ENVIRONMENTAL CONCERNS
IN COFFEE PROCESSING IN BRAZIL

Professor Peter H. May
Environmental Concerns in Coffee Processing in Brazil

Peter H. May, PhD

Abstract

In Brazil, coffee hulling is accomplished primarily using the mechanical (dry) process, which generates far lesser deleterious environmental effects than those observed in the wet process. The latter generates serious residuals disposal problems. Pulp and water contaminated by the intensity of fermentation and posterior washing of beans produce significant pollutant loads - chiefly sugars and organic materials - that are transported to waterways. Despite these environmental costs, the wet process is considered to yield a higher quality product, and its adoption has been stimulated as one means to counteract the secular erosion of Brazilian competitiveness in coffee production. An “eco-label” for dry processed coffee has been proposed as a means to counter this tendency.

Particulate matter emissions and odors represent serious environmental problems associated with coffee roasting. The work environment is commonly filled with the dust released during handling of raw beans. This dust contains allergenic compounds (chiefly chlorogenic acid) that result in exposed workers developing asthma, rhinitis or dermatitis. Smoke emitted during roasting is dense, containing a large quantity of fine particles derived from the materials that cover coffee beans, so affecting neighboring communities.

However, the most serious source of externalities in coffee processing in Brazil is associated with sediments produced during manufacture of soluble coffee, constituting 65% by weight of the raw coffee beans processed. Up to two kg of sediment is produced per commercial kg of soluble coffee. Disposal of the acidic residual liquor from soluble coffee manufacture represents another serious problem for the industry. In Brazil, most such wastes are disposed of directly to watercourses or sewage systems without treatment.

Packaging materials also represent a growing problem in the industry, which has found it necessary to use vacuum packaging with materials not recyclable under current technology to conserve the aromas and impede rancification of grounds. Such materials are composed of foil backed plastics from which separation of materials is uneconomical, requiring application of acid. Final disposal of these materials represents a “cradle-to-grave” issue that should be made a subject of concern.

How can such problems be resolved? Product quality demands driven primarily by Northern markets represent a principal push factor in the adoption of environmentally harmful technologies. Product characteristics that demand energy- and chemical-intensive coffee production and use of waste generating wet processing methods appear to have created a fundamental contradiction between environmental preoccupations and import quality demands in the North. The achievement of environmentally friendly production and processing techniques requires concerted

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more vulnerable to the collapse in the economic value of the commodity agreements. The board's elimination of subsidies and restrictions on credit for producers and processors has reduced net exports in some countries, leading to stabilization of market prices. The overall negative trend in commodity markets, negative policy impacts, and the global economic situation have diminished the relative importance of exports in coffee to the overall economy. Fortunately for Brazilian producers, global prices were depressed at the same time, increasing the competitiveness of producer/consumer trade agreements.

Brazil's historical efforts to contain coffee production in hopes of maintaining greater coffee throughputs like 1980 (Segura, 1993). Despite Brazil's dominance in international market volatility. Overall, 1.1 million tonnes of coffee producers were vulnerable to international market volatility.

Coffee trade, structural adjustment and socio-environmental vulnerability

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National coffee industry: be the most important source of income improvement in environmental characteristics of the environment. Although coffee is a very small segment of consumer, production of coffee is a valuable and local changes in both producer and consumer behavior. "Green" marketing needs to improve.
Increased producer vulnerability has in turn conditioned the manner and extent to which commodity production generates environmental costs.

Structure of Brazil's coffee production and processing industry

Nearly 300,000 producers form the base of the coffee agro-industry in Brazil (Figure 1), producing an average of 27 million sacks (450,000 mt) annually between 1985-90. In 1988, these farmers, together with hired labor and their households constituted nearly 10% of the rural population of Brazil. In traditional producing areas in Brazil's Southeast region, the prevailing tenure structure is made up of smallholders who mostly rely on family labor. Average productivity in unroasted beans is 480 kg/ha on nearly 3 million ha of coffee plantations throughout Brazil (IBC, 1990).

The agro-industrial structure in coffee is highly dispersed, with 3,000 processors engaged in cleaning, hulling, classifying and reprocessing coffee beans. A far smaller group of some 70 cooperatives at significantly larger scale are responsible for as much as 20% of unroasted coffee bean deliveries. Secondary processing involves a major food industry of 1,200 firms oriented toward coffee roasting and grinding, and 11 that produce soluble coffee extracts. Together, these firms transform roasted beans into conventional consumer products - ground coffee for filters and espresso machines, and instant coffee in granules and powder. Nearly half of overall production is exported in unroasted form, and most of the remainder stays in Brazil as ground coffee. Only 10% is processed, primarily by multinationals, for instant coffee, most of which is destined for export markets.

Environmental effects of coffee production in Brazil

In the realm of agricultural production, there exist two environmental problems of some significance in the coffee industry: declining fertility due to soil erosion, and the deposit of pesticide residues in the soil, water and coffee beans themselves.

Coffee expansion and soil exhaustion over the years have left behind vast expanses of degraded lands in Brazil, while policies to contain production in periods of glut have led to uprooting not only billions of trees but also hundreds of thousands of rural households. In the mid-1960s, the Brazilian government launched a major campaign for coffee eradication, resulting in uprooting 1.2 billion trees. Increased world prices led the government then to stimulate new plantings, dictating credit terms that required contour planting, restricting credit to areas considered agroecologically apt for coffee, and packaging subsidies for increased use of industrial inputs. This package stimulated coffee plantation renovation with improved species, fertilization and pesticide
Approximately $1.15 billion in export earnings annually due to declining prices (Figure 3). TheBrazilian coffee industry, which has been primarily export-oriented, has been hit hard by the collapse of the international coffee market. Despite increasing market share in the international market, Brazil's dominant position in the world market has been eroded. The collapse of the international coffee market, which began in the mid-1970s, had a significant impact on Brazil's coffee sector.

The Brazilian coffee sector is heavily dependent on the international market. With the collapse of the international market, Brazil's coffee industry has been forced to adapt to new market conditions. The government has implemented various policies to support the coffee sector, including programs to increase production and decrease prices. Despite these efforts, the Brazilian coffee sector has faced significant challenges.

Before government intervention, coffee growing in Brazil can be considered to have been limited. However, the government has implemented policies to increase production and decrease prices. The coffee market is heavily dependent on the international market, and any changes in the international market can have a significant impact on the Brazilian coffee sector.

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3). This decline in revenues has had a considerable effect on coffee producers, particularly smallholders (Saes & Giordano, 1992). By 1992, a decline in crop area on the order of 800,000 ha of coffee either abandoned or eradicated, has implied a reduced labor contingent of nearly 250,000 workers, whose combined direct and indirect beneficiaries number in the realm of a staggering 4 million persons (Table 1; May et al., 1994).

The most severe environmental impact of this shift has been the substitution of coffee stands by pastures, with a consequent decline in prospects for rural employment. In the most traditional producing regions, rural exodus is dramatically evident. For those who have remained in coffee production, the reduction in household income has obliged the mobilization of women and children to work on- and off-farm as a means to survive.

Abandoned coffee groves irradiate pests to neighboring growers, making it necessary to apply heavier doses of chemicals, and became fertile ground for attack by the coffee borer, a pest thoroughly eradicated in previous decades.

While in some areas declining prices made it impossible for small coffee producers to remain in production, others were able to sustain a modest level of output and to invest in efforts toward producer organization to seek alternative market channels. Because many of these farms had applied chlorated pesticides and cupric fungicides as a standard practice prior to the drop in prices, their product cannot be considered to be certifiably "organic", until after a period of transition to eliminate residual chemical buildup in soils and tree tissues (Dickinson and Lepp, 1985). Producers have increasingly adopted intercropping, shading with leguminous trees, and mulching as means to ensure adequate nutrient availability and control weed growth (Babbar and Zak, 1994).

Besides measures to secure peasant coffee farmers on the land, to produce coffee in a manner consistent with resource conservation objectives requires investment in erosion prevention and organic matter conservation, as well as development and dissemination of cost-effective biological control and integrated pest management systems (IPM) to avert pesticide spillover effects.

Coffee agroindustries and the environment

Coffee hulling, the first stage of processing, is accomplished throughout the world using mechanical (dry) and wet processing technologies. Although nearly half of the world's coffee is wet processed, in Brazil this method is only employed in a restricted area of Bahia. Mechanical (dry) hulling and, in smaller volume, "semi-dry" processing, are far more widely disseminated, constituting the vast majority of Brazil's export product. The dry method involves washing solely for separation of impurities, and hulling itself which,
Compounds is apparently reduced after roasting

In coffee dry processing industries, the work environment is commonly filled with the

Despite this potential, coffee hulls are rarely used as fertilizer in Brazil, due to their low

and animal relations as a component of sludge mixtures (Cruz, 1998; Adams & Dongan,

and conditioning) (Charles, 1997). The principal potential for washing equipment. This water may be contaminated by antioxidants, which has led

research according to recommendations on coffee washing equipment. This water may be contaminated by antioxidants, which has led

In dry processing, water is used to wash the hulls themselves, conditioning as much as

means to counteract the current crisis of Brazilian coffee.

workers' health.

although not a source of water pollution, can cause dust problems affecting plant
Particulate matter emissions and odors represent the most serious environmental effects of coffee roasting. Smoke emitted during roasting is dense, containing a large quantity of fine particles derived from the materials that cover coffee beans. The quantity of fine coffee residues produced during roasting can vary from 0.5-1.0% of raw bean dryweight (Pfluger, 1975), and is seldom completely burned off, unless an incineration stage is added. Particulate emissions vary in accordance with the heat process employed, and reach 3.5 kg/100 kg of raw coffee processed (Ajax & Lee Jr., 1979).

In the processing of soluble coffee, up to 34 kg/hr of fine coffee dust is generated from pulverizing-drying equipment operating at volumes of between 450 and 910 kg/hr. The simple addition of a cyclone reduces dust levels to around 6.8 kg/hr, the powder recovered being sufficiently remunerative to cover the expense. However, when such firms are located near residential areas, complete dust removal is often necessary, requiring considerable investment in gas scrubber equipment, whose use, despite having low operating costs, is inviable for some types of roasting facilities (Pfluger, 1975).

Odors that emanate from coffee roasting processes arise from the emission of organic compounds including alcohols and organic acids, sulfur and nitrogen oxides, which can be almost completely removed through proper incineration (USEPA, 1985). Incinerators functioning at 650° C. and catalytic combustion units at 371° C., are efficient in elimination of odors (Ajax & Lee Jr., 1979). The lower fuel cost of the latter is offset by the high cost of replacement of catalyzer elements (Pfluger, 1975).

Coffee sediments produced during manufacture of soluble coffee are of considerable magnitude, constituting 65% by weight of raw coffee beans processed (Claude, 1979). Up to two kg of sediment is produced per commercial kg of soluble coffee (Purdum, 1980; Adams & Dougan, 1987; Pfluger, 1975). The insoluble residues, having 75-80% moisture content, must be compressed to reduce moisture to at most 50%, after which they may be used for animal ration, fertilizer, as a landfill or, most favorably, as a fuel (Tango, 1971; Claude, 1979; Adams & Dougan, 1987; Pfluger, 1975).

Disposal of residual liquor from soluble coffee manufacture, acidic (pH = 4.0) and containing about 1% solids in suspension, represents another serious problem for the industry. In Brazil, most such wastes are disposed of directly to watercourses or sewage systems without treatment.

Coffee is a perishable product, whose shelf life once ground is only 20 days. To conserve the aromas and impede rancification of grounds, it has been found necessary to use vacuum packaging with materials not recyclable under current technology. These are composed of foil backed plastics from which separation of materials is uneconomical, requiring application of acid. Innovative efforts by package manufacturers are required to overcome this problem, which may become more serious in future, as vacuum packed
One mechanism to reinforce sustainable practices is that of market segmentation of specialty or cooperatively grown coffee. The principal objective of market segmentation is that of market segmentation of producer attachment to certification procedures where segmented markets can be built. But stick with environmentally friendly production techniques, making necessary a commodity market that caters those producers who not only adopt a fundamental understanding between environmental processes and import quality in the demand curve, but demand the same level of support in this response. Environmental issues are the principal push factors in this response, environmental risks. Product quality is the principal push factors in this response. The increased financial viability has led to an increase of subsidy here, but the adopted policy to the crisis (May 8th, 1993), the new policy is a more immediate and efficient policy, the same high impact techniques have been used to implement this policy in production systems, sectoral interests have generally concluded that it is first necessary to redistribute producer and consumer interests.

In these commodities, short-term improvements may be converted into a long-term basis for sustainable trade. This, however, the goal is to move away from the low of 1993. Long-term supply conditions suggest that nearly eighteen million tons of the crop was lost in 1993, coffee prices have shown a substantial recovery from the crisis terms of the early 90s, commodity policies toward sustainable trade. 

Another packaging-related area that has received recent emphasis is that of growing ground coffee using such packaging represents a segment of the Brazilian industry which is experiencing greater growth.
in small farmer coffee production has been to qualify for registry and export by roasters who participate in the Max Havelaar Foundation network in Western Europe. Such registry is limited to organized groups of farmers that produce good quality coffee on areas typically from 2-4 ha, on which they depend for a principal share of their income. Those who qualify are able to market their coffee with the Max Havelaar seal, widely recognized in European supermarket chains, and so secure a price premium that enables producers to as much as double net income. The organic characteristic is not a principle objective of this registry, although many such producers are moving toward such technologies. In this sense, the environmental characteristic of alternative coffee is more closely meshed with a social equity objective than with purely physical environmental concerns.

In Brazil, a few isolated groups of coffee growers in Rondônia, Espírito Santo and Minas Gerais have sought or obtained Max Havelaar registry. The technical assistance organizations that have officially recognized to orient growers in this sense have typically adopted "alternative technologies" (low-input, labor intensive and resource protective techniques that can be used by small farmers on marginal lands) as a starting point (APTA-CERIS-IDACO-PROTER, 1993).

The prospects for expansion in Brazilian producers' involvement in this market segment remain dubious, however, due to concern among those seeking to strengthen small farmers' organizations. This concern stems from two arguments regarding Brazilian coffee growing. First, the majority of smallholders in Brazil operate coffee plantations that are larger by far than those managed by small farmers in other countries where alternative market channels are sought (according to Zylberstajn et al. (1993), "mini" and small coffee farms in Brazil are defined as those under 50 ha). Secondly, Brazil's massive production, even if only a small proportion were to be directed toward the alternative market in Europe (still only between 2-4% of total consumption in the Low Countries, France and Germany) could result in the bottom dropping out of the market. There could thus be a negative effect of competition in the "solidarity" market that has been constructed (Agostinho Guerreiro, pers. comm.).

Internalization of environmental costs in coffee and cocoa processing industries requires a mix of economic incentives and regulatory measures. To date, the threat of enforcement and public pressure have been sufficient in some states to enlist efforts by coffee roaster/grinders to seek technical solutions for particulate and odor emissions. Incentives to equipment manufacturers that encourage the containment and recycling of byproduct materials have already been assured in secondary processing, due to Brazil's conquest of EEC markets for such equipment, subject to rigid environmental standards. Processing equipment manufacturers - in seeking remunerative international markets - have also found it beneficial to standardize environmental safeguards in their machinery produced for the domestic market.
Café libre (CAFÉ, CAFE).


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Trade.

Consumers have important contributions to make towards more sustainable commodity
differenc in the direction of product exsipation. Thus, both producers and
discolored coffee beans produced with low pesticide impacts could make a sigificant
access to environmental technologies. For example, training groups need to accept slightly
of environmental consequence of product demand can help to motivate adoption of less
produce the environmental sustainability. An informed consumer community aware
In conclusion, it is evident that consumer insistence on product quality can be a two-

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Figure 1. Exports of Coffee Beans - Brazil: 1981-92

Coffee Exports and Revenues - Brazil

Accord broken: 1985-86 and 1989-92
Source: CACEX.

Table 1. Employment in Coffee Production in Brazil: 1988 and 1992

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PLANTED AREA</th>
<th>DAILY WORKFORCE</th>
<th>DIRECT BENEFICIARIES</th>
<th>INDIRECT BENEFICIARIES</th>
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<td>3,481,600</td>
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