead of burning or letting his biomass rot like most farmers do in today's practice, re-emitting it thereby in the atmosphere, Lu sequesters his organic waste back into his soil in the form of charcoal. This action under the Kyoto Protocol earns him carbon credits verifiable

according to the standards set by the CDM (Clean Development Mechanism). Satellite and GPS technology would allow for accurate measurement of Lu's carbon levels and thereby number of carbon credits he earns.

The EACE would then link Farmer Lu's specific needs (e.g., a tractor or other supplies) with a company that can meet those needs and would like to exchange them for carbon credits. Because we can predict with reasonable accuracy the amount of carbon credits Lu will be able to create over the next few years, Lu could enter into a contract that would allow him to exchange not only his current carbon credits, but also those which he will earn in the future. Assuming both Farmer Lu and the tractor company can come to mutually satisfactory terms, each can obtain what they require through an interest-free loan in carbon credits, without having to rely on the unstable currency markets of their respective national currencies. The payment system for such exchanges could use some highly advanced technologies, more secure and more cost effective on a decentralized basis than what is currently used even in centralized, bank operated credit or debit card payments. An operational example of such a technology is the ViA stored value card which provides state of the art security against fraud for payments by guest workers in the Middle East, a population which is typically not considered bankable.[4]

Currently the vast majority of the valuable content of the biomass available in the world is dramatically underutilized, wasted, or disposed of in a way that contributes to greenhouse gas emissions. The technologies now available to process biomass from agricultural, forestry and natural growth can efficiently produce the charcoal that sequesters carbon as fertilizer, as well as produce bioenergy and various other valuable derivatives. The plan is to implement these technologies on a large scale, initially in China and various developing countries, providing for the first time to billions of farmers in the Third World a long-term, predictable income flow in carbon credits. It is therefore opportune to start planning for the design of an Enhanced Automated Carbon Exchange by creating an international alliance among corporations that would be interested in participating in a system that would enable them to use their purchases of carbon credits as a tool to increase their global market penetration. Share

The organization structure and mode of operation for the EACE would follow the approach pursued for the creation of the VISA credit card alliance among financial institutions.[5] VISA was started by seven participating banks. Today it is by far the largest financial institution in the world consisting of an alliance of more than 20,000 financial institutions, with an annual volume of US$1.2 trillion. The seven original members of the alliance had the opportunity to design the VISA system, by creating the set of contractual rules of operation of the system

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[4] Credit and debit card security systems is focused only on point-to-point exchanges, i.e. between systems and within systems if they have a secure storage. Two Swedish innovators, Lars Olof Kanngard and Bengt Arnesson have developed a secure payment system for electronic stored value cards that is protecting the transaction END-TO-END, i.e. from the originator to the final user without interruption of the security flow. This technology named STS – Secure Transaction String™ introduced by their company ViA Int'l Co Ltd (www.via.ae) gathers all the information for a transaction (the identification of the payer and the payee, the amount, the currency code and the PIN number) in a low-cost handheld device which is used to create three blocks of information, each separately encoded with a different automatic key. The final result is a totally secure exchange between all parties, unbreakable by hackers of criminal code breakers. Such advanced levels of security are important to preclude fraud in carbon credit exchanges in a highly automated EACE where the participants may otherwise never be in personal contact with each other.

[5] See Hock, Dee: a two to the *Birth of the Chaordic Age* (San Francisco: Berrett Koehler, 1999).

(including the rule on how to change the rules) which all subsequent members signed. The early participants in the alliance for creating the EACE would have therefore a similar substantial advantage in shaping the system for their own needs. Therefore, the next steps in designing an EACE system would be to identify a group of corporations interested in exploring their interest in participating in designing such a system, and decide what role they would like to play in it. Then, farmers would be educated in the system at the same time as the biomass processing is introduced, so that they can use it to their best advantage.