IMPROVING ENVIRONMENTAL PERFORMANCE IN THE COFFEE INDUSTRY OF JAMAICA

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ABSTRACT

After oil, coffee is the most widely traded commodity in the world. The industry worldwide provides employment for some 20 million persons. In Jamaica coffee is the second most important agricultural product with earnings of over US$ 30 M from export. It employs over 50,000 persons directly and over 250,000 dependents. Jamaican Blue Mountain Coffee is lauded as the best coffee in the world.

The production and processing of coffee however, has over time been criticized for its direct and potential negative impact on the environment. And as such in recent years the Coffee Industry Board has pioneered many initiatives for improving the environmental performance of the coffee industry in Jamaica. The main components of these initiatives are:

- Development and Implementation of Good Agricultural Practices
- Introduction of New Waste Management Techniques
- Development and Implementation of an 'Environmental Codes of Practice' for the local Coffee Industry. The codes embody practical solutions for the challenges to sustainable coffee production.
- Adoption of a pro-active approach to mitigate threats and enhance competitiveness

A multifunctional approach ensures that Jamaican coffee maintains the high standard of quality for which it is renowned and does so in a sustainable manner.

INTRODUCTION

The coffee plant, which is indigenous to Ethiopia, is a perennial evergreen dicotyledon. It produces fruit once per year about six to nine months after flowering. The bean (endosperm) represents about 45% of the fruit; the other 55% is generally discarded as waste (pulp and mucilage).

Coffee was introduced to Jamaica in 1728. Natural condition s proved to be most favourable and cultivation expanded rapidly. In 1814 the highest ever production of 15 million kilograms was recorded, however, present export production is approximately 3 million kilograms

Coffee Berries

Today coffee is the second most important agricultural crop in Jamaica. The industry provides employment for over fifty thousand (50,000) persons and contributes seven percent (7%) of agricultural earnings.

Coffee is produced along the central ridge of the island, which is divided into two distinct regions; the Blue Mountain and non- Blue Mountain regions. All of Jamaica’s production is renowned for its high quality but Blue Mountain coffee is particularly famous and considered among the world’s best.

The wet process is the method employed for the processing of coffee in Jamaica. This method is associated with the use of large volumes of water resulting in copious amounts of highly polluted effluent. The disposal of this along with the pulp has been a major problem in Jamaica as well as in all other coffee producing countries.

Traditionally, 15 litres of water was needed to process one kilogram of cherry coffee, generating approximately one million litres of effluent per day at peak production. BOD concentration of the effluent in excess of 2,500 part per million (ppm).

Growing coffee in a sustainable manner in hilly terrain with attack from a range of pests and diseases along with proper management and disposal of process waste has been a challenge. This paper presents the progress that has been made in dealing with these challenges and follows from the CIB adopting a comprehensive approach to bring all operations associated with coffee production and processing within acceptable environmental standards.

The coffee industry can be divided into the following sectors and associated environmental impact:

SECTOR	ENVIRONMENTAL IMPACT
Nursery	chemical usage, packaging waste
Farm	soil conservation, chemical usage disruption of biodiversity
Pulpery	waste generation and disposal
Finishing	waste generation and disposal

I. ENVIRONMENTAL ACTION BY SECTOR:

Nursery

There are four coffee nurseries in operation across the island. Negative environmental impact has been minimal and the chief concern is the disposal of poly bags at the time of planting. This problem is being addressed by the use of potting bags, which are biodegradable.

Farm Operations

Chemicals The two main categories of chemicals used in coffee production are pesticides and fertilizers. The concept of Integrated Pest Management (IPM) has been introduced to the industry. In this system, pesticide is the last resort, with physical and biological control being first choice. As an example, the coffee berry borer (CBB), *Hypothenemus hampeii* is the most important pest of coffee (in economic terms) and an Integrated Borer Management Programme has been developed. The components of the programme are as follows:

- Field sanitation which is the removal of all residual berries from the field at the end of the reaping, thus removing he host for the borer.
- Use of a trap to capture and kill the borer.
- Introduction of biological control agents (*Cephalonomia stephanoderis*, *Phymastichus coffea*), predators of the borer to reduce the berry borer population.
- The use of endosulfan, the only pesticide to effectively control the borer is now a last resort.

Coffee Berry Borer

Brocap Trap for capturing CBB

This approach has seen a 60% reduction in endosulfan usage (10,000 – 4000L), while at the same time recording a steady increase in production (~400,000 – 600,000 boxes). More environmentally friendly pesticides from natural extracts, e.g. neem extract is also being pursued as another alternative.
The use of chemical fertilizer is on the decline as organic fertilizers such as chicken litter and composted pulp is being used as a substitute. Over 80% of coffee pulp is being composted and recycled as manure. Vermicomposting is now widespread among coffee farmers.

Soil and leaf analysis prior to the application of fertilizer is a recommended practice. All these measures together reduce the need for chemical (inorganic) fertilizers.

Coffee is also increasingly being grown with shade trees, many of which are leguminous.

Pulpery

Synonymous with coffee processing via wet processing is the generation of substantial amounts of waste, both liquid and solid. The proper disposal of this effluent and pulp has been a major challenge in Jamaica and all coffee producing countries. There have been however, recent advances made in managing coffee pulpery waste in the Jamaican coffee industry.

The following has been done:

- Environmental audits of the coffee pulperies and the monitoring of effluent and receiving water bodies.
- Effluent reduction – modification to operations/process have realized a 75% reduction in water usage and correspondingly the effluent generated. An approximately US $1000 per month in savings on electricity costs has been realized from this effort.

- Effluent treatment that incorporates screening settling and anaerobic decomposition and plant-bed (constructed wetland has been introduced to most of the pulperies. Where the full system is in operation, final discharge is in compliance with regulatory standards.

Composting of the pulp has always been done in a very rudimentary manner, whereby it was deposited in an open space and left to decompose naturally. This is now being done by vermicomposting in a better-managed and more structured way. The NPK analysis of pulp and compost is given below:

Sample	pH	N	P	K
Pulp	8.18	2.38 %	600 ppm	23,550 ppm
Compost	7.70	3.00 %	2,200 ppm	15,307 ppm

Finishing Works

Finishing involves the drying, hulling, grading and sorting of coffee. The waste generated in this operation is parchment husk, approximately 0.5M kg per year. Formerly this waste was disposed of at the city dump but is now being used as an energy source for drying the coffee. 80% ($6M Ja) of the energy needed is supplied by the parchment.

In 2001-2002 the coffee industry pioneered the development and launch of environmental codes of practice (COP) for the entire industry. The process was driven by increased awareness, a need to maintain competitive advantage and market niche, as well as regulatory pressure. The document recommends best practices throughout the industry with a focus on sustainable coffee development.

There has been tremendous buy-in from industry stakeholders, with implementation of the code proceeding at a satisfactory rate. By implementing the code, one farmer in St. Ann realized $250,000 saving on fertilizer cost for one year. A programme of monitoring to determine the impact of the COP has also been established.

Future Work

Currently only the soluble portion of the coffee bean is considered to be of economic value. This represents 20% of the fruit. The other 80% (pulp, mucilage, husk and spent grounds) is discarded and in many cases, is a potential environmental hazard. A programme dubbed **"Zero Waste Process"** is being developed to find alternate economically viable uses. The table below shows some possible uses:

PULP	EFFLUENT	HUSK	SPENT GROUNDS
Animal ration	Alcohol	Charcoal	Compost
Wine & Alcohol	Methane	Paper	
'Tea'	(biogas)	Fuel source	
Caffeine	Irrigation		
Tannins			
Pectin			
Vinegar			
Compost			

One such pilot project is to be implemented at the Moy Hall coffee factory in St. Thomas for the coming coffee harvest which starts in September. The project will have the following components:

i. Commercial vermicomposting of the coffee pulp.
ii. Biodigester to treat pulpery effluent and produce methane gas.
iii. Co-generator fueled by the biogas to meet the electricity needs of the pulpery, including heat for the drying of coffee.

iv. Discharge from the biogas plant to be used to irrigate surrounding coffee field.

v. Husk to be converted to charcoal for commercial use thereby providing a substitute to trees.

The local coffee industry has come along way in improving its environmental performance is now on a path to sustainability. It is targeted to achieve environmental certification by 2006.

II. Mycotoxins – Their Impact on Food Safety with Focus on Coffee

Mycotoxin is the broad classification for a group of chemicals which are produced from molds, which grow on agricultural produce. These molds infest **coffee**, cereals (wheat, barley, oats) beans and peanut at levels varying widely among commodities and geographic locations. Molds occur naturally under environmental conditions of high temperature and moisture, and of course, a food source.

The mycotoxin of importance to the coffee industry is **Ochratoxin A** (OTA), which has been detected in a variety of feeds and foods, mostly in countries with temperate and tropical climates. OTA is very heat resistant, thus prolonged heating such as takes place in roasting and brewing coffee does not destroy OTA. It is known to be harmful to mammalian species and has been proven to be nephrotoxic and carcinogenic.

Where does it originate

Ochratoxin A is produced by the molds:

- Penicillium sp.
- Verrucosum sp.
- Aspergillus ochraceous

Coffee infected with mould

Ochratoxin A in Coffee

Limits on OTA content in coffee is currently being implemented by many countries (especially in the EU). This could have serious economic consequences for both growers and exporters.

It is important for coffee stakeholders to have a knowledge of what they are up against, the source from which OTA may arise and the implications of contamination of their produce. Such knowledge will make them better able to implement preventative measures.

Health Implications of OT-A:

- Suspected to be cancer causing.
- Toxic to the kidneys
- Has been shown to be affect immune functions.
- In regions of the world where human exposure to Ochratoxin is very high, kidney tumors and cancers occur, similar to those found in swine deliberately fed OT-A.

Special attention has been paid to OT-A since a link has been established between OT-A and human Balkan Endemic Nephropathy (BEN), which is a chronic kidney disease that causes progressive kidney failure. A link has also been established between OTA and urinary tract tumors.

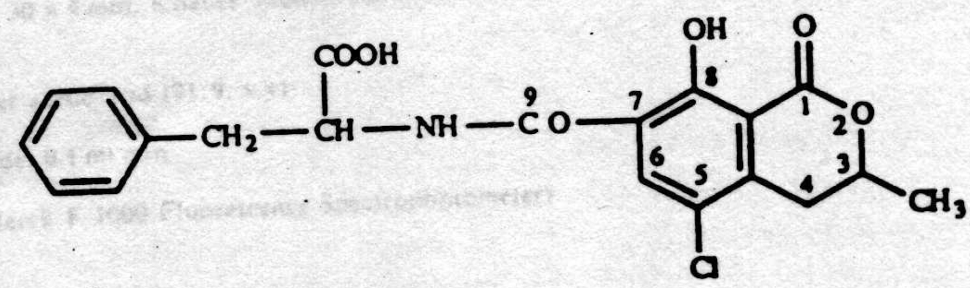

Fig. 1. Chemical structure of ochratoxin A.

The cut off level for Ochratoxin A, where it exists, is 2-4 ppb.

The European Commission's Scientific Committee for Food (SCF) has thoroughly investigated this toxin and has recommended a maximum limit of 5 ppb (parts per billion or micrograms per kilogram) in any one product.

Many countries, primarily in Europe have introduced maximum allowable limits for OTA and tolerable daily intakes for human exposure.

Local Industry Response

The local industry has been proactive in its response to the increasing concerns for OTA in coffee. The following actions have been taken:

- The Research Department has been mandated to keep up to date on the most recent developments in respect of OTA in coffee and is keeping the local industry informed.
- Acquisition of analytical instruments for OTA analysis and staff training in on OTA detection.
- Routine monitoring of OTA levels in local and exported coffee.
- Identification and monitoring of critical control points in the production process.

Laboratory Analysis of OTA

The levels of OTA generally found in Jamaican coffees are generally well below the maximum allowable limits for both local and exported coffee.

Recommendations to Reduce Incidence of OTA

1. Identify in the process critical control points for mold infection and OT-A formation and put preventative measures in place.
2. Process fresh cherry coffee as soon as it is delivered.
3. Dry coffee to a moisture content $\leq$ 13%.
4. Store coffee in well-ventilated, leak-proof containers.
5. Check and discard defects and discarded matter known to increase contamination load (whole cherries, husks, moldy beans, etc.)
6. Prevent mechanical and insect damage to beans.
7. Reduce storage time of cherries and green beans.

Prevention is not possible but contamination can be minimized by proper identification of critical points of production and storage.

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