

WORLD·WATCH

Working For A Sustainable Future

Chocolate Could Bring the Forest Back

by Chris Bright

Excerpted from November/December 2001 WORLD WATCH magazine

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Chocolate Could Bring the Forest Back

The forests of Bahia, in eastern Brazil, are among the most diverse in the world. But in their current state, they are too fragmented to survive over the long term. Chocolate could help restore them.

by Chris Bright

First encountered the witches' broom on a big farm in Bahia, Brazil's chocolate state (see map, page 10). Bahia is where about 85 percent of Brazil's cocoa is grown. This farm is one of several that belong to the family of my host, Eduardo Athayde. With Eduardo at the wheel of a rental car, we were bouncing down a rutted dirt road, peering into the wet, green confusion on either side. Dense stands of cacao, the little trees that bear the chocolate fruit, packed the understory of a patchy, towering rainforest. The cacao seemed like shrubbery sprouting in a ruined cathedral. And if you glanced up towards the vault, you could travel hundreds of years into the past. You look all the way up one of those buttressed, tan or cream-colored trunks, up to an island of foliage so high overhead it makes your neck hurt, and there it is: a fragment of the ancient, shattered canopy, crowded with epiphytes—arboreal plants that look like giant pineapple tops—and dangling liana vines, and who knows what else.

But the witch was in the cacao, not the canopy. I watched the little trees for its mark—the broom—and was soon rewarded. "There!" Eduardo stopped the car so I could plunge into the shrubbery and drizzle to inspect an ailing tree. It really didn't look that bad. Clumps of tender new stems had sprouted from several branches, then wilted and turned brown. The brooms looked as though they had grown too fast, the way an over-fertilized seedling looks. And then they had died. That's all. The witch might kill the whole tree, or it might not. But either way, the tree would no longer be commercially productive—even worse, it would be a factory of infection.

The witch is the fungus *Crinipellis pernicioso*. A "native disease" of cacao, it lives among the wild cacao trees in the northern and western portions of the Amazon basin. Unlike Bahia, that region is part of the tree's original range. In its native forests, wild cacao doesn't crowd the understory; it grows in loose patches, here and there. And the wild plants are extremely variable in their genetic characteristics, including their susceptibility to the fungus. So a fungal spore, adrift in a sea of moist, still Amazonian air, has relatively little hope of alighting on a susceptible host.

But in the plantations of Bahia, the cacao is so dense the trees often touch each other, and they carpet thousands of hectares of the countryside. So a fungal spore, drifting in the air of a Bahian plantation, can readily find susceptible tissue—a bud or young fruit pod on any of millions of genetically vulnerable trees. If the fungus colonizes a fruit pod, the pod's lode of cocoa beans will likely be spoiled. If it colonizes a bud, then about six weeks later the infected tissue will produce a broom, a sort of cancer that diverts the tree's energy from healthy growth. The broom itself will die, and then pink, flower-like structures called basidiocarps will emerge from it. Each basidiocarp will release up to 90 million new fungal spores.

The fungus's destructive potential in the dense plantation environment has long been understood, which is why Bahia has had a quarantine for many years on the movement of cacao from Amazonia. And the quarantine worked, until May 1989, when the fungus was discovered on a Bahian cocoa farm. How it got there remains a matter of speculation but in any case, this initial outbreak was suppressed when

the infected 200-hectare stand was sprayed with fungicide and burned by officials from CEPLAC (the Comissão Executiva do Plano da Lavoura Cacaueira), Brazil's premier cocoa research agency. Towards the end of the year, however, a much larger infestation was discovered on another farm, where workers had apparently cut away some of the infected trees and thrown them in nearby rivers. From that moment, any hope of avoiding an epidemic was lost. The fungus had reached out of Amazonia. It was going to swallow the prosperity of Bahia. It would become a vegetable version of the Black Death.

So much was invested in the Bahian cocoa apparatus and now it is broken. In the wake of the fungal invasion, the harvest has collapsed from its peak of nearly 400,000 tons in the late 1980s to 105,000 tons today. The local economy has gone the way of the harvest. The export value of one of those peak yields probably approached \$900 million. But in 1999, cocoa exports for the whole of Brazil, as reported to the U.N. Food and Agriculture Organization, came to only \$4.9 million (both figures are in year 2000 dollars). And according to CEPLAC, some 90,000 farm workers have lost their jobs. The area in production has shrunk too, from around 600,000 hectares to perhaps 450,000 hectares today.

But none of this is even detectable in the international cocoa market. And it's easy to see why it wouldn't be, if you look through the graphs beginning on page 22, which show various aspects of that market. Cocoa is now grown throughout the tropics—it's a crop in increasingly plentiful supply. Production is expanding and the general price trend is downwards. Brazil currently produces only 4 percent of the world's cocoa, down from 24 percent in 1983. In Africa, Côte d'Ivoire, which already accounts for 42 percent of global production, is continuing to ratchet up its output on the strength of a labor system that reportedly includes child slavery, although the extent of this practice is a matter of dispute. (A future issue of *WORLD WATCH* will include an update on African cocoa.) In Southeast Asia, Vietnam and

Malaysia are reportedly considering mass plantings of the latest, most productive cacao clones. Even if the witches' broom could be eradicated tomorrow, intense competition and low prices would seem to offer little hope to Bahia's farmers.

So perhaps the witches' broom is only the proximate cause of Bahia's troubles. Perhaps there's a kind of systemic dysfunction below the disease. After all, the fungus owes its ferocious infective power to intensive monoculture, and in Bahia, this system appears to have gone just about as far as the local economy can take it. Something has got to change. Bahia's cocoa farmers are going to have to make some decisions.

And those decisions will be a matter of global biological importance. Those huge trees dominating the cacao on Eduardo's farm, as on thousands of other Bahian farms, are part of the Mata Atlântica, or Atlantic Forest, one of the most biologically diverse biomes in the world—and one of the most endangered. Less than 8 percent of the original forest remains. Because of its richness and rareness, the Atlantic Forest is considered a biodiversity "hotspot"—a top priority for global conservation. (For an overview of the Atlantic Forest biome, see "The Restoration of a Hotspot Begins," page 8.)

In Bahia, which is in the northern portion of the biome, the forest was often thinned so that cacao could be planted as an understory crop. Some 50 to 60 percent of Bahian cacao is grown in this agroforestry system, which is known in Brazilian Portuguese as *cabruca*. This arrangement approximates cacao's native habitat, although it admits more light to stimulate more fruit production. But the native ecology of cacao was not what inspired farmers to extend *cabruca* into so much of Bahia's remaining forest. They were responding to two lessons from their own experience: (1) cacao does well in this system, and (2) cutting down immense trees is hard work. So where the objective was to produce cacao rather than timber, they cut as little as possible. Hence *cabruca*, a de facto conservation system, and

A Cacao Chronology:

Critical Moments in the Relationship Between *Theobroma cacao* and *Homo sapiens*

ca. 1000 B.C.: The tree's earliest known name, "kakawa," comes into use among the Olmec, the people of the Mexican Gulf Coast who built the first of the great Mesoamerican civilizations. It is likely that the Olmec are cultivating the tree.

400 B.C.–A.D. 100: The Maya of northern Guatemala adopt the word "cacao" from the Olmec. The tree is presumably coming into cultivation among the Maya as well.

450–500: Clay chocolate-drinking vessels begin to appear among the grave goods of the Maya nobility—strong evidence that chocolate consumption is an important status symbol. (The Maya consumed their chocolate as a foamy liquid often laced with red pepper and other spices.)

ca. 900: By the time classic Maya civilization collapses and the Toltec state emerges, cocoa beans are a major Mesoamerican

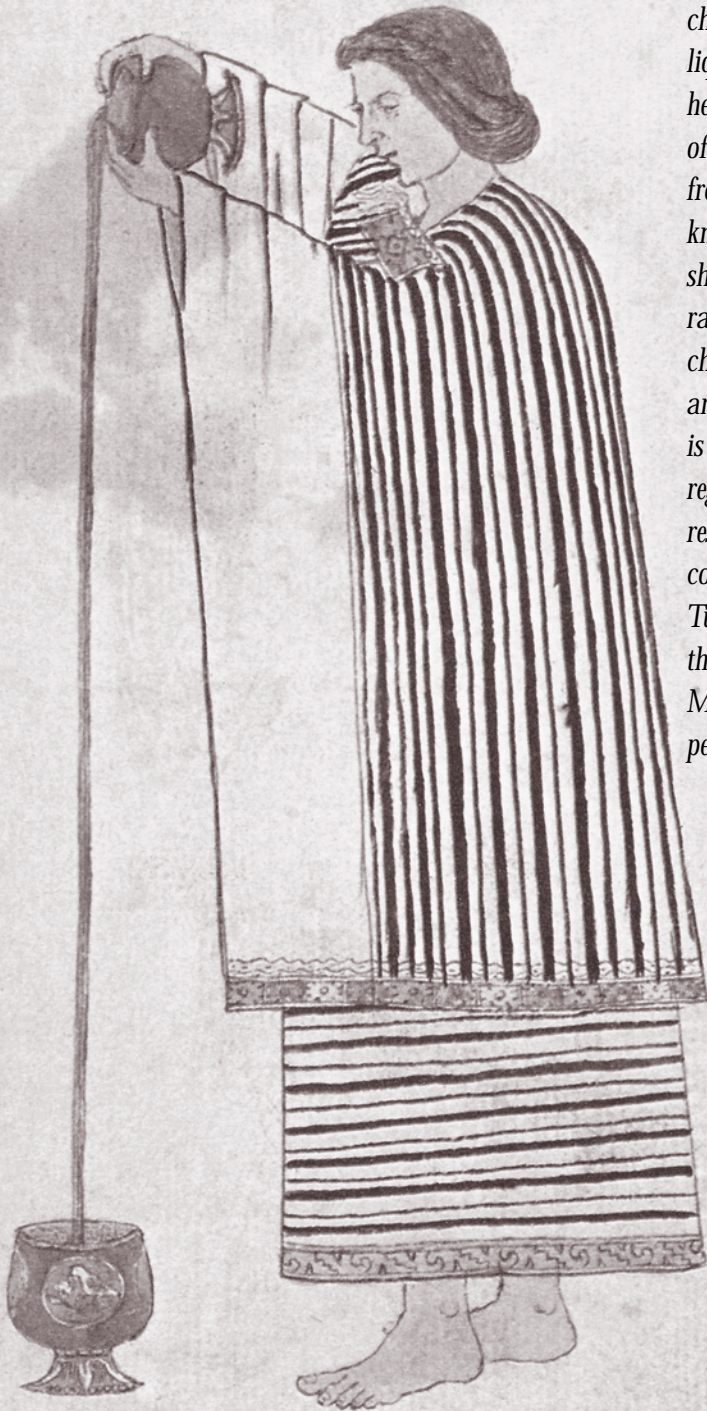
commodity. Control of the main cocoa-growing regions becomes a prime objective in the intermittent warfare that scars the next several centuries.

ca. 1500: The Aztec empire, founded in the late 14th century in the area that is now Mexico City, annexes the richest cocoa region in Mesoamerica: Xoconochco (along the Pacific coast of modern Chiapas, Mexico and Guatemala).

india mexicana

Raising Foam

Indigenous Mesoamerican chocolate was consumed as a liquid with a thick, foamy head, the most valued portion of the drink. This watercolor, from a 16th century book known as the Codex Tudela, shows an Aztec noblewoman raising foam by pouring the chocolate from one vessel to another. Although the image is "Europeanized," experts regard it as an authentic representation of Aztec life in the conquest period. The Codex Tudela is in the collection of the Museo de América, in Madrid. Reproduced with permission.



the reason there is still forest in places like Eduardo's farm. You could say that the fate of those giant trees is now linked to the fate of the little trees they shelter.

The \$60 billion flavor

The fruit of the cacao tree is a thick-rinded pod, about 20 centimeters (8 inches) long. But the pod varies a good deal in size, and in most other traits, depending on the type of cocoa being grown. Sometimes it's long and narrow, so that it looks like a miniature U.S. football, but partly deflated and covered with thick, longitudinal ridges. Sometimes it looks like a squat, warty, little melon. Sometimes it's green; sometimes it's a medley of green, yellow, and red. The pods develop directly from the tree's trunk and main branches, rather than from its peripheral growth, as with most fruit trees. This characteristic can look quite odd the first time you see it. A tree in full fruit looks like it is being attacked by a swarm of parasitic gourds.

Inside the pod is a tight, cylindrical whorl of 20 to 40 white or whitish-purple seeds, in an arrangement that looks a little like an ear of corn but with giant kernels and almost no cob. The seeds are enveloped in a sweet, white pulp. In South America, the native peoples sometimes scoop the seeds from a pod and suck off the pulp, but they spit the seeds out. Raw cocoa seeds are bitter; they don't even hint at their potential to produce one of the world's most intoxicating tastes.

Before people started moving the cacao tree around, its range probably extended from upper Amazonia into Central America, perhaps as far north as Chiapas, the southernmost state of Mexico. In the South American part of its range, the indigenous peoples apparently never discovered the simple alchemy that will convert cocoa seeds to chocolate. But along the Gulf Coast of southern Mexico, the Olmec people were probably cultivating the tree—and maybe even producing chocolate—as early as 1000 B.C. Cacao was so important among later Mesoamerican cultures—the Maya, the Toltec, the Aztec—that its beans were used as a currency throughout the region. The consumption of chocolate—which among the Aztec, at least, appears to have been a prerogative of the wealthy—was literally a way of eating money.

The native Mesoamerican peoples consumed their chocolate in liquid form. The beans were lightly fermented, then dried, roasted, and ground on a stone *metate*. The resulting powder was flavored with various other substances—red pepper was a favorite addition—and stirred into water. By holding a vessel of this liquid at chest height and carefully pouring it into another on the ground, a skillful preparer could raise a thick foam, the most valued portion of the drink. (The foam was produced by the fat in the cocoa—the “cocoa butter”—and sometimes also by special foaming additives.) Mesoamerican peoples seem to have had a substantial repertoire of chocolate-containing beverages and porridges. We know this, for example, from the writings of the notorious Diego de Landa, the 16th century Bishop of the Yucatan who was responsible for the mass murders of hundreds of Maya; Landa liked the taste of various Mayan chocolate-cornmeal gruels.

In the early 17th century, chocolate arrived in the Old World and became a favorite refreshment at the Spanish court. Over the course of the century, it spread from one European elite to another, becoming somewhat democratized in the process—cheap enough, by the end of the century, to be enjoyed by the merchant classes. About a hundred years after its arrival, its popularity in London was such that chocolate houses had begun to supplant the city's famous coffee houses. (As in the New World, all European chocolate of this era was consumed as a liquid; solid “eating chocolate” of reasonable quality was not available until 1847.) The Europeans discarded most of the Mesoamerican additives, although they often retained vanilla, which is prepared from the seed pod of a Central American orchid. But they substituted many seasonings of their own. An elaborate recipe might call for ambergris, a waxy, violet-scented substance that accumulates in sperm whale intestines and sometimes washes up on tropical beaches. A more commonplace preparation might include cinnamon or cloves, but by far the most durable European addition was sugar. Mesoamerican chocolate does not appear to have been sweetened. (These details are taken from the fascinating culinary history of chocolate, *The True History of Chocolate*, by Sophie and Michael Coe.)

Apart from the change in seasonings, early Euro-

1521: Tenochtitlan, the Aztec capital, falls to Hernan Cortes. The conquistadores discover that cocoa beans are in use throughout Mesoamerica as a currency—a practice that is probably many centuries old.

1544: A delegation of Kekchi Maya from Guatemala visits the Spanish court of Prince Philip (later Philip II). Among the gifts are

containers of the Mayan chocolate drink—the first recorded appearance of cocoa in the Old World.

1560: The earliest known introduction of cacao into Asia: the tree is brought to the island of Sulawesi, in Indonesia, from Caracas, Venezuela.

1585: The first official shipment of cocoa beans reaches Seville.

1590: This may be the date at which the Spanish introduce cacao to Africa, by bringing the tree to Fernando Po (now Bioko), an island off the coast of Cameroon. By other accounts, the first African introduction did not occur until

pean chocolate was prepared in essentially the same way that the Maya and Aztec prepared theirs. Even today, the ancient Mesoamerican procedure still operates deep within the industrial machine: the beans are still lightly fermented, dried, roasted, and ground. But then a set of more complex techniques comes into play. The powder may be “dutch” (treated with potassium or sodium carbonates to make it easier to mix in water), defatted (by removing much of the cocoa butter), “conched” (ground as a liquid in special stone vats), or combined with milk to produce milk chocolate.

Yet despite the increasingly sophisticated technology that is being directed at the cocoa bean, the taste of chocolate itself remains chemically indefinable. In her book, *The Emperors of Chocolate*, Joël Glenn Brenner describes the state of current research into the chocolate flavor: apparently, the taste is a composite sensation created by some 1,200 different substances, none of which clearly dominates the others. Some of these substances taste just awful on their own; Brenner mentions one that has the flavor of rotten fish. The bean’s chemical complexity is one of the reasons why you don’t find bars of artificial chocolate at the local market. (Carob, a tropical fruit sometimes sold as a chocolate substitute, could be considered a perfectly authentic food in its own right.)

Chocolate has another quality that might make it hard to imitate artificially: the behavior of its fat. Cocoa butter has a melting point just slightly lower than the temperature of the human body. When you eat a piece of chocolate, the cocoa butter melts in your mouth, releasing the flavor complex. The melting itself creates that velvety “mouth feel” that is characteristic of chocolate. And since cocoa butter is not readily absorbed by the human body, this is not a fat that is likely to make *you* fat.

But while substitution is not a likely development, adulteration is common. Cocoa is a relatively expensive ingredient—relative, that is, to sugar or vegetable oil. So it’s not surprising that conventional manufacturing should favor these latter ingredients over cocoa. And indeed, there is not much chocolate in many mass-market “chocolates.” The cocoa butter is often replaced by cheaper fats, such as lecithin or palm oil, which are also easier to work with when

manufacturing chocolate coatings. The proportion of cocoa solids (the nonfat component of the ground beans) tends to be fairly low as well. In a common chocolate bar, for example, it may be about 20 percent, or as low as 10 percent if the candy is a “filled chocolate” product. Premium chocolate, on the other hand, is typically around 50 percent cocoa solids, but it can be as high as 70 percent. And because it contains much less sugar and little if any vegetable oil, upscale chocolate generally has far fewer calories than the standard products. Chocolate aficionados often argue that chocolate ends up taking the blame for problems actually caused by excessive sugar consumption.

Modern chocolate-making serves a global market that is worth more than \$60 billion annually. And from cocoa beans to chocolate bars, the industry has increasingly come to be dominated by a small number of large companies—a trend that is typical of processed foods in general. (See “Where Have All the Farmers Gone?” September/October 2000.) Because the chocolate business is intensely competitive, companies tend to keep their statistics to themselves and comprehensive market-share data are difficult to find. But according to an article in the March/April 2000 issue of *Candy Business* magazine, the ten largest primary processors of cocoa now account for 67 percent of the world’s ground beans; that figure is projected to rise to 75 percent by the end of the decade. *Candy Business* reports that three intermediate processors (Barry Callebaut, ADM Cocoa, and Blommer Chocolate) now control about 55 percent of the world’s “industrial chocolate” (chocolate that has yet to be processed into a finished product). The retail level is dominated by six multinationals: Hershey, Mars, Philip Morris (which owns Kraft-Jacobs-Suchard-Côte d’Or), Nestlé, Cadbury-Schweppes, and Ferrero; in 1998, according to the European Fair Trade Association, these six companies controlled about 80 percent of the retail market.

Fruit of the shade

Chocolate owes its origin to tropical rainforest, the richest ecosystem type on earth in terms of species diversity. On the long list of benefits that such

1822, when the tree was established on the island of Principe, south of Bioko.

1600–1650: Chocolate becomes a favorite drink of the Spanish court.

ca. 1600: According to some accounts, this is the era in which the Spanish bring cacao to the Philippines, a Spanish colony

since 1543. (Other accounts suggest that cacao does not arrive there until 1663.)

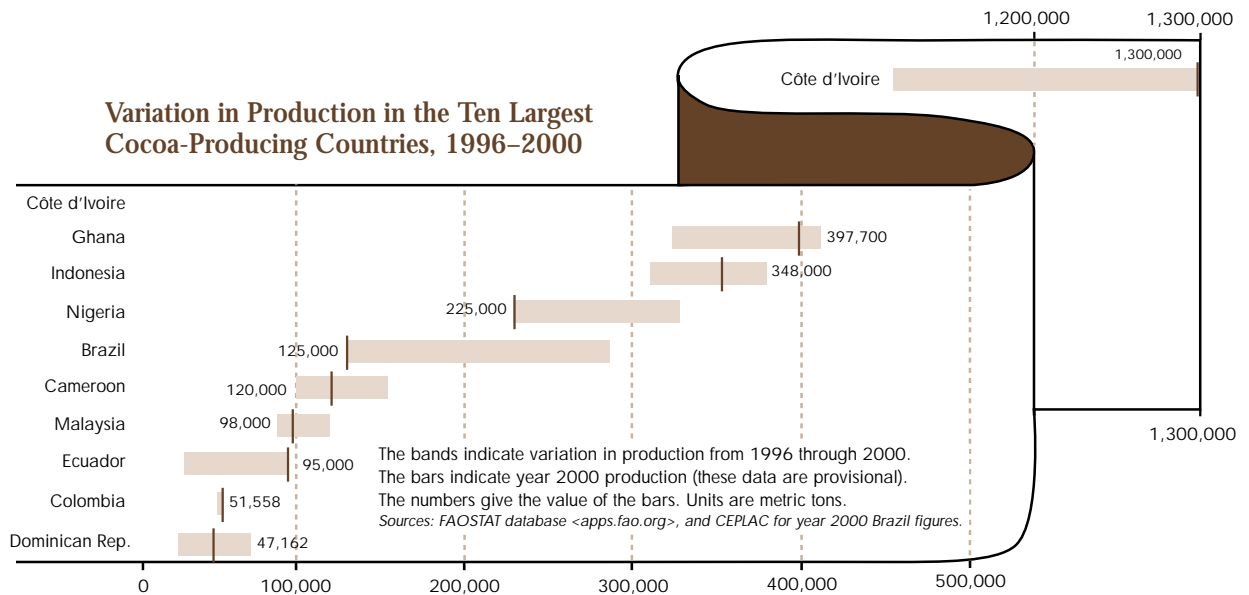
1657: London’s first chocolate house opens.

1659: In France, David Chaliou is granted a royal monopoly on the production of chocolate, which is acquiring a medical

mystique. All sorts of medicinal properties are attributed to it.

1668: Florence, Italy has at least one chocolate house; the chocolate drink has become popular with Florentines who can afford it.

ca. 1680: The French begin major



forests have conferred upon humanity, there is a line somewhere for chocolate—well below the entries for carbon storage, presumably, or hydrological stability, but it's there. A pleasant but rather trivial gift of the forest—as long as you think of the benefit working only in our direction. But chocolate may be a matter of profound importance, if we can repay that gift by consuming it in a way that will *benefit the forests*.

Certainly, those forests need all the help they can get. They are unraveling rapidly, primarily because of logging and burning (to clear land for pasture and crops). The data on tropical deforestation are vague and conflicting, but it's likely that the average annual loss currently exceeds 130,000 square kilometers—an area nearly the size of Greece. (This estimate comes from the World Resources Institute Pilot Analysis of Global Ecosystems, or PAGE project, which was released last year.) And that's only the area deforested outright: nearby forest communities generally suffer a great deal of collateral damage in the form of habitat loss, drying, additional burning, hunting pressure, and the invasion of nonnative species. But the extent of such degradation is even harder to quantify than the deforestation itself.

Despite all the attention that this problem has received over the past several decades, it is still far from clear, in most of these forests, whether conservation

will prevail in any meaningful way. The technical studies continue to pile up, but there are still basic disagreements over what conservation strategies work best. From a purely ecological point of view, the most effective approach would seem to be pretty simple: put the most valuable remaining forests behind park boundaries. But even when those boundaries are enforced—and frequently they aren't—the areas enclosed are not usually large enough to sustain the full range of ecosystem processes over the long term. The standard alternative is “sustainable forest management” (SFM), which attempts to make the forests pay their way into the future by logging them at a sustainable rate. But this approach too has come in for serious criticism. A recent study by Conservation International argues that SFM is not economically competitive with conventional logging practices—and that it is not necessarily less destructive either. The latter point might seem to be ruled out by definition, but it hinges on what is being defined as sustainable: a moderate timber yield may be sustainable more or less indefinitely, but the cutting may not sustain the original structure and composition of the forest. (The CI study suggests that where logging is inevitable, the best conservation option may often be to allow conventional logging and then to protect the cut-over area.)

At first glance, it may be hard to see much con-

production of cocoa on the Caribbean island of Martinique.

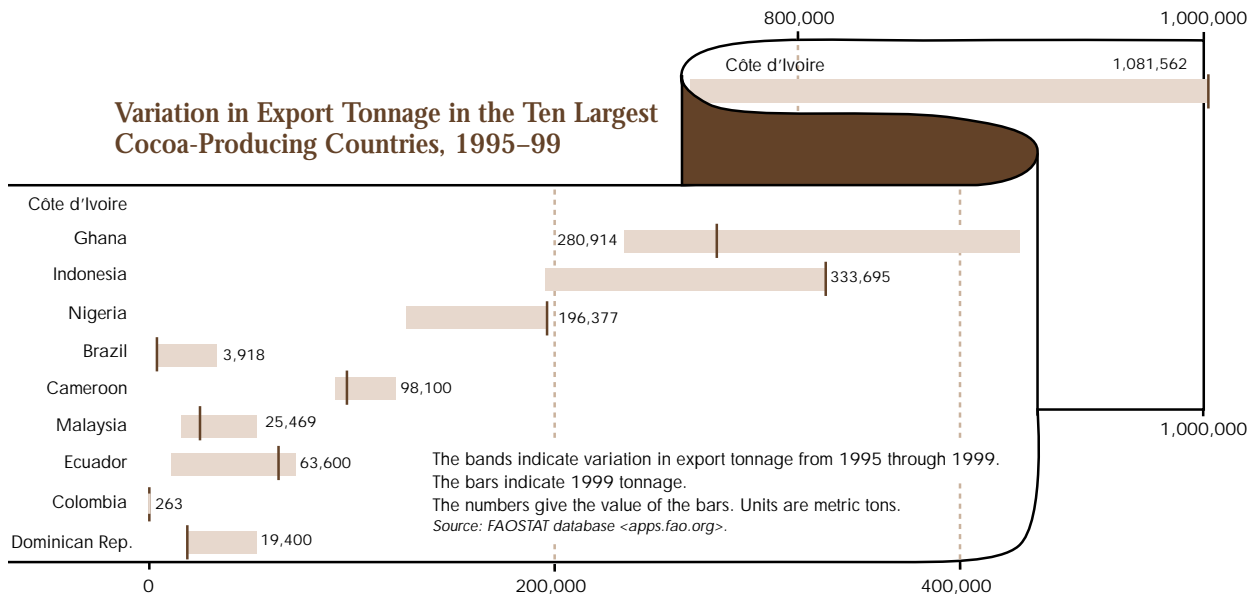
1700–1720: In London, chocolate houses eclipse coffeehouses and taverns as centers for amusement, business, and political debate.

1727: A major blight devastates

Trinidad's cacao plantations, which are planted with a variety of the tree known as *criollo*, native to southern central America. By the 1750s, Trinidad's plantations have been replanted with a different variety, *forastero*, from northern South America. Hybridization of the *forastero* imports with the *criollo* blight survivors produces cacao's only other major variety: the *trinitario*.

1746: French attempts to break the Spanish dominance of cocoa production bring cacao to the state Bahia, in Brazil (well south of the tree's native Brazilian range). The transplant is a huge but a delayed success: Bahia becomes a major cocoa-producing region by the end of the 19th century.

Variation in Export Tonnage in the Ten Largest Cocoa-Producing Countries, 1995–99



ervation potential in the cacao tree, since in most places where it is grown, its relationship to the forest has hardly been benign. Nearly 7 million hectares (70,000 square kilometers) are now in cocoa production—an area about the size of Ireland. Virtually all of this area was once tropical rainforest and in a good deal of it, the forest was obliterated for the express purpose of growing cocoa. And yet, the arrival of cocoa has not always caused the complete dissolution of forest; plantation conditions vary greatly. Cacao is sometimes grown on cleared ground, and in full sun once the young trees are established. (The more light it receives, the more productive a tree is likely to be, at least over the short term. That’s the advantage of growing in full sun; the disadvantage is that the tree is more prone to stress—from drying, for example—so its productive life may be shorter.) But because cacao is adapted to shade, it’s commonly maintained under some sort of loose canopy, either a thinned native forest or a tree plantation.

This shade tolerance is a promising asset. Cocoa is one of those crops, like shade-grown coffee, that can supply an economic rationale for preserving tropical forest canopy, albeit in a modified state. Cacao has several other characteristics that could make it a valuable ally of the forests. In the first place, it’s fairly easy on the soil, because of its heavy, soil-building leaf lit-

ter and because its nutrient demand is relatively low, at least for moderate levels of production. Second, it’s a rainforest exclusive: because of its temperature and moisture requirements, it cannot be grown commercially outside tropical rainforest areas. Any value that cocoa adds to these areas cannot therefore be depreciated by production elsewhere. Finally, it’s a hotspot crop. All the major cocoa-producing areas are so rich in biodiversity that they rank as hotspots: the Brazilian Atlantic Forest, Mesoamerica, the west African forests, the Indonesian-Malaysian archipelago, and Southeast Asia. If cocoa can be fashioned into a tool for conservation, it would appear to be a tool of considerable strategic importance.

But clearly, business as usual is not going to accomplish this transformation. A “forest friendly” cocoa would relate to the landscape in a way that is very different from the current standard. To begin with, it would have to embrace the three principles that appear to be coalescing into a new paradigm for tropical agroforestry. In other words, more and more cocoa would have to be:

Organic, that is, grown without artificial fertilizer or pesticides. Organic production avoids the damage done to soils, waterways, and forest by pesticides and synthetic fertilizer.

Fair-traded, that is, sold into an audited system

1765: Chocolate production begins in North America, with the establishment of a cocoa bean grinding mill in Massachusetts.

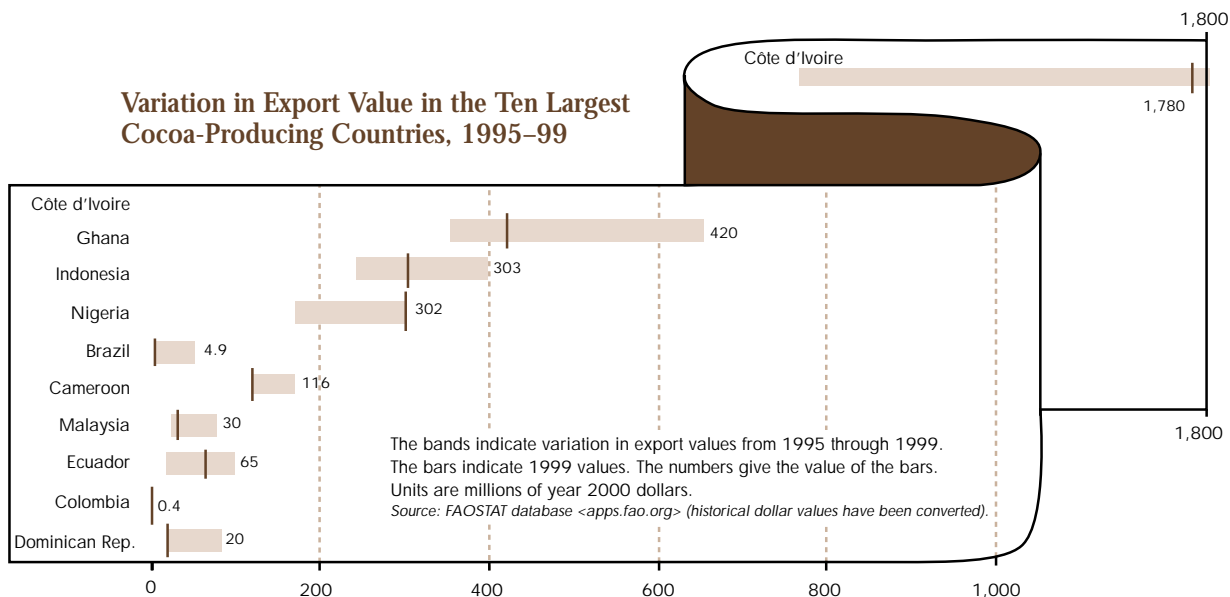
1778: The Dutch bring cacao from the Philippines to Jakarta, Sumatra, where they establish a propagation facility that soon leads to major production in the Dutch East Indies (now Indonesia and Malaysia).

1828: The Dutch chemist Conrad van Hooten patents a technique for pressing most of the fat from roasted and crushed cocoa beans, improving the digestibility of the resulting powder. The addition of alkaline salts makes the powder easier to mix in water. This “Dutch cocoa” permits mass production of cheap chocolate.

1847: The English manufacturer J.S. Fry & Sons uses cocoa powder to create the first successful mass-produced chocolate bar.

1850–1860: The cocoa pod borer, a moth whose larvae infest the cacao fruit, emerges in the Indonesian archipelago. Established plantations are ruined, and production is driven ever further into previously

Variation in Export Value in the Ten Largest Cocoa-Producing Countries, 1995–99



that guarantees growers a decent price and farm workers a decent wage. This is obviously of great social importance, but it's ecologically important too, because it can help build broad economic support for the other elements of this paradigm.

And finally, *shade-grown under native, regenerating forest*. (Of course, only forests that have already been substantially altered should be used for shade cultivation; cacao should no longer be planted into undisturbed forest.) Bahia's cabruca system already partly meets this need, but unlike standard cabruca, a really ecological cacao would have to allow for canopy regeneration—that is, instead of managing the understory purely for cacao, forest saplings would have to be allowed to emerge, to replace the canopy trees when they eventually die.

There is strong precedent for the shade criterion in the cabruca system, and "fair trade" is essentially just a common-sense labor right. (That doesn't make it easy to achieve, but at least it's not hard to understand.) It's the first item, organic production, that can be the toughest sell. Many farmers seem to have a hard time believing that large-scale organic production is possible, and it is true that the transition to organic can be tough. It usually takes several years to learn the skills of organic growing and to build the system's resistance to pests. Organic certification, through an inde-

pendent organization or sometimes through a government program, is the key to receiving the higher price that organic products generally command, but that takes time too. It's usually about three years before farm soils can be certified as clear of pesticide residues.

Once the transition is complete, however, organic can make as much sense financially as it does ecologically. Consider the organic cocoa program run by the Bahian environmental group IESB (Instituto de Estudos Sócio-Ambientais do Sul da Bahia). As of August 2001, the program had enrolled 75 farms, of which 20 had completed the three-year transition to certified organic. Those 75 farms cover about 5,800 hectares, mostly in cabruca; the certified farms account for 834 hectares of the total. A separate distribution system has been set up for the harvest: it's sold abroad through a local cooperative, rather than through the big international processors that buy conventional cocoa. Pests like the witches' broom tend to be less of a problem in organic systems, because the cacao is less dense. But as you might expect, the harvest is also smaller. IESB estimates the organic yields at 40 to 90 percent of conventional yields, the range being largely a function of variation in soil fertility. That might not sound very encouraging until you look at the bottom line. Because organic systems don't use expensive agrochemicals, the

undisturbed forest. The borer remains cacao's most important insect pest.

1853: The Cadbury family business, which had begun as a tea and coffee shop in Birmingham, becomes purveyor of chocolate to Queen Victoria. Cadbury-Schweppes is now one of the world's largest chocolate companies.

1879: The first really successful introduction of cacao to the African mainland occurs, when the tree is brought from the island of Fernando Po (now Bioko) to the Gold Coast (now Ghana).

1879: In Switzerland, the chemist Henri Nestlé and the chocolate manufacturer Daniel Peter find a way to mix chocolate

with milk—an objective that had frustrated chocolate aficionados for centuries. To overcome the incompatibility between the two substances, they use a low-fat form of chocolate (cocoa powder), and a low-water form of milk (condensed milk—an earlier Nestlé invention). The mixture is then enriched with additional cocoa butter

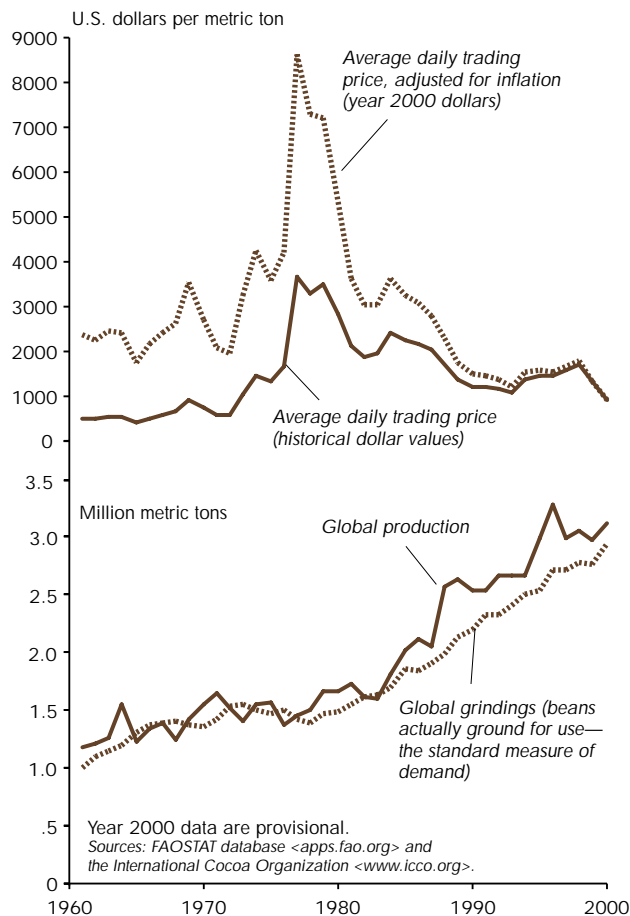
production costs are usually much lower, so net profit may rise even when yield declines. On its certified farms, IESB reports an average increase in net profit of about 80 percent.

The international picture is a scaled-up version of the Bahian one. Various forms of shade-grown, organic, fair-traded cocoa are being sold by small, “boutique chocolate” companies. (Many of these companies are listed in the links page of the International Cocoa Organization website, www.icco.org.) But the amount of cocoa produced for this niche market is a tiny percentage of the global harvest. For example, only about 6,000 tons of organic cocoa are produced annually; that’s less than two-tenths of 1 percent of total cocoa production. And yet, even this small-scale production is proof that organic cocoa works.

This new paradigm is fundamental, but it’s just the beginning, and it may turn out to be—relatively speaking—the easy part. Here’s what will almost certainly be the hard part: a truly ecological cocoa will have to be a force for *forest continuity*. In their present state, the cabruca stands and the other forest fragments in Bahia are generally too small to support genetically viable populations of many plants and animals over the long term. Even where the stands are regenerating, they will still tend to lose species eventually. To prevent this, cabruca management will have to be integrated into a broader strategy that aims to connect the fragments to each other by planting forest corridors between them. If the corridors are to preserve both the species diversity of the forest and the genetic diversity of individual tree species, they will have to be planted with seedlings from local fragments. The current fragments, in other words, are the gene banks from which the future forests must grow.

Reinventing cocoa

“Monoculture can be a very successful way of growing crops,” says Martin Aitken, who runs the Mars company’s cocoa research facility in Bahia. “but when it goes wrong, it goes spectacularly wrong.” In Bahia, monoculture has gone just about as wrong as it can go. That fact, combined with certain other conditions, may have created an unusual opportunity: at this time, Bahia may be the best place in the world to



World Cocoa Production, Demand, and Trading Prices

launch a large-scale effort to develop a forest-friendly cocoa. The need for change, the capacity for change, and a major ecological benefit for change—all these elements have now emerged in Bahia.

The need for change: In order to overcome the witches’ broom, many stands of cacao are going to have to be replaced by more resistant stock. CEPLAC released its first generation of resistant cacao cultivars in 1997 and so far, 35,000 to 50,000 hectares have been planted in them. These trees are beginning to bear fruit, and results are encouraging. A second generation of CEPLAC cultivars, even more resistant to

and cocoa solids. Milk chocolate is an instant commercial success.

1879: The Swiss chocolate manufacturer Rudolphe Lindt invents the “conch,” a machine for stone-grinding chocolate. Because it produces a much finer-grained, more mellow chocolate, conching soon becomes a standard manufacturing process.

1894: Milton Hershey, already the owner of a caramel candy business, founds the Hershey Chocolate Company in Pennsylvania. Like Cadbury-Schweppes and Nestlé, Hershey is today one of the largest chocolate manufacturers in the world.

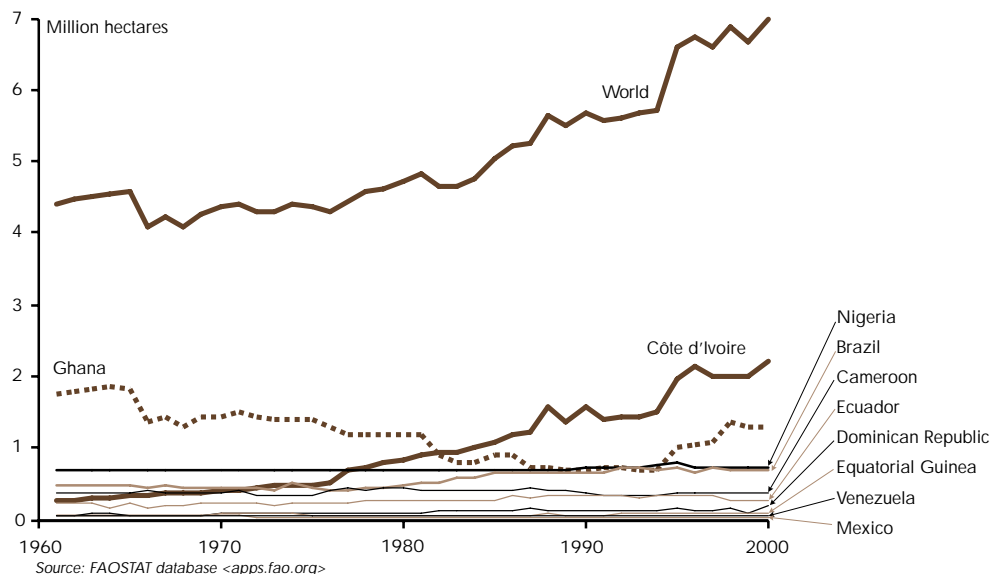
1905: Cacao arrives in Côte d’Ivoire, the

country that is today the world’s biggest cocoa producer.

1911: The cocoa yield in Ghana approaches 40,000 tons—at the time, a world record national harvest. Cacao, a New World tree, has become primarily an Old World crop. Today, roughly two-thirds of cocoa production is from Africa.

the broom, should be available soon. Simply planting resistant trees, however, is not going to solve Bahia's problems. Even if the broom is vanquished, Bahia is going to have a hard time competing with Africa in the conventional cocoa market. Consider the huge disparity in the cost of labor: in Bahia, farm workers generally make the Brazilian minimum wage, which currently amounts to a little over \$850 per year.

In Côte d'Ivoire, by far the world's largest cocoa producer, workers are typically paid around \$165 per year (assuming they actually get paid). That's less than a fifth the Brazilian wage. Planting those resistant cultivars will push Bahia's production costs even higher, at least for the next several years. (It costs about \$1,500 to replant 1 hectare of cacao.) Production costs may eventually decline if large numbers of farmers adopt the strategy that CEPLAC currently recommends: a broom-resistant, nonorganic regime intended to produce 1,500 kilograms of cocoa per hectare per year (versus around 900 kilograms per hectare on the higher-yielding Ivoirian plantations). But even then, it is hard to see how this high-yield strategy will serve the long-term interests of producers, who are already facing low prices because the global market is flooded with cocoa. Bulk production of "generic cocoa" just doesn't seem to be the game best suited to Bahian conditions. It would make more sense to develop higher-value products, like "forest friendly" chocolate, and a stronger demand for them. A comprehensive remedy, in other words, will have to be built not just on the farm, but in the markets and media that influence the demands of consumers abroad.



Cocoa Bean Area Harvested: World and Major Growing Countries

The capacity for change: Bahia probably has the best agronomic infrastructure of any cocoa-producing region in the world. CEPLAC has nearly 40 years of fieldwork and research to its credit. It's staffed by experts with an intimate knowledge of their area and it has some 200 field extension agents. IESB has already developed a proven organic cocoa program. CEPLAC, IESB, the Mars Company, and professors at a local university, the Universidade Estadual de Santa Cruz, are all investigating polycultural agroforestry systems in which cacao would figure as a major component. Polyculture, the growing of several crops simultaneously on the same piece of land, doesn't have to be organic, but organic farmers often use polyculture to reduce their vulnerability to the pests of any particular crop. Polyculture outside cabruca is already underway to some extent; cacao is sometimes interplanted with banana, for example, or rubber. Within cabruca, polyculture is trickier because there's less light to work with, but it should be feasible to include various other shade tolerant crops, such as the fruit- and fiber-producing palms, açai (*Euterpe oleracea*) and piassava (*Attalea funifera*).

In addition to its intellectual resources, Bahia has

1917: The first reports of a virulent fungal disease called frosty pod rot emerge from Ecuador. The disease, which is currently confined to northern South America and southern Central America, can cause a total collapse of the yield.

ca. 1920: In Minnesota, Frank Mars founds the Mar-O-Bar Company, the precursor

of Mars, Inc., another of the world's largest chocolate manufacturers.

1936: Cocoa Swollen Shoot Virus emerges in Ghana and spreads throughout the west African cocoa-producing region during the next two decades. The virus remains the most important pest of cacao in Africa.

1987: Food-Tek, a food chemistry firm in New Jersey, takes out the first patent on an altered molecular structure in cocoa butter. Food-Tek's invention is the first (reasonably) edible heat-resistant chocolate. A similar invention in the following year, by the Batelle Memorial Research Institute in Switzerland, attracts major industry investment. Heat-resistance is widely regarded as

enormous genetic resources at its disposal, since a substantial portion of the cacao tree's native range is within Brazilian borders. Much of this native genetic wealth has yet to be tapped for disease resistance, fruit production, and other useful characteristics.

Bahian farm owners may also be ready for change. In general, these people are—or were—wealthy, at least in local terms. But at this point many of them are in debt, or without sufficient collateral for additional loans. And it's probably safe to say that nearly all of them are frustrated. They have weathered past cocoa crises (created by previous price downturns), largely by waiting them out. By and large, they have taken that approach this time as well, but they know that beyond the witches' broom, the overall trend in cocoa prices is not promising. The passive strategy is becoming less and less attractive. Yet the radical alternative—selling the farm—is not a very handsome option either, since land values have declined greatly in the wake of the crisis. Some farmers are moving into other crops, such as palm heart, coffee, or even cattle, and sometimes cutting cabruca to do so. But there is still a general reluctance to abandon the crop that was once the key to prosperity. In short, Bahian cocoa growers would appear to make a good constituency for change: they are relatively conservative, but they are educated, influential, and increasingly restive—and there aren't that many of them. A plan that attracts significant interest from them would likely also get government attention, especially if it addressed a basic problem for a much broader constituency: the need to do something for those 90,000 unemployed farm workers.

A major ecological benefit for change now: In Bahia, most of the largest surviving undisturbed forest fragments lie along the coast; most cocoa is grown farther inland. But the cabruca and other fragments in the cocoa region are well worth preserving in their own right. Even though it is hardly pristine, cabruca accounts for a good deal of the remaining forest. In southern Bahia, roughly half the surviving canopy is in cabruca. And at least in some contexts, cabruca may hold a lot more biodiversity than is commonly assumed. A research project near the Una Reserve, along the coast of southern Bahia, is turning up sur-

prisingly high levels of diversity in landscapes that include cabruca, undisturbed forest, and pasture. Many forest animals are apparently using nearby cabruca as a kind of supplement to their main habitat. In one night, for example, the Una researchers found 23 bat species foraging in one cabruca stand. The golden-headed lion tamarin (*Leontopithecus chrysomelas*), an endangered primate, also uses cabruca in this way. And in 1994, a new member of the ovenbird family was discovered in cabruca: the pink-legged graveteiro ("twig-gatherer") spends most of its time in the canopy, upside-down, foraging for insects. This little bird was unusual enough to merit, not just a new species, but a new genus. It's classified as *Acrobatornis fonsecai*, and you can see a picture of it on the cover of this magazine. Apart from their intrinsic value, the cocoa farms have probably also helped preserve the less disturbed forests elsewhere by employing people who might otherwise have invaded those forests in search of arable land. But current unemployment in the cocoa region is almost certainly putting additional pressure on surviving forest.



Bahia has an opportunity to reinvent cocoa. It may be possible to undertake a form of large-scale cocoa production that favors ecological stability at relatively high levels of diversity, that favors reasonably high employment, and that creates products that link consumers in distant societies with these objectives. Here are three steps that, I believe, would get the transformation off to a strong start.

1. Find a way for CEPLAC, the federal cocoa agency, to buy into the new agricultural paradigm.

CEPLAC's concern for the local economy would acquire an effective ecological complement if it were to launch a major organic cocoa initiative. It would not be necessary for the agency to abandon its support of conventional cocoa-growing regimes, but simply to offer growers access to in-depth expertise on organic as well. Without at least an implicit endorsement from the region's most important agricultural agency, progress towards an alternative paradigm is going to be difficult. So the new paradigm needs CEPLAC, but

key to boosting chocolate consumption in the tropics and warm temperate regions.

1989: The cacao witches' broom, a native fungal pest of cacao in Amazonia, is identified in Bahia, Brazil's main cocoa-producing state. Over the next decade, Brazilian cocoa production drops to one-quarter its previous level. The witches' broom is

currently confined to northern South America and Panama.

2000: In October, a British television documentary ignites a debate on child slavery in the cacao plantations of Côte d'Ivoire, currently the world's main cocoa producer. According to the program, "up to 40 percent of the chocolate that we eat may be

contaminated with slavery." Côte d'Ivoire officials reject the charges; the industry promises to investigate. (Slavery was important in plantation development in both the Old and New Worlds.)

CEPLAC could profit from the new paradigm as well. CEPLAC was built from a 10 percent levy on cocoa exports, and the collapse of cocoa has crippled the agency. An organic initiative could be used to attract new funding, from international donors.

2. Begin to build a stronger consumer constituency for "forest friendly" farm products.

On a global basis, the \$22-billion-a-year organic sector is the fastest-growing portion of the entire agricultural economy. Evidently, more and more consumers are willing to pay a somewhat higher price in order to prevent damage traditionally viewed as an "external cost" of production—in this case, the damage caused by agricultural chemicals. Such willingness is a marketing opportunity that should be aggressively pursued. When consumers buy such products, they are not simply purchasing the commodity itself; they are purchasing a connection—to a way of life, to an ideal, to a region or issue that they care about. Producers can improve the value of that connection by offering consumers more to connect *with*. In the case of Bahia, cocoa could be certified as coming not just from organic cabruca, but from *regenerating* organic cabruca. It could be certified as "bird friendly," since Bahia has a very rich bird fauna, and birds have charisma. And the certification should extend beyond chocolate, to pharmaceuticals and cosmetics that include cocoa butter, and to other organic crops planted in or around the cabruca. Finally, there is a possibility that could jump this type of certification from niche-market status to mainstream public consciousness: cocoa could contribute not just to forest conservation, but to forest *restoration*. After decades of publicity on tropical deforestation, the idea of coaxing the forests back out onto degraded ground could have a very powerful "good news" appeal. That would require a third step:

3. Build an "agroforest linking capacity."

If the cabruca and other small forest fragments in the Bahian countryside are to survive, they must be linked: corridors of forest must be planted between them, or the patches must at least be extended towards each other, where complete continuity is not feasible. (Continuity is much better than a gap, but a gap can be crossed by some organisms, so it's still a great improvement over isolation.) The corridors would presumably be a varying mixture of restored natural forest and crop-producing agroforest. There is no single law, policy, or economic opportunity that can be invoked to link the fragments—but there are many economic and legal situations that could be turned into opportunities for this kind of effort. The complexity of these activities, in my view, argues strongly for establishing a single program or perhaps an independent agency whose sole mission is agro-

forest linkage. Such an agency would function as a kind of local version of the grand corridor planning that the Brazilian government has undertaken on a national basis, with the help of various domestic and foreign partners. (See "The Restoration of a Hotspot Begins," page 8, for more on corridors.) The national plan is necessarily focused on the areas with the best remaining natural fragments. The program envisioned here would work in an analogous way, but it would focus on the many "lower grade" areas that are still critically important in the aggregate.

In pursuit of both its funding and its objectives, the program would need a flexible agenda. For instance, it should attempt to capitalize on the growing concern in eastern Brazil over the need for better watershed management. City water supplies have deteriorated from deforestation; much of the public seems to understand this connection and some politicians have voiced an interest in repairing it.

The program should look for ways to employ as many people as possible in forest restoration and agroforestry. It should regard job development as a funding opportunity—as something it can request funding to do. And it should look abroad, at other environmental public works programs, for useful precedent. An obvious starting point would be South Africa's "Working for Water" program, which employs about 24,000 people to clear away the invasive exotic trees and shrubs that are choking off municipal water supplies. Working for Water has become one of South Africa's most effective job creation programs. Poor Bahians could be "working for water" as well—by planting trees, rather than uprooting them.

It could well be objected that such proposals are just not realistic. And indeed they aren't, but that is their virtue. After all, it is ordinary, day-to-day realism that generally creates the big problems. It is a refusal to be realistic, in the usual sense, that generally leads towards solutions. Pesticide manufacturing, for instance, is a sophisticated, \$31-billion-a-year business. Very realistic—but who would have believed that the farm-based craft of organic growing would become the most rapidly expanding part of the agricultural sector? And yet it is. Our relationship with the chocolate tree is thousands of years old and it offers us much more than can be found in the cocoa commodity brand of realism. Cocoa may help us rejuvenate both the forests themselves—and our relationship to them. What is the promise in the velvet taste of chocolate? Food, forests, and life.

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