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Sustainability Analysis of the Coffee Industry in Costa Rica

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Documento en Proceso. Escrito por Lawrence Pratt, director adjunto del Centro Latinoamericano para la Competitividad y el Desarrollo Sostenible, CLACDS, y Claudia Harner, Investigadora-Consultora de CLACDS. Este trabajo busca estimular la reflexión sobre marcos conceptuales novedosos, posibles alternativas de abordaje de problemas y sugerencias para la eventual puesta en marcha de políticas públicas, proyectos de inversión regionales, nacionales o sectoriales y de estrategias empresariales. No pretende prescribir modelos o políticas, ni se hacen responsables el o los autores ni el Centro Latinoamericano de Competitividad y Desarrollo Sostenible del INCAE de una incorrecta interpretación de su contenido, ni de buenas o malas prácticas administrativas, gerenciales o de gestión pública. El objetivo ulterior es elevar el nivel de discusión y análisis sobre la competitividad y el desarrollo sostenibles en la región centroamericana. El contenido es responsabilidad, bajo los términos de lo anterior, de CLACDS y no necesariamente de los socios contribuyentes del proyecto. August, 1997.

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EXECUTIVE SUMMARY

The economic prosperity resulting from Costa Rican coffee production and commercialization has financed much of the country´s modernization over the last 150 years. Starting in the 1970s, with the help of international aid agencies such as the United States Agency for International Development (USAID), Costa Rica converted many of its traditional shade grown plantations to sun grown ones in an effort to grow more coffee and increase income. By the mid-1980s, Costa Rica boasted the highest yield rates (production per hectare) in the world, obtaining 1,518 kg of milled, high quality arabica beans per hectare per year. Yet these "modern" production techniques - although they have increased yields - also require an expensive, input-intensive production strategy which leads to substantial, irreversible environmental damage. Today, Costa Rica accounts for the highest number of sun grown coffee farms in Central America - 40% of total coffee production. In general, the number one priority in Costa Rica has been high yields - not less environmentally impacting coffee.

Although the prevailing coffee cultivation techniques have led to serious negative environmental impacts, the Costa Rican coffee processing industry has made significant progress in cleaning up its operations. In 1992, an interinstitutional agreement between the National Coffee Institute (ICAFE) and three government ministries was signed. The agreement consists of four stages, and the ultimate objective is to reduce pollution generated from the coffee processing industry by a total of 80%. As of August 1997, the first three stages have been completed, and compliance has achieved significant results. Water usage in the processing of coffee has been reduced from an average of 15.5 liters of water per kg of cherries to 3.87 liters per kg of cherries. Sedimentation tanks have been designed to remove 50% of suspended solids. The removal and transport of the coffee pulp without the use of water has allowed for the generation of contaminates to be decreased by 50%. At the end of these three stages, pollution has been reduced by 70%, with a total investment of about $11 million in clean technologies. The final stage is currently underway, which all plants must finish by the end of the 1997-98 harvest. The progress the industry has made in cleaning up its coffee processing activities will most definitely contribute to a cleaner natural environment in Costa Rica, and is a model example for other coffee producing countries interested in greening their own operations.

Perhaps the biggest obstacle to sustainability is the fact that the Costa Rican coffee industry is so tightly regulated, with little room for innovation. ICAFE controls the entire export process as well as national coffee consumption. The procedures are impressively complex, burdened with bureaucracy and regulations. ICAFE also determines the final price that processors pay the producers, based on a variety of considerations - yet quality is not a determining factor. Thus, although coffee prices vary throughout the country (there can be differences of up to $50 between regions), those farmers who produce high quality coffee are not necessarily compensated for their efforts; and low-quality producers are not penalized. Although the government claims that the fixed price system guarantees the producer a fair price for coffee, it is also very rigid, because it does not stimulate the production and commercialization of high-quality, gourmet, or less environmentally impacting coffee. There are no incentives for producing such coffees, since in the government's eyes, coffee is, more or less, one and the same - no matter how ecologically sound it is grown.

Furthermore, as a result of the tightly regulated system, only twelve exporting companies account for 95% of total exports. In fact, Cafe Capris (Volcafe), Cafinter (Esteve), and Ceca (Rothfos), multinational conglomerates, control 40% of total coffee exports. Their main goal is

to sell quantity, not quality, and as a result, Costa Rican coffee is a somewhat generic product. This phenomenon has put the country at a great disadvantage, since these large players are not necessarily interested in promoting “Costa Rican” coffee, or for that matter, gourmet or less environmentally impacting coffee. Processing plants do little to position their own brands in distinct markets, either through exporters, or on their own. Processors are trapped in a vicious circle: they have very little knowledge of these growing markets, which in turn keeps them from developing sales strategies to differentiate and place their brands successfully among international roasters.

In summary, the system in Costa Rica does not encourage the practice of less environmentally impacting methods, nor the exploration of niche gourmet or other higher valued added coffee markets. As a result, the country is excluded from these growing segments. Until the current system is liberalized to encourage and reward producers who experiment with less environmentally impacting techniques and new niche markets, this will continue to be the case.

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1. BACKGROUND INFORMATION ON THE COFFEE INDUSTRY IN COSTA RICA

Coffee has played an important economic and political role in Costa Rica since the 1830s, when it first began exporting the crop to South America and to Europe. The government of Costa Rica has heavily promoted coffee throughout the country's history and is still very much involved in regulating the industry today. The economic bounty resulting from coffee production and commercialization has financed much of the country´s modernization over the last 150 years. By the mid-1980s, Costa Rica boasted the highest yields in the world, obtaining 1,518 kg of milled, high quality arabica beans per hectare per year. (Brenes, 1997).

1.1 Background of the Coffee Industry

Approximately 108,000 hectares are dedicated to coffee in Costa Rica. Of this total area, 40% is "technified," or full sun grown coffee; 10% is traditional, or shade grown; and 50% consists of "intermediate" systems, which may include some degree of shade. Costa Rica produces the arabica species only, in eight zones around the country: Alajuela, Heredia, San Jose, Cartago, Los Santos, Turrialba, Perez Zeledon, and Coto Brus. Costa Rica classifies its coffee as Strictly Hard Bean, Good Hard Bean, Hard Bean, Medium Hard Bean, High Grown Atlantic, Medium Grown Atlantic, Low Grown Atlantic, and Pacific. Strictly Hard Bean is cultivated between 1200 and 1650 meters, and Good Hard Bean between 1000-1200 meters. These two are considered "specialty coffee" caliber, and account for 50% of national production. Hard Bean and High Grown Atlantic are grown 800-1200 meters above sea level, and account for 20% of production. The remaining 30% of production is grown at altitudes of less than 900 meters above sea level, and is considered of lesser quality. (Gonzalez, 1997) Coffee accounts for about 5% of total employment, and about 21% in the agricultural sector. (ICAFE, 1996) There is a national policy not to increase the amount of land dedicated to coffee, and instead to focus on increasing yields on existing territory. (personal communication with Zamora Quiros, 1997).

PRODUCTION STRUCTURE

size of coffee plantations (fanegas)[1]	Number of producers	% of total producers	% of total production
0 - 150 fanegas	74,081	95.9%	55.5%
150.1 - 500 fanegas	2,659	3.4%	19.4%
more than 500 fanegas	501	0.7%	25.1%

Source: Gonzalez and ICAFE

1.2 Economic Importance of Coffee

Over the past decade, coffee's contribution to total exports has fallen, due mostly to lower coffee prices. In Costa Rica, coffee exports accounted for anywhere between 20-30% of total exports from 1970 to 1989. (Rice, 1996) In 1985, coffee reached the peak of its importance to

[1] One fanega (2 double hectoliters) is equal to approximately 1 quintal (which is equal to 45.37 kilograms).

the country's economy, accounting for 34% of foreign exchange earnings. Unemployment and financial impoverishment resulting from the collapse of the International Coffee Agreement in 1989 affected millions of farmers in the coffee growing countries of Latin America, including Costa Rica. For example, between 1988 and 1991, the world price for coffee declined by 38%. (Brenes, 1997) Prices have risen dramatically since the 1993 Coffee Retention Plan, which is an accord among 28 coffee producing countries (referred to as the Association of Coffee Producing Countries) from Latin America, Asia and Africa that seeks to restrict international market supplies by requiring members to withhold a specified percentage of coffee stocks from exportation.[2] However, much of the recent boost in prices is attributable to a mid-1994 freeze that destroyed a large portion of the Brazilian coffee crop. Today, coffee is Costa Rica's second most important export after bananas, and is the third largest foreign exchange earner after tourism and bananas, accounting for about 10-15% of the country's foreign exchange. (Gonzalez, 1997)

There are about 65,000 coffee farms in Costa Rica, and 85% of them are small farms (under 10 hectares) (Rice, 1996). Coffee production is dominated by small producers, which are responsible for more than half of total coffee production. Large producers account for 25% of national production (yield of 30 fanegas per hectare). The average national yield during the 94-95 harvest was 30.51 fanegas per hectare. (Gonzalez, 1997) Costa Rica's largest single export markets are the US (19% of the 95-96 harvest), Germany (18%), and the United Kingdom (10%).

COFFEE'S IMPORTANCE IN THE ECONOMY

Year	Exports (in 60 kg. Bags)	Value in US$ (FOB)
1990-1991	3 145 000	263 600 000
1991-1992	3 220 000	201 600 000
1992-1993	3 144 000	201 500 000
1993-1994	2 869 000	300 200 000
1994-1995	2 698 000	414 300 000

Source: ICAFE

1.3 The Structure of the Costa Rican Coffee Industry

The coffee industry in Costa Rica is heavily regulated, with four main participants: coffee producers, processors, exporters, and roasters (mostly for the national market).[3] The National Coffee Institute of Costa Rica (ICAFE) each year determines how much of the coffee will be dedicated to domestic consumption (usually no more than 10%), and how much can be exported. ICAFE controls the entire export process as well as national coffee consumption. It also determines the final price that processors pay the producers. Costa Rica is currently the

[2] This "witholding amount" can be up to 20% of members' yearly coffee harvest which is deemed of exportable quality. However, there is currently no retention rate due to the high prices that have characterized international coffee markets. The coffee industry complains that the retention scheme is extremely difficult to manage.

[3] Law No. 2762 (1961) regulates the relationship between producers, processors and exporters.

only coffee producing country in the world where the government sets the prices that producers receive. (personal communication with Sanchez Solera, 1997).

Coffee producers are free to sell their coffee to any of the 95 processing plants (beneficios) they like at a price set by the government (see discussion below). Small and medium sized plants are usually independent, and are responsible for about 20% of national production, with an average of 21,000 fanegas processed per beneficio. 33 beneficios belong to exporting companies, and account for processing about 40% of national production, with an average of 40,000 fanegas processed per beneficio. The rest of the beneficios are part of cooperatives. 25 cooperative plants process about 1,320,000 fanegas per year, with an average of 52,800 fanegas per beneficio. These plants process about 40% of national production. (Gonzalez, 1997).

The majority of processing plants are located in Alajuela, San Jose, Cartago, and Heredia. In fact, 70% of the plants are located around the Tarcoles River watershed in the Central Valley, where 50% of the national population lives. (Conejo, 1996) Since they cannot legally compete by paying a higher price, processing plants try to distinguish themselves to producers by offering financing, technical assistance, input sales (such as pesticides and fertilizers), free transport of the coffee from the farm to the plant, and other perks. Plants then sell their processed coffee to national exporters, who resell it to importers or roasters in other countries.

Today, exporters in Costa Rica usually buy coffee from different processing plants, mix the coffees, and sell them as their own brands. As a result, unique coffees are often lost in the shuffle. Selling prices are based in large part on New York futures prices. In Costa Rica, coffee is a volume business and is treated like a commodity. Twelve exporting companies account for 95% of total exports. Cafe Capris (Volcafe), Cafinter (Esteve), and Ceca (Rothfos), multinational conglomerates, control 40% of total coffee exports. The remaining 5% of exports is controlled by processing plants directly. Most coffee exporters do not undertake promotional activities. Those that have been undertaken concentrate on building the image of individual companies - not of Costa Rican coffee per se. (Gonzalez, 1997).

Finally, national roasters acquire up to 10% of the harvest, usually of lesser quality. Today in Costa Rica, roasters prepare two types of coffee: one of inferior quality, which is mixed with sugar, and one of better quality, called cafe puro. The first coffee (the one mixed with sugar) dominates 80% of the domestic market. (Gonzalez, 1997).

One of the most distinguishing factors of the Costa Rican coffee industry is the government's impressively complex price fixing scheme, which has been in place since 1961. (see Annex A)[4] This scheme is extremely paper-intensive, difficult to understand, and is described here only in very basic terms. After an exporter signs a contract with an importer or international roaster, he deducts 2.5% in export taxes from the agreed upon free on board (FOB) price (described under fiscal policies below - 1% of the sales price goes to the government, 1.5% goes to ICAFE) as well as $1.65 fixed transport fee per qq (which the exporter keeps) before paying the processor.[5] This price, net of these two charges, is what the exporter pays the processor, and is called the "precio riele."

[4] Annex A is a copy of ICAFE's final price calculation - orginally 11 x 18 inches - which is conducted for each of the 95 benefios. Most of the expenses are calculated from additional forms, which are not enclosed.

[5] ICAFE must approve **every** contract that is signed by a Costa Rican exporter before it is considered valid and before the transaction can actually take place.

ICAFE then calculates the final (minimum) prices that producers receive by deducting a series of expenses from the precio riele. These expenses include a 20% income tax[6]; a contribution to the National Coffee Fund FONECAFE[7]; processing costs[8], and a 9% profit margin on this subtotal as compensation, regardless of a beneficio's efficiency. However, if the beneficio's yield is lower then what ICAFE has determined to be the national minimum yield, the beneficio must pay the difference in costs of this "lost" amount. During the 1995/96 harvest, 15 beneficios were penalized for having a yield less than the determined national minimum average. (personal communication with Juan Rafael Gonzalez, 1997).

To complicate the process further, a processor must classify his coffee as either "mature" coffee, which consists of mature, red coffee cherries (and which is further broken down into either "high zone" (zona alta) or "low zone" (zona baja), depending on the altitude of where the coffee is grown); "green coffee," which consists of green coffee cherries; or "natural coffee" (also called cafe bellota), which are cherries that have already fallen to the ground and are thus partially dry. The "natural coffee" is of lesser quality, so it receives a price of 20-30% lower than that of "mature" or "green" coffee. During the harvest season, the processing plant must send a form detailing what kind of coffee is being processed to ICAFE every 15 days. At the end of the harvest, the types and quantities of coffee that have been harvested are taken into account in determining the final prices paid to producers.

ICAFE does not determine the coffee prices until after the harvest is over, so producers are paid for their coffee in increments throughout the year by the processors until final prices are determined. By the end of the year, ICAFE determines the individual prices that each of the 95 beneficios will pay their producers. Indeed, the entire procedure is a complex process burdened with bureaucratic procedures and regulations.

One of the results of this complex regulatory structure is that quality (i.e. the quantity of small vs. large beans, etc.) is not really a determining factor of prices (since mature coffee is only separated as coming from either a high or a low zone), nor is a plant's processing efficiency. Although coffee prices vary throughout the country (there can be differences of up to $50 per quintal between regions), those farmers who produce high quality coffee are not necessarily compensated for their efforts; and low-quality producers are not penalized. Some coffee industry participants say this system has led to the decline in the quality of Costa Rican coffee during past years. (Gonzalez, 1997, and personal communication with Sanchez Solera, 1997) As a result, some coffee industry players are looking for other ways to assure quality. For example, Federacion de Cooperativas de Caficultores R.L. (FEDECOOP), a Costa Rican umbrella organization of 20 coffee cooperatives, is in the process of obtaining ISO 9000 certification for its export operations and processing plant. It is also examining the possibility of ISO 14000 certification in the future. FEDECOOP plans to help some member cooperatives pursue certification, too. (personal communication with Sanchez, 1997) In fact, one of

[6] This 20% income tax entails a separate worksheet. It entails a series of deductions including processing costs which are **different** than those deducted from the "precio riele" (and which must be approved by the Ministry of Agriculture - not just ICAFE); the 9% margin; the contribution to FONECAFE; and additional agricultural production costs determined by ICAFE. The tax is determined per 46 kg bag.

[7] The amount paid into the fund depends on the export selling price of coffee. When the price is between $0 and $92, no contribution is made. Between $92.10 and $100, there is a 3% "tax;" between $100.10 and $125 it is 4%, between $125.10 and $150 it is 6%, and when the price is greater than $150, the "tax" is 10%. (Gonzalez, 1997)

[8] The processing costs are determined by ICAFE at the end of the harvest, and are different for each coffee producing region. These costs include transportation, supplies and machinery, insurance, workers' benefits and social costs, electricity and other fuel sources, water treatment, etc. The national average for the 1995/96 harvest was 42.15 colones per kilogram. (personal communication with Juan Rafael Gonzalez, 1997).

FEDECOOP´s cooperatives has already entered the ISO 9000 process, and hopes to have each of its producers certified as well.

2. SHADE GROWN VERSUS SUN GROWN COFFEE

2.1 Shade Grown Coffee

This traditional form of growing requires that coffee be planted beneath a forest canopy of trees. The canopy varies throughout coffee-growing regions, from indigenous rainforest to mixed forest. In a traditional coffee plantation, the trees fix nitrogen from the atmosphere into the soil, eliminating or greatly reducing the need for nitrogen-based fertilizers.[9] Pesticides are less necessary because of the birds that thrive in the shade giving overstory. Weeds tend to be less prevalent in shaded plantations, and can and are controlled with machetes rather than herbicides. Leaf litter, accumulating beneath the trees, is home to insects that devour nematode pests that bore into coffee beans. Thus, toxic nematicides are not required on shade plantations. The coffee grown in the shade develops more slowly, creating a higher sugar content that, when the beans are roasted, is said to give the coffee a richer, fuller flavor. Such coffee commands a higher price in international markets.

In addition to coffee, shade grown coffee farms typically cultivate diverse crops that can include cacao, fruit, avocado and trees for firewood. These various species are important for maintaining the biodiversity of the coffee farm and are also an important source of additional income. The diversification helps protect small producers from international market fluctuations, natural occurrences, and other uncertainties. By providing an alternative to deforestation, traditional coffee systems also constitute an important check against greenhouse gas emissions that contribute to global warming. As rainforests disappear at the rate of 17 million hectares per year, shade tree systems have become a secure haven for migratory birds, too, and represent an excellent habitat for the natural wildlife still surviving in the subtropical regions. (Rice, 1996).

Shade grown coffee also provides essential habitat for diverse communities of other tropical forest species. Findings by University of Michigan biologist Ivette Perfecto and colleagues from research in Costa Rica suggest that local species diversity of beetles, ants, wasps, and spiders on a single tree species (Erythrina poeppigiana) in shade grown coffee plantations approximates the arthropod diversity levels on single tree species in undisturbed tropical forest. (Perfecto, 1996) Also, traditional coffee is often integral to agro-forestry systems in which tree species are cultivated together with coffee and other agricultural commodities. Where geographic and market conditions are favorable, economic returns can be achieved through sustained-yield timber production in association with coffee. For example, research in Costa Rica has shown that timber production from the precious hardwood species Cordia alliadora can occur with no significant damage to growing coffee crops. (Rice, 1996).

2.2 Sun grown coffee

Over the last two decades, in an effort to grow more coffee and increase foreign exchange earnings under the regulated system, many farmers in Central America and other parts of the

[9] Such species include Inga spp., Erythrina spp., and Gliricidia sepium. (Perfecto, 1996).

world have “modernized,” or “technified,” their coffee farms. Technification employs a hybrid plant that grows in full sunlight, which grows three times faster than a coffee plant on a shade grown farm. This method results in an increase in the density of coffee plants from 1000-2000 per hectare to 3000-7000 per hectare in a sun grown plantation. (Rice, 1996) Sun grown coffee trees have a life of 12 -15 years, whereas those in a traditional plantation have a life of more than double this. Not surprisingly, sun grown coffee farms are much more chemically intensive and have higher input costs - and are thus much less sustainable. They lack the nitrogen supplied by the bacteria in the roots of certain shade trees and thus depend on a steady diet of fertilizers and other chemicals. This is made worse by the fact that certain chemicals banned for their severe health effects in countries of the Western Hemisphere remain approved for agricultural use in some Latin American countries. For example, a 1990 report from the US General Accounting Office found that Costa Rica continues to permit the use of chlordane, a highly toxic insecticide that persists for years in the environment. (Rice, 1996).

Furthermore, due to the lack of a forest canopy in a sun grown coffee plantation, there are fewer insect-eating birds, which means insecticides must be used to protect the crop instead. Such input-intensive procedures result in much higher production costs than those of traditional systems. In one study, the production cost for a hectare of modern and traditional coffee was US$1738.94 and US$269.47, respectively. (Perfecto, 1996) In other words, the cost to produce 1 kg of coffee was US$1.24 for modern coffee and US$0.85 for traditional coffee.

International Aid Agencies such as USAID heavily promoted the conversion of shade plantations to sun grown ones in the 1970s, due to the fear of the fungal disease “la roya del cafeto (Hemileia vastatrix),” or coffee rust. Coffee rust was responsible for the destruction of coffee production in Asia in the second half of the nineteenth century, and the disease made its way to Brazil in 1970. (Rice, 1996) The theory of switching to sun grown coffee was that if the leaves of the coffee plants were kept dry, the fungus would be kept away because it could only survive in a humid environment. In reality, throughout most of Central America, the fungus has not presented the problems originally anticipated, even in shade grown areas. This is most likely due to the existence of a dry season, and the high altitudes as well as cooler temperatures - conditions that inhibit, instead of promote, the disease’s onset.

MAJOR DIFFERENCES BETWEEN SHADE AND SUN GROWN COFFEE

	Traditional	Intensified
Varieties Used:	arabica, bourbon, maragogipe	caturra, catuaí, Colombia, Garnica, catimor
Size (meters:)	tall (3-5 meters)	short (2-3 meters)
Shade:	moderate to heavy, covering 60-90% of ground area	none to moderate, up to 50% of ground area
Shade trees used:	tall (25 m) natural forest species, fruit trees, bananas	short (5-8 m), selected leguminous species, heavily pruned
Density of coffee plants (number per hectare):	1000 to 2000	3000 to 7 000, with some areas up to 10 000
Years until first harvest:	4 to 6	3 to 4
Plantation life span:	30 years (and more)	12 to 15
Agrochemical use:	none to low	high
Pruning:	sometimes not pruned at all, otherwise individualized treatment	standardized "stumping back" (cutting trunk at 12-16" to promote sprouting of new growth) after first or second year of full production
Labor Requirements:	seasonal for harvest and pruning	year-round maintenance with higher demands at harvest

Source: Rice, 1996

2.3 The case of Costa Rica

As mentioned above, in the 1970s, USAID instituted a series of projects aimed at increasing production for the small coffee producer in several countries in Central America and the Caribbean. USAID's strategy involved technology transfer to small growers, entailing a more industrial approach to production, including shade reduction and heavy chemical inputs. During this coffee technification period, more than $80 million was directed to small producers in the region, much of it funneled through a Costa Rica-based program called Programa de Mejoramiento del Café (PROMECAFE). (Rice, 1996) Yet these "modern production" techniques, although they have increased yields, have also increased costs over the long run, while at the same time reducing biodiversity and causing erosion, chemical contamination, and the inhibition of natural nutrient recycling. Today, Costa Rica accounts for the highest number

of sun grown coffee farms in the region - 40% of total coffee production - followed by Honduras, with 35%. (Rice, 1996).

The prevailing mentality in Costa Rica is still that shade trees (especially in high altitudes) provoke diseases, which only further increases existing agrochemical use. In the Central Valley, for example, shade is almost non-existent; farmers believe that good soils and high altitudes make shade trees unnecessary. Furthermore, Costa Rica has the highest coffee production costs in Central America, not only because of its input-intensive (and thus costly) cultivation techniques, but also because of high labor costs (which includes mandatory social benefit costs). High taxes only add to the problem, given the current regulatory structure and prevailing sun grown techniques. As a result of the constraining regulatory regime, we expect that Costa Rica's priority will continue to be high yields - not less environmentally impacting coffee. (personal communication with Zamora, 1997).

3. COFFEE PROCESSING

In Costa Rica, coffee is wet processed. Fresh ripe cherries are fed into a pulper which usually consists of rotating disks or rotating cylinders each fitted with adjustable knives. These are designed to separate the bean from the flesh of the fruit while leaving each bean intact in its parchment envelope. The pulp is usually eliminated with running water and the parchment is collected either in washing channels or in fermentation tanks. During fermentation, the slippery mass called mucilage, which adheres to the parchment after it has been pulped, is broken down by enzymes and leaves the parchment clean and crisp. Then the mucilage is washed, drained and discarded. The washed coffee is transported to the washer pump, where a second and final wash takes place. Mechanical drying takes from 24 to 36 hours, depending on the dryer and fuel used. After coffee beans have been dried and ventilated, they are ready to be stored. (Amorin, 1995).

Until recently, the absence of adequate facilities prevented coffee processors from performing the processing functions with little environmental impact. They lacked the technology to build the infrastructure to classify, pulp, ferment, wash and dry the coffee efficiently. Because of the use of inadequate processing technology, the pulp and waste water generated by the processing failed to be treated and was dumped around the facilities and into rivers, polluting water sources and forgoing the use of coffee pulp as a potentially rich organic fertilizer. More specifically, the pollutants produced by coffee beneficios include waste waters, smoke, peelings (cascarilla or pergamino), mucilage, suspended solids, sugars, soluble and insoluble organic wastes, effluent from fermentation tanks, colloidal gels of pectin, and pesticide residues. However, a four-stage interinstitutional agreement was signed in 1992 by the National Coffee Institute (ICAFE), Ministry of Public Health (MSP), the National Electricity Service (SNE), and the Costa Rican Water Institute (ICAyA). Due to the agreement, which aims to reduce pollution by a total of 80% by the 1997-98 harvest, these problems have been greatly reduced.[10]

Water pollution from coffee processing, as in all coffee producing countries, has been a serious problem in Costa Rica. Before the agreement, 100 processing plants were producing 3.5 million fanegas of coffee fruit per year, resulting in 3 million qq of green beans, 360,000 tons of pulp, and 10 million m^3 of waste water (ICAFE, 1997). These wastes went to the watersheds of various rivers in the country: 58% of wastes went to Tarcoles, 14% to Terraba, 13% to Parrita, 12% to Reventazon, and the remaining 3% to various watersheds in the country. (ICAFE, 1997).

The pollution problems of the Tarcoles river watershed, located in the Central Valley, were especially serious since during the harvest time 80% of the river's pollution was due to coffee processing wastes. (ICAFE, 1997). This meant that the Tarcoles river received a pollution load (as measured in Biological Oxygen Demand - BOD and Chemical Oxygen Demand - COD) from the coffee industry in an amount *six times greater* than the sewage load produced by the metropolitan area of San Jose, with 1.5 million inhabitants. In fact, 330 kg of COD were produced per ton of coffee processed.[11] (Vasquez Morera, 1996) In other words, one fanega of processed coffee was the equivalent of all the contamination produced by 250 adults per day. (ICAFE, 1997) More than 60% of the Costa Rican population has been affected by these contamination problems, since the Central Valley is the most heavily populated region in the country. However, today, after the completion of the first three stages of the interinstitutional

[10] The agreement is discussed in detail on pages 20-21 of this report.
[11] In comparison, 10 kg of BOD are generated for every ton of poultry processed. (World Bank, 1988).

agreement, total watershed pollution from the beneficios has been reduced by 70%. (ICAFE, 1997).

4. ENVIRONMENTAL IMPACTS OF THE COFFEE INDUSTRY IN COSTA RICA

The principal determinant of coffee's environmental effects is whether it is shade or sun grown. Purely shade grown coffee has little, if any, negative environmental impacts. Since most of the coffee in Costa Rica is sun grown (only 10% of total coffee is purely shade grown), the cultivation of the crop boasts few positive environmental effects. In shade grown systems, there is little or no need for nitrogen-based fertilizers because the shade trees fix nitrogen through their roots from the atmosphere into the soil. The presence of natural predators such as insects and arthropods, frogs and toads, reptiles, birds and small mammals is enhanced by the forest cover. These predators stimulate biodiversity and serve as control agents. As a result, pesticides are less frequently used. Weeds are less prevalent and controlled by machetes, which diminishes the need for herbicides. (Weeds compete for scarce nutrients in the soil, diminishing the available micronutrients for the coffee plants.) Shade trees retain and channel water and prevent soil erosion, too, through the mechanical binding and pulling effect of their roots. Finally, the cultivation of additional crops maintains the biodiversity and health of the ecosystem, attracting a variety of insects and animals that depend on each other for survival.

Shade tree systems are also a haven for over 150 bird species, many of which are migratory. Traditional, shade coffee production has been shown to be highly beneficial to biodiversity conservation in tropical forest ecosystems. According to a recent report from the Smithsonian Migratory Bird Center, the trend toward technification amounts to a devastating loss of habitat for the birds, which have taken to the coffee plantations in past decades owing to the deforestation of their original rainforest homes. In northern Latin America, traditional coffee covers very significant areas with closed canopy, agro-forestry systems with high species diversity. For instance, neotropical migratory birds that winter in northern Latin America constitute 60 to 80 percent of the bird species that inhabit forests throughout the eastern US and Canada; neotropical migrants also constitute a large fraction of bird species in the forests of the Pacific Northwest. (Rice, 1996) Birds numbering in the hundreds of millions and representing more than 120 species migrate annually through or to the Central American isthmus. (Rice, 1996).

4.1 Environmental effects from Costa Rican coffee production

4.1.1 Bioproductivity

4.1.1.1 water and soil contamination

Fertilizers, pesticides and other substances, especially when used in large amounts on sun grown coffee farms, contaminate water and soil sources. Because coffee cultivation techniques in Costa Rica are so input intensive, much evidence on these negative environmental impacts has been documented.

Although the government of Costa Rica has long since outlawed the use of most chemicals banned for use in the US and the European Union, many coffee producers openly disobey these laws. A common coffee farmer in Costa Rica might apply as many as 15 different types of chemicals to his crop to fight insects, control molds, rusts and fungi, kill competing vegetation, and fertilize the coffee (Brenes, 1997). In fact, agrochemical use amounts to 20% of the total costs of coffee production in Costa Rica. (Conejo, 1996) Pesticides most used in the country include the herbicide paraquat (177 metric tons per year), the fungicide hidróxido de cobre (181 tons) and the nematicide terbufos (138 tons). (Boyce, 1994) The deadly herbicide paraquat was outlawed by the United States in the 1970s, but is still in use in Costa Rica, although its use is restricted (yet not well enforced). In fact, ICAFE included it in the list of the five most commonly used chemical herbicides that contributed to the average coffee producer's basic cost structure (Brenes, 1997). Although pesticides residues are less of a problem on roasted coffee, they can pose serious health threats to the workers who apply them.[12]

Heavy synthetic fertilizer inputs in coffee have contributed to nitrate contamination of water sources. In 1987-88, the average use of nitrogen on coffee farms was 272 kg per hectare per year. (Boyce, 1994). This is a problem because only 30% of the nitrogen applied is absorbed by the coffee plants. The other 70% leaches into the ground with water and is absorbed by the soil, or turns into a gas. Nitrate contamination has affected drinking water aquifers in Costa Rica, with documented groundwater pollution by nitrate in some cases exceeding World Health Organization levels (Rice, 1996).[13] Research has shown that 41% of the precipitation absorbed by the Tarcoles river, for example, is absorbed by aquifers. Most of the Central Valley's population depends on these aquiferous sources for its potable drinking water. (Boyce, 1994) In high concentrations, nitrates can cause infant methemoglobinemia ("blue baby syndrome"), a potentially fatal condition that impedes oxygen transport in infants' bloodstreams. Other recent studies on groundwater pollution have demonstrated that levels of nitrate in the most important aquifers in the Virilla river watershed occasionally reach or even exceed the limit recommended by the WHO as well. (Conejo, 1996).

Additional human health concerns surrounding nitrate contamination of groundwater include suspected links between nitrates and certain cancers, birth defects, hypertension, and development problems in children. (Rice, 1996) Although there have not been any studies done on the relationship between gastric cancer and nitrate consumption in Costa Rica, it is interesting to note that Costa Rica has the highest level of gastric cancer in the world.[14] This health problem is mostly concentrated in the Central Valley - where over half of all coffee production takes place.

4.2 Soil Deterioration And Erosion

Lack of shade trees also leads to soil deterioration and erosion. Erosion is a serious problem in Costa Rica, and higher erosion rates occur on sun grown coffee plantations where shade has been reduced. In 1989, research undertaken by the Ministry of Agriculture and the United Nations Food and Agricultural Organization indicated that 28% of soils in Costa Rica are

[12] In 1989, 12% of the samples of coffee and tea taken by the USFDA had residues. The pesticides detected on Costa Rican coffee have been lead aresenate, paraquat, and the organic chlorides lindane, dieldrin, DDT and BHC. (Boyce, 1994).
[13] The EPA and WHO standards for nitrate are 10 mg/l.
[14] There is some evidence that there is a correlation between this type of cancer and the use of pesticides, especially nitrates. (Boyce, 1994).

characterized by moderate erosion (11-50 tons of lost soil per hectare per year) and 32% suffer severe erosion (between 51 -200 tons). (Conejo, 1996).

In Costa Rica's Central Valley, where rainfall can reach up to 2.5 meters annually, the leaching of soil nutrients into the groundwater can be significant. Within these high-rainfall areas, unshaded coffee loses nearly three times more soil nitrogen than shaded plantations. In general, shade coffee systems have been shown to be more conservative recyclers of nitrogen than unshaded plantations. (Rice, 1996). Rational use of chemical fertilizers integrated with organic fertilizers coming from coffee pulp and leaf mulch due to pruning enhances soil productivity and reduces soil erosion. Unfortunately, Costa Rican practices use more chemical than organic fertilizers. Overapplication of chemicals can eliminate insects and micro-organisms that play vital roles in the enhancement of soil productivity and plant nutrition.

Finally, two of the most toxic chemicals use in coffee cultivation stay in the soil for extended periods of time: lead arsenate and paraquat. The half-life of paraquat, for example, is 10 years. Residuals of up to 49 mg/kg of lead arsenate and 49.3 mg/kg of paraquat have been detected in coffee plantation soils, although paraquat's use is restricted and lead arsenate is prohibited in Costa Rica. (Boyce, 1994)[15] Since many coffee plantations are found in urban and semi-urban areas, people can be exposed to chemicals by consuming coffee and other crops that are harvested from the same soil, or from breathing dust from the soil, a real possibility given the wind conditions of the Central Valley.

4.2.1 Habitat

Negative downstream effects affecting other habitats and industries have been documented, too. For example, it has been estimated that $1.8 million (414 million colones) of damage affecting the livestock industry is due to pesticides annually - and around $19,000 (4.4 million colones) of this is due to the pesticides used by coffee growers. In beekeeping, coffee pesticides are responsible for 5% of the total damage caused by pesticides annually. (Boyce, 1994).

4.2.2 Coastal and other water resources

Water from coffee zones reaches coastal lands and can affect the shrimp fisheries in the mangrove swamps and other coastal areas because of the water's associated bioburden, in turn causing adverse living conditions. Ecological impacts result from the discharge of organic pollutants from the processing plants to the waterways, robbing aquatic plants and wildlife of essential oxygen. Costa Rican health officials have expressed concerns over harms to marine life along part of the Pacific Coast where rivers contaminated by coffee processing wastes flow into the ocean. (Rice, 1996).

4.2.3 Quality of Life

Waste water and coffee by-products (pulp) from processing cause serious contamination of most notably rivers, and thus drinking water, wildlife, and aquatic system health. In Costa Rica, nearly 3 m^3 of solid waste is generated for every 60 kg bag of green coffee produced.

[15] Paraquat's oral acute toxicity is 100-126 mg/kg in rats. At very low levels of exposure, paraquat can cause skin injuries and second degree burns. Premalignant skin lesions develop where skin exposed to paraquat is also exposed to sunlight. Lead arsenate's oral acute toxicity is 10 mg/kg in rats. (Universidad Nacional, 1994).

Traditionally, these solid wastes and their accompanying waste water end up being released directly into adjacent rivers. This is the single largest source of water contamination in Costa Rica. (Brenes, 1997).

The organic material produced by coffee milling fouls streams by significantly increasing the amount of particulate matter in the water. According to Costa Rican government estimates from the early 1980s, coffee processing residues account for two-thirds of the total BOD (the principle measure of organic pollutant discharges) in the country's rivers. The phosphorous and nitrogen contained in this particulate matter spurs the reproduction of algae and bacteria that can consume it. The population explosion of these creatures kills life in the waterways by depriving it of limited oxygen supplies. In addition, because of the presence of fermented coffee wastes in rivers and the large amount of oxygen necessary to oxidize them, the rivers becomes highly acidic. High rates of fish kills are common just downstream from a wet mill coffee processor. (Saklad, 1994).

The great majority of waterways in the Central Valley in Costa Rica are contaminated with sediments, agrochemical residues, and organic wastes from urban settlements, coffee processing plants and industrial activities. This contamination has rendered most of the surface water unfit for human consumption, irrigation or recreational activities. Surface water pollution has, in turn, caused an increase in the use of groundwater. Though the aquifers are relatively protected from microbial contamination by soil and rock layers of variable thickness, they are vulnerable to chemical contamination and overuse, as discussed above. Chemicals may reach groundwater deposits by leaching through soil layers or through rivers which are associated with the aquifers (Conejo, 1996).

Since coffee is a hand-picked crop, many workers are inevitably exposed to high concentrations of chemicals for long periods of time. One study conducted in 1986 estimated that 459 chronic intoxications (that year) were due to exposure to coffee pesticides. (Boyce, 1994) In addition to water pollution caused by milling, the coffee roasting process is also responsible for producing airborne pollution. In the roasting process, green coffee beans are roasted for at least 15 minutes at temperatures higher then 260 C (500 F). This process makes the beans emit their internal oil, producing the characteristic deep brown/black color of the roasted beans. At the same time, roasting creates a black smoke of CO_2, water coffee oils, and particulate coffee matter that is often released directly into the air unless catalytic converters are used to reprocess these emissions.

5. INSTITUTIONAL FRAMEWORKS THAT AFFECT THE COFFEE INDUSTRY

5.1 Legislation and Regulation

As is the case in many other Central American countries, Costa Rica boasts a whole set of environmental laws. Traditionally, Costa Rican environmental legislation has employed a "command and control" approach. Overall, environmental legislation in Costa Rica can be characterized by:

- a wide range of laws that cover similar issues, thus making specific applications difficult;
- dispersion of environmental law responsibilities among different institutions, leading to conflicts, rivalry, duplication of efforts, and poor management of the already scarce financial and human resources;
- lack of understanding of the various institutions' domains and institutional frameworks, resulting in poor coordination between key groups;
- a lack of regulations for individual laws and thus no enforcement, causing laws to be abstract principles with no real effects;
- the absence of effective penalties for not obeying laws;[16]
- a lack of sensitivity to environmental issues on the part of the public sector employees designated with the enforcement of such laws; and
- a lack of participation from affected groups in the formulation of laws. (Chacon, 1997)

To try and alleviate some of these problems, the government is currently conducting a study to identify the environmental control duties of various agencies, with special attention paid to those of the Ministry of the Environment and Energy (MINAE) and the Ministry of Health. One of the goals of the project is to design a new environmental control system that is more efficient. One possibility the government is exploring is the creation of a single environmental control office, much like the Environmental Protection Agency (EPA) in the US, to eliminate duplication and minimize costs. (Chacon, 1997).

5.1.1 Water pollution legislation highlights in Costa Rica

It is little known that water legislation related to the coffee industry in Costa Rica dates back to the 1930s, because for the most part, it was never really enforced. Decree No. 14, from 1936, prohibits coffee residue discharge to rivers or the application of these to soils without composting. It establishes that all coffee processing plants must have facilities in order to adequately separate and treat coffee processing residues. This Decree was reformed by Decree No. 19, in 1937, in which some processing plants were allowed to deposit residues in ditches or gullies built in the soil, covering them with limestone and soil. The Water Law (No. 276) was approved in 1942. Articles 56, 57 and 162 state that coffee processing plants, factories and other industries which need to utilize public water must have authorization from

[16] Fines that *do* exist are low and practically voluntary, since the ignorance of a fine is not punishable with jail terms. This would violate Article 38 of the Constitution, which prohibits going to prison because of debts. (Chacon, 1997).

the government. Surface water contamination that causes ecological or social damage will be penalized. The penalty is prison for three months to a year or a fine now equivalent to US$1.30 to US$ 5.20. (Conejo, 1996) More recently, Article 264 of the General Health Law (No. 5395) from 1973 states it is the Ministry of Health's responsibility to certify that companies are complying with whatever water quality regulations currently exist. The Environmental Control Department of this Ministry is to verify the quality of water treatment plants, although until recently, there was only one state lab which had the ability to verify performance. Other laws that address water quality include the Aqueduct and Sewer Law (Law No. 2726, 1960), and the Potable Water Law (Law No. 1634, 1953). (Segura, 1993, and Chacon, 1997).

As discussed in detail below, the Ministry of Public Health (MSP), the National Electricity Service (SNE) the Costa Rican Water Institute (ICAyA), and the National Coffee Institute (ICAFE) signed an interinstitutional agreement in 1992 to diminish surface water contamination due to organic discharge by coffee processing plants. This agreement was prompted, to a certain extent, by Article 132 of the Wildlife Conservation Law (1995). The Article prohibits the dumping of contaminated waters into other water bodies, and requires agroindustries to have water treatment systems in place. The Ministry of Public Health was assigned the responsibility of controlling, certifying and monitoring the enforcement of this Article.

However, there is not yet much enforcement of this law, because industries complained that the law was too difficult to abide with. As a result, in addition to the coffee industry, various other industrial sectors have signed agreements with the Ministry of Health to define chronological, step-by-step action plans for meeting the law's guidelines. Due to the fact the Ministry of Health has been so accommodating, a bitter dispute is underway between the Ombudsman (Defensoria del los Habitantes) and the Health Ministry. The Ombudsman accuses the Health Ministry of violating the Wildlife Conservation Law, since it is allowing for agreements instead of sanctioning industries which do not yet have treatment plants installed. Despite this criticism, the Health Ministry continues not to penalize those companies which have signed agreements. (Chacon, 1997).

5.1.2 Regulations concerning the use of agrochemicals

Pesticides have been regulated for more than 40 years in Costa Rica (starting with Decree No. 11, 1954), but it was not until the 1970s that regulations were modified. Today, regulation and control of pesticides is controlled by three Ministries: the Ministry of Agriculture (MAG), for pesticides for agricultural use; Ministry of Health for domestic health; and the Ministry of Employment for protection of workers in contact with these products. Article 32 of the Ley de Sanidad Vegetal (No. 6248, 1978 and reformed through No. 7064, 1987), administered by the Ministry of Agriculture, states that it is prohibited to contaminate waters with pesticides or other chemicals. The law allows for the restriction or prohibition of pesticides in order to protect health, environment, animals or agriculture. (Segura, 1993).

Despite the existence of pesticide laws, they do *not* prohibit the import of banned or restricted pesticides in other countries. Pesticide laws in Costa Rica only require that the use of the chemical must be permitted in the country of origin. Thus, pesticides which are prohibited in one country (e.g. the US) can easily be imported by way of a third country. Furthermore, pesticides that *are* prohibited in Costa Rica can still be used, since all that is needed is the signature of an appropriate authority ("regente") to get around the restriction and obtain authorization. Many of the pesticides used in Costa Rica are prohibited in other countries, such as bromuro de metilo, paraquat, and tridemorf, among others. Of the 25 top imported pesticides

in Costa Rica, of those used by coffee, all have WHO classifications of extremely dangerous, highly dangerous, or moderately dangerous. (Conejo, 1996) Not surprisingly, Costa Rica imports the largest quantity of pesticides per agricultural worker in Central America, importing 38 kg per agricultural worker during the decade of the 1980s. (Conejo, 1996) In fact, on average, Costa Rica's pesticide use per km_2 is ten times the world average. (Conejo, 1996).

5.1.3 Financial Policies and Practices

In Costa Rica, banks provide financing to coffee growers only on the condition that they follow the banks' guidelines for cultivation. Banks tie access to credit to certain technological packages that include the use of agrochemicals, rather than to more ecologically sustainable technologies. These "guidelines," which are frequently outdated, are viewed by the banks as a way of guaranteeing successful coffee cultivation, and thus repayment. However, they encourage (or perhaps even force) farmers to use certain amounts of specified agrochemicals, from pesticides to fertilizers - some of which are illegal in Costa Rica. Thus, the use of extremely harmful substances is encouraged; innovative, less environmentally impacting cultivation techniques are not an option if a grower hopes to obtain a loan. Since there is only one set of guidelines, banks do not take into account the different ecosystems in the country or the different growing conditions.

5.1.4 Fiscal Policies and Practices

The government plays an important role in the coffee industry. There are three main taxes. First, coffee producers must pay a 20% tax on their net coffee earnings (Law No. 7550, 1995; explained in detail on page 7 of this report). However, instead of directly paying this amount to the government, it is deducted from the payment that producers receive from the processors. In this way, processors act as "holders" for the tax administrators, paying the government the 20% that they have withheld from the producers three times yearly. Second, if the FOB price of coffee is above $92 (per 46 kg bag), exporters must pay a 1% tax to the government on the total amount exported. (Derecho Ad-Valorem Law on Coffee Exports). Third, exporters must also pay a 1,5% tax to ICAFE on the FOB price of the coffee they export (Law No. 2762). Of this 1,5%, 1% finances the research and administration costs of ICAFE, and 0,5% goes to promotional activities and "sustainable development" technologies. (ICAFE, 1996) Finally coffee producers must contribute to the Price Stabilization Fund (Fondo de Estabilizacion de Precios - FONECAFE), which was created in 1992 to help stabilize coffee prices when the international prices are below production costs in a crisis situation.[17]

The result of the system in Costa Rica is the distortion of market realities in such a way as to lead to suboptimal performance and a lack of innovation. Under the current, extremely complex system, profits are virtually fixed. In addition, the system provides no leeway for experimentation with novel, less environmentally impacting production techniques. As a result, due to this regulation, there is little or no incentive to produce higher value coffee or to change current growing methods - although this is where international markets are pointing and paying premiums for. The prevailing justification of the current system is that the procedures protect and benefit the predominantly small producer. However, the time has come to seriously reevaluate the effectiveness of the current system. If the Costa Rican coffee industry wants to

[17] The amount paid into the fund depends on the export selling price of coffee. When the price is between $0 and $92, no contribution is made. Between $92.10 and $100, there is a 3% "tax;" between $100.10 and $125 it is 4%, between $125.10 and $150 it is 6%, and when the price is greater than $150, the "tax" is 10%. (Gonzalez, 1997)

successfully participate in the expanding marketplace for gourmet and other higher value-added coffees, the current procedures must be liberalized.

5.1.5 The Interinstitutional Coffee Agreement

In 1992, the Ministry of Public Health (MSP), the National Electricity Service (SNE) the Costa Rican Water Institute (ICAyA), and the National Coffee Institute (ICAFE) signed an inter-institutional agreement to diminish surface water contamination due to organic discharge by coffee processing plants. This agreement was prompted, to a certain extent, by Article 132 of the Wildlife Conservation Law (1995). The Article prohibits the dumping of contaminated waters into other water bodies, and requires agroindustries to have water treatment systems in place. The Ministry of Public Health was assigned the responsibility of controlling, certifying and monitoring the enforcement of this Article. Fines for non-compliance range between 50,000 and 100,000 colones.

The creation of the agreement has forced processors to clean up their operations. Some plants were even shut down because they could not, or would not, comply with the agreement. The agreement consists of four stages, and the ultimate objective is to reduce pollution generated by the coffee processing industry by a total of 80%. The program includes technical support for the modernization of the entire coffee processing system, based on research conducted during past years. Written indications and information about recommended equipment is being offered by specialists from ICAFE as well. However, there are no special (i.e. subsidized) funds available to coffee processors to ease the financial burden of these major clean technology investments. As of August 1997, the first three stages have been completed. A summary of the stages' requirements follows.

5.1.5.1 Stage 1

- Establishment of recirculation systems in the different coffee processing stages in order to reduce the amount of water used.
- Establishment of one effluent duct to facilitate control and monitoring.

5.1.5.2 Stage 2

- Recovery of small solids in waste waters.

To fulfill this requirement, processors were required to install "V wires" ("tamices finos") to recover particles larger than 0.75 mm.

5.1.5.3 Stage 3

- Implementation of efficient separation, treatment and disposal systems to decrease suspended solids by 50%.

This was achieved through the construction of sedimentation tanks as well as small sludge lagoons for the disposal of the sediment.

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- The development of methods to remove and transport the pulp within the processing plant without the use of water.

5.1.5.4 Stage 4

- Anaerobic treatment of waste waters to achieve the 80% grand total reduction in COD, BOD and total solid wastes. Research is currently underway to determine how this will best be achieved, most likely through the installation of anaerobic reactors and/or lagoons.

5.1.6 Results

Compliance with the first three stages of the agreement has achieved significant results. Water usage in the processing of coffee has been reduced from an average of 15,5 liters of water per kg of cherries to 3,87 liters per kg of cherries. (Morera, 1996) In fact, some plants have even reduced their water usage to 1,55 liters per kg, and others have also benefited from lower electricity bills due to the recirculation of water. Sedimentation tanks have been designed to remove 50% of suspended solids. The removal and transport of the coffee pulp without the use of water (Stage 2) has allowed for the generation of contaminates to be decreased by 50%. At the end of these three stages, pollution has been reduced by a total of 70%, with a total investment of about $11 million in clean technologies. (ICAFE, 1997 and Morera, 1996).

The final stage is currently underway, and requires the most investment (in dollar amounts). Anaerobic treatment is characterized by generating bio-gas, a mixture of methane and CO_2. It is hoped that the methane generated will be used by processors for heating purposes within the processing plant. Recently, ICAFE, along with the Beneficio San Juanillo and the collaboration of the Dutch government, finished constructing an anaerobic reactor with a capacity of 400 cubic meters. ICAFE hopes to promote this system as a model to the rest of the sector. Already, 21 plants have completed this final stage, reducing pollution by an additional 15%. All plants must finish this last stage by the end of the 1997-98 harvest. (ICAFE, 1997).

The agreement, however, has not been without criticism. Article 132 of the Wildlife Conservation Law establishes December 7, 1994 as the final date of compliance. Yet the industry has pushed forward the dates for compliance with the agreement twice, with the final target date for achieving the last stage now the 1997-98 harvest. In addition, the agreement talks about reductions in pollution in percentages (of solid wastes, BOD and COD), without ever addressing individual processing plant amounts or a total maximum allowable amount of pollution. Also, there has been no financial support from the government. (Chacon, 1997) Large plants have been better able to absorb the costs of complying with the agreement, while smaller plants have been the hardest hit. For example, investment amounts needed to comply with the first stage ranged from 1.8% (for large plants) to 18% (for small plants) of total operating costs during the 1993 - 94 harvest. (Conejo, 1996) Despite these criticisms, the coffee industry has achieved great success in generating solutions to what have been some of the most serious pollution problems in Costa Rica.

6. RECENT TRENDS IN INTERNATIONAL COFFEE MARKETS

While traditional tinned ground and instant coffee sales have slumped, coffee bars and specialty beans have become the fastest growing trend in the food industry over the last two years. (Lane, 1994) The worldwide market for specialty coffee is currently US$5 billion, and the US accounts for half of it. Sales of such coffee in the US increased from approximately $1 billion in 1990 to $2,5 billion in 1995. (Rice, 1996).

International initiatives to promote environmental protection in coffee producing countries are growing, too. The Specialty Coffee Association of America recently established an Environmental Policy Task Force to address ecological issues associated with coffee. (Rice, 1996) The International Coffee Organization (ICO), the principal coffee trade group worldwide, held a seminar on "Coffee and the Environment" in May 1996 at the ICO's headquarters in London. A number of specialty coffee firms participated in the First Sustainable Coffee Congress on September 16-18, 1996, in Washington, DC, which was hosted and organized by the Smithsonian Migratory Bird Center.

6.1 Organic and gourmet coffee in Costa Rica

Today, organic coffee accounts for just one or two percent of the $5 billion worldwide market for specialty coffee. However, organic coffee currently exhibits the fastest growth among gourmet coffee types. (Rice, 1996) Certified organic coffee obtains significant price premiums, from 10 to 15 percent above gourmet coffee without the organic trademark. In 1992, for example, in the US, the price premium was between $1 and $1.50 per pound; in Europe, organic coffee can command twice the price of conventionally grown coffee. (Ramaswami, 1992).

This price premium often translates into substantially higher returns for coffee growers, although the net benefits of moving to certified organic production can vary substantially from producer to producer, depending on added production costs and other variables. (Rice, 1996) Organic coffee cooperatives pay thousands of dollars each year to cover certification costs such as the time and travel expenses of field inspectors. The downside to organic certification from many growers' perspective is the cost of periodic inspection. For the many small coffee growers who are de facto or "passively" organic producers because they cannot afford to use agrochemicals, inspection costs can present a major obstacle to certification, and thus to the premium price they might otherwise obtain for their coffee. (Rice, 1996).

Currently, four countries are producing the majority of organic coffee: Mexico, Guatemala, Peru and Indonesia. (Rice, 1996) Within Latin America, Peru outnumbers other countries in terms of area, with nearly 44,000 hectares under certified production. Mexico, which produces nearly as much organic coffee as Peru, does so on just under 26,000 hectares. Costa Rica has 550 certified hectares. Other Central American countries with land devoted to certified organic coffee include Guatemala (about 7000 hectares), El Salvador (4900 hectares), and Nicaragua (1400 hectares). (Rice, 1996) Organic coffee growers are typically organized into local cooperatives that are affiliated with, and bound by the standards of, international certification programs. The largest of such programs is Organic Crop Improvement Association International (OCIA), which at the end of 1995 claimed more than one million certified hectares (2.5 million acres) and 30,000 grower-members worldwide. (Rice, 1996) Other programs certifying organic coffee include the European-based Naturland and Demeter. To ensure properly certified organic coffee, several coffee companies have established direct relationships with growers, often forming community cooperatives. Because no broker is involved, these companies can

pay growers more than they would have received from commercial coffee producers, which often results in avoiding costly certification programs. (Rice, 1996).

Costa Rican exporters are organized to sell large, mixed quantities of generic coffee; selling smaller amounts of specialty coffees is less common.[18] (personal communication with Sanchez Solera, 1997) However, with the creation of the Gourmet Coffee Association of Costa Rica in 1993, exports are expected to increase over the next few years. The Association is working to promote Costa Rican gourmet coffee in international markets, and has even formed a strategic alliance with the Specialty Coffee Association of America. The alliance allows for exchange of promotional and educational material, access to information about the gourmet coffee market, and other privileges. In terms of Costa Rican organic coffee, there are around 17 producers who have found their niche in this market. The “Tierre Madre” (Mother Earth) plant processes and promotes the coffee of eleven of these producers in the Central Valley. The other six producers are in a consortium of eight cooperatives called Coocafe in Guanacaste and Heredia. In 1993, together these producers were responsible for producing 2,692 fanegas of coffee on 134 hectares. (Conejo, 1996)

6.2 The social justice movement

Coffee producers in certain countries enjoy premium prices for their coffee due to the connections they have forged during the last decade with groups that make up what is known as the "solidarity," "social justice," "alternative trade," or "fair trade" movement. The movement is based on the idea that producers of traded commodities in developing countries can be economically successful if they receive fair prices in international markets for what they produce. Recent years have seen a growth of the movement, with trade unions, church groups, and other organizations becoming involved. In Europe, for example, fair trade coffee accounts for 11 000 metric tons of traded coffee annually, distributed in around 35 000 supermarkets. (Rice, 1996).

Like organic coffee, coffee distributed through alternative trade channels currently represents a small fraction of the worldwide specialty coffee market. Sales have increased, however, as more and more coffee drinkers have learned about the poverty and working conditions characterizing small coffee producers' lives. Global sales of coffee in the social justice market amounted to $400 million in 1995, according to estimates from the International Federation of Alternative Trade (IFAT), an association that oversees 36 alternative trade organizations worldwide through a code of ethics established in 1990 and updated in 1995. (Rice, 1996) Moreover, the IFAT's Code of Ethics includes environmental expectations for the participation of alternative trading organizations (ATOs). The two-point environmental section of the code states:

- It is also the aim of ATOs to encourage the production of goods by means which preserve the environment and conserve scarce resources and in ways which cherish the skills and develop the capacities of the producers and do not harm their health. This applies equally in the First World as in the Third World.
- ATOs are committed to encouraging development which is sustainable and responsible in terms of the long term survival of the human species and of the natural world. (Rice, 1996).

[18] Neither ICAFE nor the Gourmet Coffee Association of Costa Rica maintain statistics on the amount of gourmet coffee exported per year.

The social justice market is organized around the International Coffee Register, which is a company owned by the fair trade groups Max Havelaar, TransFair, and the Fair Trade Foundation. A total of 286 coffee-producing cooperatives are members of the Register, representing about half a million growers around the world. Under current arrangements, grower groups are guaranteed $1.26 per pound for green (ready-to-roast) coffee. (Rice, 1996) If world prices average above this figure, producers receive five cents per pound above the world price.

There are currently about 15 licensed importers of fair trade coffee. If a producer cooperative needs a cash advance to use for purposes of extending credit to individual growers, or for other expenditures, the importers provide advanced funding that can total up to 60 percent of the contracted coffee with that cooperative, at rates of interest negotiated between the importer and the coffee cooperative. (Rice, 1996).

These social justice, or fair trade markets, are more developed in Europe, where they originated, than they are in the United States and Canada. With support from their own social democrat governments and non-governmental organizations, European solidarity groups have been active for many years in Latin America. Community development projects funded by the private sector or via government funds have long been a part of development work in this region. (Rice, 1996).

In Costa Rica, the social justice movement is not very well developed. It will probably continue to have a low profile, due in large part to the fact the country enjoys a higher standard of living and more stability than its regional counterparts. In general, coffee growers in Costa Rica enjoy relatively high wages and a comfortable way of life. Still, there are some social justice activities underway. Coocafe R.L., for example, began operations in 1988 with the technical support of the German-based Friedrich Ebert Foundation. Coocafe's mission was to unite regional cooperatives of the smallest and poorest coffee growers in Costa Rica under one administrative organization in order to provide them the market power necessary to obtain a fair price for their product. Coocafe exports five brands of coffee, one which carries the Transfair seal and two which carry the Max Havelaar seal. Most of the coffees are sold in shops specializing in Third World products. Its Cafe Foresta charges consumer $1.00 extra per kg, with the promise that this money goes to support reforestation projects initiated by poor producers. (Saklad, 1994).

6.3 Conclusions

Clearly, special market niches for organic and “fair trade” coffee have been well developed in recent years, most notably in Europe and the US. In many ways, strong overlap exists between the certified organic, gourmet and social justice coffee movements. The fair trade market makes linkages with small peasant producers who, because of their inability or unwillingness to use costly chemical inputs, produce what can be regarded as a "passively" organic or "organic by default" coffee. (Rice, 1996) The true issue at hand is how continued market expansion can promote environmental initiatives, such as forest conservation, as well as higher incomes for coffee growers who implement less environmentally impacting methods. Based on current trends and growing international environmental awareness, it is likely that coffee companies will increasingly support, buy and get the word out about shade grown coffee. Even the big players may be heading down that path. For example, Procter & Gamble, the owner of Folgers, recently purchased Millstone Coffee, which markets a certified organic coffee.[19] (Rice, 1996) Most likely, increased demand for less environmentally impacting coffee on consumers’ part will have a profound effect on shade grown coffee conservation objectives in certain countries.

The Rainforest Alliance ECO - OK label is one step in the right direction. The label signifies that the coffee is less damaging to the environment, but is not necessarily organic. Coffee is certified according to criteria developed by the Fundación Interamericana para Investigaciones Tropicales, a Guatemalan Non-governmental Organization (NGO). Certification criteria for the “ECO-O.K." effort on coffee include the use of native perennials as shade, as well as the maintenance of vegetation buffer strips of forest next to rivers, streams, and lakes. This initiative provides an incentive to keep traditional coffee growers (i.e. shade) from switching over to sun grown, and encourages sun growers to use best practices. Many coffee roasters have also started to market "bird-friendly coffees," organic blends purchased from shade grown coffee cooperatives. In the United States, Counter Culture, in Durham, North Carolina, has introduced a brand called Sanctuary. Thanksgiving recently unveiled Song Bird Shade Grown Coffees, sales from which (15 cents per package) are donated to the American Birding Association. (Rice, 1996) However, Costa Rica is excluded from much of this activity in large part because so much of its coffee is sun grown. Until the current system is reformed to encourage producers to experiment with less environmentally impacting methods and new niche markets, this will continue to be the case.

[19] General Foods, Procter & Gamble and Nestlé control more than 50% of the roasted coffee market. (Monitor Company, 1997).

7. OVERALL CONCLUSIONS AND RECOMMENDATIONS

Due in large part to the fact that only 10% of the coffee is grown in full-shade tree systems, it is clear that current cultivation techniques in Costa Rica have serious environmental consequences. Unfortunately, through ICAFE, the government has spent the past few decades training and convincing coffee farmers that the best and most profitable way to grow coffee is with the heavy use of chemicals, without the employment of a large number of additional trees. However, in recent years, ICAFE has started to undertake various research projects with environmental components. For example, an assistance program conceived by the Ministry of Agriculture with the United Nations Food and Agricultural Organization in 1992 stimulated small farmers to produce other agricultural commodities (such as mangos, oranges, avocados, tomatoes or peppers) without seriously or permanently affecting coffee yields. Income derived from selling these products is aimed to help balance fluctuations in harvests and markets that coffee production might generate. ICAFE is also experimenting with diversification of macadamia nuts, strawberries, oranges and cardamom. It is also investigating tomato and bean growing options to take advantage of the alternating growing cycles of these crops with coffee.

The Institute is studying the effects of organic versus chemical fertilizers as well. Coffee pulp, a waste product, can be used as an organic fertilizer, and this practice is well promoted in Costa Rica, in a variety of plantation types. For example, ICAFE has developed a publication on how to transform coffee pulp into fertilizer, which is distributed to coffee producers. (Conejo, 1996). Coopro Naranjo R.L, the processing plant with the most capacity in all of Costa Rica, composts the 20,000 tons of pulp it generates per harvest, and then sells it to affiliated farmers at a low price. Since pulp contains 12% protein, in can also be used as animal feed. It can be used as a fuel source as well. In fact, ICAFE, through research, has determined that 1 kg of dry pulp can produce 4200 kilocalories. (Morera, 1996).

ICAFE is also researching the impact of additional timber-yielding species grown on a plantation, such as Laurel and Eucalyptus, on coffee yields. Furthermore, ICAFE is promoting substitute chemicals that are less environmentally impacting. ICAFE has much credibility among the coffee farmers, so its recommendations are considered seriously and usually implemented by coffee producers. Finally, ICAFE has taken the lead on organizing a seminar called “Competitiveness and Quality in Harmony with Nature,” which will take place in September 1997. The Conference aims to educate participants about research currently underway on less environmentally impacting coffee cultivation methods throughout the region. Despite all of these encouraging activities, it remains a challenge to convince coffee producers to abandon many of the green revolution technologies that they have used for so many years - and that have made Costa Rica the highest-yielding producer in the world. Retraining farmers to reject these “traditions” will take a lot of time, demonstration and education.

On the coffee processing front, due to the creation and seriousness of the interinstitutional agreement, it seems that Costa Rica has adequately addressed the corresponding environmental issues. The coffee industry has already invested about $11 million in clean technologies, and is expecting to invest about $9 million more in this final treatment stage. (Quesada, 1997) Indeed, the agreement has forced the coffee industry to internalize many of the environmental costs which were traditionally either ignored, or paid by the state (or by other sectors of the economy). Establishing policies to ensure that most of the environmental costs are borne by local coffee processing plants has thus forced more environmentally benign coffee production, as well as reduced water usage and energy costs. The progress the industry has

made in cleaning up its coffee processing activities will most definitely contribute to a cleaner natural environment in Costa Rica, and is a model for other coffee producing countries interesting in greening their own operations.

7.1 The major hurdle to sustainability: the structure of the coffee industry

The Costa Rican coffee industry is tightly regulated, with little room for innovation. The main problem is the fixed price system which gives control to a small group of only 12 exporters that control virtually the entire coffee export market. As a result, overall, Costa Rican coffee is a generic product and is not promoted as country specific. In addition, the system does not encourage the practice of less environmentally impacting methods (most of which have lower costs), nor the exploration of niche gourmet or "environmentally friendly" coffee markets. In Costa Rica, the exploration of gourmet coffee production is a recent trend; the Gourmet Coffee Association of Costa Rica, for example, was formed only four years ago in 1993. Furthermore, the country only claims about 500 acres of certified organic production, and is not in a very strong position to pursue "ECO-OK" or bird friendly coffee certification in the near future. The fact that Costa Rica is lagging so far behind other countries in adapting to market trends is strong evidence of a serious problem.

7.1.1 The fixed price system

Although the government claims that the fixed price system guarantees the producer a fair price for coffee, it is also very rigid, because it does not stimulate the production and commercialization of high-quality, gourmet, or less environmentally impacting coffee. In the current system, coffee is, more or less, one and the same - no matter how ecologically sound it is grown. Furthermore, the system does not allow for any negotiation between the parties involved in the value chain. Special projects to stimulate the quality of coffee which would increase the price obtained for exported coffee are difficult to develop. Under the current system, the processor cannot, for example, transfer the costs of commercialization incurred to develop gourmet coffee niche markets to producers or to consumers.

7.1.2 An exporter´s oligopoly

The Costa Rican coffee industry appears to be highly concentrated, with four multinationals controlling almost half of the export market. With such high concentration, exporters seem to be more focused on selling quantity, not quality. This phenomenon is placing the country at a great disadvantage, since in the past, these large players have not actively promoted Costa Rican gourmet or less environmentally impacting coffee.

Furthermore, processing plants do little to position their own brands in distinct markets, either through exporters, or on their own. Processing plants merely decide which exporter they will sell their coffee too, at what quantity and when. Not surprisingly, then, most processing plants do not have sales or marketing departments. Processors are trapped in a vicious circle: they have very little knowledge of market trends, which in turn keeps them from developing sales strategies to differentiate and place their brands successfully among international roasters.

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7.1.3 Recommendations

Clearly, the system as it stands must reexamined. In summary, the results of the current system are:

- a deterioration in coffee quality, since quality is not rewarded (and as evidenced by the fact that some producers are seeking other means of ensuring quality, such as ISO 9000);
- a lack of incentive for producing less environmentally impacting coffee, since high yield goals - which require input-intensive coffee production methods that may not necessarily justify themselves from a broader social perspective - are most rewarded in the current system;
- the stifling of innovation, since it is extremely difficult to work outside of the rigid system;
- the absence of promoting *Costa Rican* coffee, per se, so that it is instead treated (for the most part) as a commodity; and
- a sluggish response to the recent, profitable international coffee market trends.

The liberalization of the coffee industry structure would help to alleviate the problems currently facing the Costa Rican coffee industry. Due to the low international prices in the 1990s, shrinking profit margins have put pressure on coffee processing plants either to close or to enter into alliances with exporters. Processing plants have also bought out roasting companies. Many exporters formed strategic alliances with foreign companies or sold their operations to them. (Brenes, 1997) As a result, the local industry is already to a great extent vertically integrated, and would be well-positioned for such market liberalization.

The revision of the system would help to improve quality and boost profitability. The number one concern of producers in a survey conducted by ICAFE in the 92-93 and 94-95 harvests was the low profitability of coffee. In the 94-95 harvest, profitability was $24.90 per fanega (before taxes), in 95-96 it was a loss of $3.30, and in 96-97, it was $22.30. (Gonzalez, 1997) By abolishing the fixed price system, producers would be paid according to different criteria than under the current structure. Such criteria would include first and foremost quality, and for certain markets, degree of sustainable production methods.

In a free market system, industry players could target whichever markets they choose - generic, gourmet, organic, less environmentally impacting, or “bird-friendly.” Farmers would then have more economic incentive to improve quality and to change their current methods of cultivation accordingly. Many industry players would be rewarded and enjoy higher profits, while others would be driven out of the market. Finally, without the current regulation, producers, processing plants, and exporters would work more closely together to develop international niche markets - and position their unique brands accordingly.

BIBLIOGRAPHY

Alfaro, Rosario and Jose J. Rodriguez. "Impacto Ambiental de los Desechos Agroindustriales (Cafe, Pina y Palma Africana)." 1992: Universidad Nacional, Escuela de Ciencias Ambientales, Departamento de Quimica, Heredia, Costa Rica.

Amorin, Cesar, and Jose Chavarria, Victor Mencia, and Carlos R. Lola. "El Salvador Coffee Subsector Analysis." 1995: Appropriate Technology International, El Salvador.

Boyce, James K., and Alvaro Fernandez Gonzalez, Edgar Furst, and Olman Segura Bonilla. Cafe y Desarrollo Sostenible: Del Cultivo Agroquimico a la Produccion Organica en Costa Rica. 1994: Departamento de Publicaciones Universidad Nacional, Heredia, Costa Rica.

Brenes, Esteban R., and Isabel Bolanos, Ramon Burciaga, Marco Jimeno, and Francisco Salas. Case study on Cafe Britt. 1997: Journal of Business Research 38, p. 23-33, New York.

Chacon, Carlos (Environmental Lawyer and Consultant to INCAE). Analysis prepared exclusively for INCAE: "Aspectos Relacionados con las Politicas Publicas y la Sostenibilidad de 5 Actividades Economicas en Costa Rica: Turismo, Forestal, Pina, Cafe y Palmito." 1997.

"Chancado en Seco." *Boletin Cafetico de la Camara Nacional de Cafetaleros*, Julio 1996, p. 4.

Conejo, Carlos, and Rafael Diaz, Edgar Furst, Eduardo Gitli, and Leiner Vargas. "Comercio y Medio Ambiente: El Caso de Costa Rica." Informe preparado para la Conferencia de Naciones Unidas sobre Comercio y Desarrollo (UNCTAD). 1996: Centro Internacional en Politica Economica para el Desarrollo Sostenible, San Jose, Cosa Rica.

Departamento de Investigacion y Transferencia de Tecnologica en el Cultivo del Cafe. "Informe Anual de Labores 1995." 1996: ICAFE, Heredia, Costa Rica.

Eco- O.K. Certification Program Press Release: "Eco-O.K. Coffee: Using Economic Incentives to Stimulate Environmental Improvements in the Coffee Industry," 1997.

"El grano de oro gana pureza." *El Financiero*, 24 de febrero - 02 de marzo de 1997, p. 10.

Gonzalez, Armando (Executive Director of Juan Vinas Estate and Consultant to INCAE). "Diagnostico de la Competitividad de la Industria del Cafe de Costa Rica." 1997.

Goodland, Robert J.A., and Catharine Watson and George Ledec. Environmental Management in Tropical Agriculture. 1984: Westview Press, Boulder, Colorado.

"Green Beans: ECO-O.K. Coffee Hits the U.S." *The Canopy*, A Rainforest Alliance Publication, September/October 1996.

Instituto del Cafe de Costa Rica (ICAFE). Copy of a slide presentation on the interinstitutional agreement given to FEDECOOP by ICAFE, 1997.

Instituto del Cafe de Costa Rica y la Universidad Nacional Escuela de Historia. "El Cafe: Historia y Sabor de Costa Rica," 1992.

Instituto del Cafe de Costa Rica. Informe Sobre la Actividad Cafetalera de Costa Rica, 1996. 1996: San Jose, Costa Rica.

Kopper, Eduardo. "Appellation for Costa Rican Coffee." *Specialty Coffee Association of America Monthly Bulletin*, June 1997, p. 9.

Lane, Hilary. "Coffees With Conscience." *E / The Environmental Magazine*, January/February 1994.

"Latin American Pesticide Market Growth." Pesticide Action Network North America (PANNA), San Francisco, CA. April 16, 1996.

Monitor Company. "Hipotesis sobre los Clusters: Cafe." May 1997.

Morera, Rolando Vasquez. "Descontaminacion de las Aguas Residuales en el Beneficiado del Cafe en Costa Rica." 1996: ICAFE, San Jose, Costa Rica.

O'Brien, Mary. "What is Paraquat?" Pesticide Action Network North America, San Francisco, CA. June 9, 1997.

Pennybacker, Mindy. "Coffee: The Grounds for Organic." *Green Guide*, February 7, 1996.

Perfecto, Ivette, and Robert A. Rice, Russell Greenberg, and Martha E. Van der Voort. "Shade Coffee: A Disappearing Refuge for Biodiversity." *BioScience*, Vol. 46, No. 8, September 1996, p. 598-607.

Quesada, Laura. "Beneficios de cafe bajan polucion." *La Republica*, 7. de julio, 1997, p. 4a.

Ramaswami, R. "Green Coffee for a Cleaner Planet." *Tea and Coffee Trade Journal*, Vol 164, No 4, pp 21-5, 1992.

Ramirez, J.E. "Poda y Manejo de Coffea Arabica." 1996: Insituto del Cafe de Costa Rica, San Jose, Costa Rica.

"Recirculacion de aguas, una meta...un gran logro." Corporacion Cafetalera la Meseta S.A (promotional material).

Rice, Robert and Justin Ward. "Coffee, Conservation, and Commerce in the Western Hemisphere: How Individuals and Institutions Can Promote Ecologically Sound Farming and Forest Management in Northern Latin America." 1996: the Natural Resources Defense Council and the Smithsonian Migratory Bird Center, Washington, DC.

Saklad, Hunter, under the supervision of visiting professor Betty Diener. Case study on COOCAFE, R.L. 1994: Centro de Investigaciones, INCAE, Alajuela, Costa Rica.

Salvasen, David. "The Grind over Sun Coffee." *ZooGoer*, July/August 1996, p. 5 - 13.

Segura, Olman. "Environmental Impact of Coffee Production and Processing in El Salvador and Costa Rica." Prepared for the United Nations Conference on Trade and Development. 1993: Universidad Nacional de Costa Rica, Heredia, Costa Rica.

Srivastava, Jitendra P., and Nigel J. H. Smith and Douglas Forno. Biodiversity and Agricultural Intensification Partners for Development and Conservation. 1996: The World Bank, Washington, DC.

Thrupp, Lori Ann. "New Harvests, Old Problems: Feeding the Global Supermarket." Global Pesticide Campaigner (Pesticide Action Network), Volume 5, Number 3, September 1995.

Universidad Nacional. Manual de Plaguicidas para America Central. 1994: Heredia, Costa Rica.

Williams, Dr. Wayne T., Regional Environmental Advisor, and Dr. Mario Contreras, Regional Integrated Pest Management Advisor. "Environmental Assessment Coffee Technology Transfer Project (USAID/El Salvador)." 1992.

Weiss, Kenneth D. "The US Market for Specialty Coffee." LAC TECH project, US AID, Washington DC, 1992.

World Bank. Environmental Guidelines. 1988: Washington DC.

Wille, Chris. "The Birds and the Beans." *Audubon*, November - December 1994, p. 58 - 64.

Personal Communications with:

Kathia Chaves, Executive Director, Asociacion de Cafe Finos de Costa Rica, July 1997.

Armando Gonzalez, Executive Director of Juan Vinas Estate, July 1997.

Juan Rafael Gonzalez, Departamento de Liquidaciones, ICAFE, August 1997.

Ing. Agr. Luis E. Zamora Quiros, Director, ICAFE, 1997.

Carlos Rodriguez, Departamento de Exportaciones, ICAFE, August 1997.

Luis Diego Sanchez Solera, Executive Director, Federacion de Cooperativas de Caficultores R.L. (FEDECOOP), 1997.

Chris Wille, Director of the ECO - O.K. Certification Program, July 1997.