

PN-ABU-946
94736

Winrock International
Environmental Alliance

Environmental & Natural Resources Policy & Training Project



*Winrock International
Environmental Alliance*

Center for Policy Negotiation

Development Assistance Corporation

The Futures Group

Institute for International Research, Inc.

Iowa State University Center for
Agricultural and Rural Development
Resource and Environmental
Policy Division

The Johns Hopkins University

KBN Engineering and Applied
Sciences, Inc.

The Keystone Center

Management Systems International

New York University Institute for
Economic Analysis

The RAND Corporation

Resources for the Future

Tellus Institute

Tropical Research & Development, Inc.

Tufts University Program for
Study of Sustainable Change
and Development

Tuskegee University

University of Maryland International
Institute for Ecological Economics

University of Rhode Island

Winrock International Institute for
Agricultural Development

Yale University School of Forestry and
Environmental Studies

The Office of Environment and Natural Resources of the Bureau for Global Programs, Field Support, and Research of the U.S. Agency for International Development sponsors the Environmental and Natural Resources Policy and Training (EPAT) Project. The Winrock International Environmental Alliance has responsibility for EPAT's applied research and technical assistance activities.

1611 North Kent Street, Suite 600, Arlington VA 22209 - USA
Telephone (703) 525-9430 FAX (703) 516-0481

Delivery Order No. 18
Project No. 532-9106 under 936-5555
Contract No. DHR-5555-Q-00-1085-00

**Environmental Implications
of Agricultural Trade and
Policy Reform Programs in Cameroon:
Pest and Pesticide Management**

Patricia C. Matteson
and
Martin I. Meltzer

December 1994

Prepared for

Office of Sustainable Development
Division of Productive Sector Growth and the Environment
Bureau for Africa
U.S. Agency for International Development

by

Environmental and Natural Resources Policy and Training (EPAT) Project
Applied Research, Technical Assistance and Training
Winrock International Environmental Alliance
Arlington, Virginia
USA

EPAT Team Members

Dr. Patricia C. Matteson, entomologist, Iowa State University*

**Dr. Martin I. Meltzer, agricultural economist, Tropical Research and Development, Inc., and
Department of Veterinary Medicine, University of Florida**

*** Address after January 1, 1995: Departamento de Proteccion Vegetal, Escuela Agricola Panamericana (EAP), Apartado Postal 93, Tegucigalpa, Honduras**

Contents

Contents	i
Acronyms	iii
Preface	v
Foreword	vii
Executive Summary	ix
I. Introduction	1
II. Prereform Pest and Pesticide Management in Cameroon	3
A. Pest Problems and Pest Management	3
1. Patterns of Pesticide Use	3
a. Cash and Food Crops	3
b. Migratory Pests	6
c. Vectors of Human and Animal Diseases	7
2. Status of Alternative Pest Management Approaches	7
a. Organic Crop Production	7
b. Integrated Pest Management	8
c. Research Capacity	8
B. Procurement, Distribution, and Marketing of Pesticides	9
C. Cameroon's Ability to Regulate and Monitor Pesticide Use	12
1. Agricultural Extension	12
2. Pesticide Legislation and Regulations and Their Enforcement	13
3. Pesticide Disposal	14
D. Health and Environmental Impacts	15
III. Pesticide-related Donor Policies	17
A. Crop Promotion	17
1. Plantation and Parastatal-supported Crops	17
2. Nontraditional Export Crops	17
B. Marketing and Input Supply	18
C. Availability of Credit to Purchase Inputs	18
D. Environment	19
IV. Agricultural Trade and Policy Reforms Affecting Pesticide Use	21
A. The CFA's Devaluation	21
B. Privatization of Parastatals	21
C. Liberalization of Cooperatives	22
D. Free Markets in Inputs	22

V.	Impact of Donor Policies and Reforms on Pesticide Use, the Environment and Public Health	23
A.	Projected Changes in Pesticide Use by Crop	23
1.	Bananas	23
2.	Cotton	23
3.	Maize and Vegetables	23
4.	Coffee and Cocoa	24
B.	Incentives for Integrated Pest Management	24
C.	Environmental and Health Impacts	24
1.	The Key Role of Policy Implementation	24
2.	Environmental and Health Concerns	25
a.	Acute Poisoning	25
b.	Chronic Poisoning of Applicators and Consumers	26
c.	Water Pollution	26
d.	Toxicity to Nontarget Species	26
e.	Ozone Depletion	27
VI.	Agricultural Trade and Policy Recommendations	29
A.	Economic and Policy Environment	29
1.	Privatization and Liberalization of Markets Should Be Pursued, Ending Pesticide Subsidies	29
2.	Pesticide Grants from Donors Should End	29
3.	Credit and Pesticide Consumption Should Not Be Linked	29
4.	The Equity of Nontraditional Export Crop Projects Should Be Examined	29
5.	International Environmental Initiatives Should Be Supported	30
B.	Pest and Pesticide Management	30
1.	Least-toxic Pest Management Should Be a Priority	30
2.	Donors Must Support the Enforcement of Pesticide and Environmental Regulations	31
3.	Regional Collaboration for Pesticide Management	31
	References	33
	Appendix A: Persons Contacted in Cameroon	37
	Appendix B: Summary of Hazards of Pesticides Used in Cameroon	41

Acronyms

CARFOP	African Crop Protection Research and Training Center (Organization of African Unity)
CFA	Communaute Financiere Africaine (franc, Cameroonian currency)
CIPCRE	International Circle for Promoting Creation
CIRAD	International Cooperation Center for Agricultural Research for Development (France)
CPS	Crop Protection Service, MoA
EC	Emulsifiable concentrate (pesticide formulation)
EU	European Union
FAO	United Nations Food and Agriculture Organization
FONADER	National Rural Development Fund
FONGEC	Federation of Cameroon Environmental NGOs
GTZ	Gesellschaft für Technische Zusammenarbeit (Agency for Technical Cooperation, Germany)
HPR	Host plant resistance (to pest infestation)
ICRISAT	International Crop Research Institute for the Semi-arid Tropics
IDA	International Development Association
IITA	International Institute of Tropical Agriculture
IPM	Integrated pest management
IRA	Agricultural Research Institute, MoA
JICA	Japan International Cooperation Agency
MoA	Ministry of Agriculture
MRL	Maximum residue level (allowable for pesticides)
NEAP	National Environmental Action Plan
NGO	Nongovernmental organization
NTE	Nontraditional export (crops)
SODECAO	Cameroon Coffee and Cocoa Development Corporation (parastatal)
SODECOTON	Cameroon Cotton Development Corporation (parastatal)
STP	Stage-and-target (cotton crop) protection
T & V	Training and Visit extension system
UCCAO	Central Agricultural Cooperative Union of the Western Province
UDEAC	Customs and Economic Union of the Central African States
ULV	Ultra-low volume (pesticide application)
UNDP	United Nations Development Programme
UPAC	Central African Crop Protection Union
USAID	United States Agency for International Development
UTAVA	Aerial Treatment Unit
WP	Wettable powder (pesticide formulation)
WVLV	Water-based very low volume (pesticide application)

Preface

This report is prepared in conjunction with the analytical agenda of the Policy Analysis, Research and Technical Support (PARTS) Project of the U.S. Agency for International Development's Bureau for Africa. The PARTS Project covers a broad range of subjects in agriculture, natural resources, agribusiness, and private-sector development. Walter I. Knausenberger conceived and manages this series of studies on pesticide policy under the leadership of John Gaudet, the Bureau for Africa's Environmental Coordinator (and head of the Environmental Protection Unit), and Curt Reintsma, Chief of the Division of Productive Sector Growth and Environment within the Office of Sustainable Development. The study and analysis are being conducted through the Bureau's PARTS Project buy-in to the Environmental and Natural Resources Policy and Training (EPAT) Project of USAID's Bureau for Global Programs, Field Support and Research.

The study is the result of a two-week visit to Cameroon in early 1994. Despite the limited time in Cameroon, a large amount of data was collected, enabling the team to provide a comprehensive overview of the use and management of pesticides in that country. The collection of data would not have succeeded without the assistance given to the team by all who were asked to help. The list of contacts at the end of this report reflects those who should be thanked for their efforts.

In particular, the authors would like to thank Seraphin Njomgue, Assistant Director of Crop Protection, for organizing their visit to Cameroon, for guiding and facilitating fact-finding activities, and for providing information. The authors are also grateful to John McMahon, Agricultural Development Officer, USAID/Cameroon, Werner Roider, Senior Agricultural Economist, World Bank Cameroon (Yaoundé), and Walter Knausenberger for logistical support, contacts, and information.

The following colleagues reviewed drafts of the report and provided supplementary information: Richard Tobin, Institute for International Research; Akinwumi Adesina, West Africa Rice Development Association; Noel Chabeuf and Theodore Nkodo, the World Bank; and Louise Shaxson and Bill King, Natural Resources Institute. The considerable editorial assistance of Topical Research and Development, Inc., is appreciated.

Curt Reintsma
Division Chief
AFR/Productive Sector Growth and
Environment Division

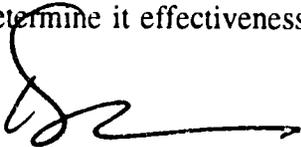
Foreword

This report is one of a series of reports on the environmental and economic implications of agricultural policy reform and trade and promotion policies in sub-Saharan Africa completed for the U.S. Agency for International Development's Bureau for Africa. Pesticides are the particular focus of this and related studies. Pesticides are recognized as essential inputs to promote agricultural productivity, but they are also unique among agricultural inputs in the potential risks they pose to human and environmental health. Major economic restructuring has been sweeping sub-Saharan Africa in the past five years, yet little attention has been paid to the implications of these reforms for the use and distribution of pesticides.

Several dilemmas and challenges for the development process have been introduced by the withdrawal of government from a role in the distribution of pesticide inputs, and by the associated restructured pricing and subsidy policies. In part, the dilemmas are unique to this subsector, simply due to the intrinsically toxic properties of pesticides, which sets them apart from other agricultural inputs and from other commodities of commerce such as fertilizers. For these reasons alone, pesticides deserve a special examination. Specific attention is also paid to the opportunities for promoting alternative pest-management technologies and strategies.

This report is directed at analysts, decision makers and policy makers having a stake in these issues, in interested governmental and nongovernmental organizations in Cameroon, as well as among donors and international financial institutions. Related reports examine pesticides and the agrichemical industry in sub-Saharan Africa; the policies on pest and pesticide management of major bilateral donor agencies; and the implications and consequences of policy reforms vis-à-vis pest management in Kenya and Uganda. The cost of writing and printing the present report is estimated to be about \$15,000.

We hope that this report will assist in the process of changing policies and programs to promote the minimized but responsible use of pesticides and the development, availability of, and access to integrated pest-management technologies. The report's utility for its intended users will determine its effectiveness.



David Hales
Deputy Assistant Administrator
Center for the Environment
USAID/G/ENV
Washington, D.C. 20523



Twig Johnson
Director
Office of Environment and Natural Resources
USAID/G/ENV/ENR
Washington, D.C. 20523

Executive Summary

Crop protection in Cameroon is almost exclusively **dependent on pesticides**. Organic farming and integrated pest management (IPM) technology are not available to the average farmer. The impoverishment of agricultural research institutions will ensure that this situation does not change in the foreseeable future except perhaps in cotton (with French research support for the cotton parastatal SODECOTON) and on large farms growing export crops under the management of foreign firms. Superior pest-management technology, including daily information from Europe facilitating compliance with the European Union's maximum residue levels (MRLs) for pesticides, **gives large, heavily capitalized producers of nontraditional export (NTE) crops a competitive advantage** over small-scale entrepreneurs who may wish to enter the market.

More than 80 percent of pesticides used in Cameroon are applied to cash crops. Information on crop losses is not readily accessible, but pest damage was considered severe enough to justify extensive pesticide **subsidies for farmers growing cocoa, coffee, cotton, and other industrial crops**. At their peak in 1984, subsidies covered 96 percent of total pesticide market volume. Subsequent **pesticide donations** to Cameroon from the Islamic Bank for Development and from Japan contributed to the subsidy system.

Subsidies helped cocoa and coffee dominate the pesticide market until 1989, when declining world market prices for those commodities left Cameroonian agricultural support institutions bankrupt and led farmers to abandon or uproot plantations. **The agricultural sector has been depressed** since then, and the **pesticide market shrank** from \$44 million in 1986 to \$13.4 million in 1992. Banana and cotton pesticides, particularly insecticides, now dominate the market. Substantial market expansion for those crops appears unlikely: European agencies regulate banana exports; and, although the SODECOTON credit system requires farmers to pay for fixed amounts of pesticide inputs distributed in kind, a program to reduce the use of pesticides is shrinking the value of insecticides applied to cotton. The grim commercial outlook, **inadequate public and private investment in agriculture, and government involvement in pesticide procurement and distribution have prevented private pesticide dealers from expanding their marketing operations**. It is not clear how this lack of distribution capability will be resolved if demand for pesticides increases again.

Legislation and regulations governing the safety and management of pesticides exist in Cameroon, and a short-term donor project is helping the pesticide registration system to become operational. Donors and nongovernmental organizations (NGOs) are also supporting the development of a national environmental action plan (NEAP) that, if implemented, could improve the management of pesticides through pollution monitoring and mitigation. Despite these efforts, Cameroon does not have the expertise or resources to enforce pesticide or environmental regulations effectively. Therefore, **pesticide marketing and use are not under effective control in Cameroon**.

Pesticide-related health impacts and pollution have never been investigated in Cameroon. Much of Cameroonian pesticide use is undoubtedly dangerous in view of pesticide misuse, hazardous and substandard chemicals, smuggling of illicit products, and lack of regulation.

Donor policies affect pesticide use indirectly. Except for the short-term pesticide registration project, there are no donor-funded pest or pesticide management projects in Cameroon. Donors are **supporting the cultivation of plantation and parastatal-managed crops such as coffee, cocoa, and cotton, and nontraditional export crops such as vegetables.** That support can be expected to increase the demand for pesticides for the crops in question. Donors are also **promoting the privatization of parastatals and the establishment of free markets in agricultural inputs, leading to the abolition of input subsidies.** Nonetheless, the **outlook for government implementation of those policies is still uncertain.** In addition, the government and donors are considering programs to **make more credit available** to smallholder farmers for buying inputs. The recent donor-supported liberalization of cooperatives may facilitate input availability.

If alternatives and appropriate extension training were available to them, farmers paying full market price for pesticides might be motivated to eliminate unnecessary applications and be receptive to alternative approaches to pest management, including IPM. **Alternative crop protection technologies are not available, so measures that increase credit availability and access to pesticides can be expected to increase pesticide use.**

The Cameroonian currency was devalued by 50 percent in January 1994. The devaluation doubled the prices received for exports as well as the prices of imported goods such as pesticides. These price changes should stimulate the production of export- and import-substitution crops. A subsequent increase in the world market prices for cocoa and coffee will make those crops even more attractive. **Even though higher prices for pesticides could act as an incentive to reduce use, the absence of alternative crop protection options means that pesticide use on coffee, cocoa, maize (an import substitution crop), and vegetables may grow in the near future.** This can be expected to increase pesticide-related health and environmental problems: acute and chronic poisoning of pesticide applicators and food consumers, water pollution, harmful effects on nontarget species, and ozone depletion.

Agricultural trade and policy measures should be taken to rationalize pesticide use, mitigate health and environmental hazards of pesticides, develop alternative crop protection technologies, and encourage farmers to reduce their use of pesticides. Such measures include: **donor support for research and extension on IPM and organic farming and for the enforcement of pesticide and environmental regulations; compliance with international environmental conventions;** a phased program of **rapid subsidy removal**, including through the privatization of agricultural input markets and by ending nonemergency donations of pesticides from foreign countries; and **delinking credit provision and pesticide use.** In addition, donors should **monitor the beneficiaries of their NTE crop projects.** If benefits accrue mostly to a few large-scale, wealthy producers due to their superior access to IPM and other relevant management resources, donors should invest in more appropriate development initiatives.

I. Introduction

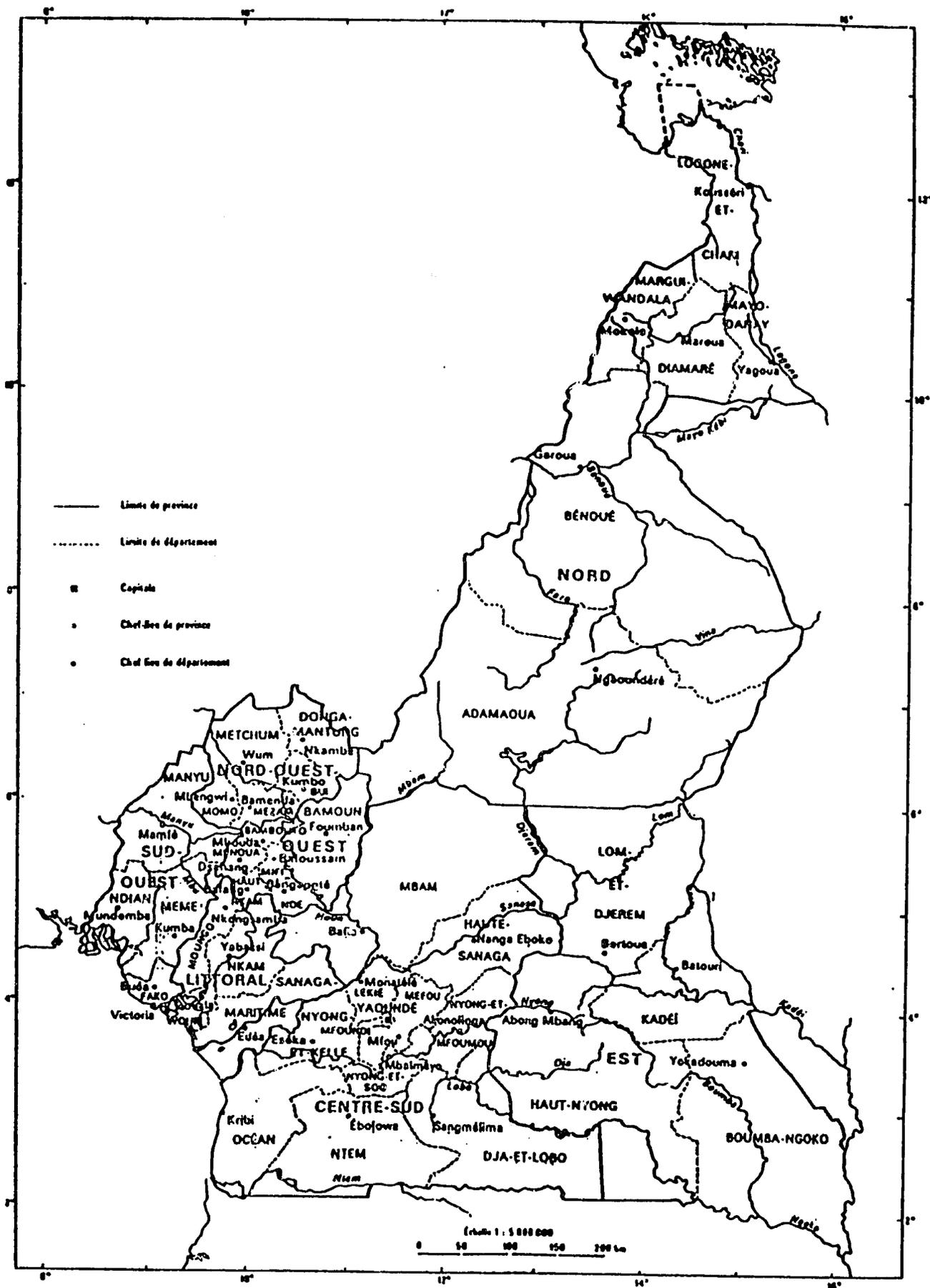
This is one of three country studies that examine the policies of governments, international lending agencies, and donors that affect pesticide use on crops intended for export (Meltzer, Matteson, and Knausenberger 1994; Matteson and Meltzer 1994). The objective is to assess the indirect impacts of those policies on the environment, on public health, and on the likelihood of increased reliance on IPM. Policy recommendations follow from the findings.

The policy impacts projected for Cameroon in this report are tentative in that they are based on limited information and on conditions that can change unpredictably. Economic reforms are in progress now, and their pace and extent are still uncertain. Both the political and the economic situation (particularly prices of export commodities) are volatile. Further political deterioration, even civil war, could usher in a prolonged hiatus in development.

The crop regimes studied were chosen as a function of their importance, the amount of pesticides applied to them, the availability of data, and opportunities for comparison among countries. Crops considered herein are the traditional Cameroonian export crops, namely coffee, cocoa, cotton, maize (usually imported to Cameroon but exported from other countries studied), and the NTE crops bananas and vegetables. The private sector is developing NTE crops, with considerable donor support in the case of vegetables.

The authors spent two weeks in Cameroon in February and March 1994 conducting interviews, collecting documents, and making field visits in Yaoundé, West Province (Bafoussam, Foubot), and Douala. See Figure 1. Appendix A contains a list of persons contacted in Cameroon.

Unfortunately, most of the documents assembled during the field visit were misrouted during shipment and were unavailable while this report was being drafted. This document is thus largely based on qualitative information derived from interviews. Sometimes only broad generalizations can be made about topics concerning which quantitative data would have been desirable, particularly information about trends in pesticide use over time. Recent reports by Heurreux, Kone, and Walla (1992), and Szmedra (1994), however, provided valuable economic data.



Administrative Divisions of Cameroon
(from Laclavere 1979)

II. Prereform Pest and Pesticide Management in Cameroon

A. Pest Problems and Pest Management

1. Patterns of Pesticide Use

a. Cash and Food Crops

Some information exists on crop losses to pests in Cameroon, but it is incomplete, out of date, and scattered in the gray literature (P. Mbondji-Mbondji, personal communication, 1994). More than 80 percent of pesticides used in Cameroon are applied to cash crops, and pest damage was considered severe enough to justify extensive pesticide subsidies for farmers. Some organisms were declared "national pests" and have been the target of subsidized control campaigns: cocoa capsid bugs; cocoa black pod disease; coffee berry disease (anthracnose); *Antestia* bugs on coffee; coffee berry borer beetles; and migrant pests such as locusts and grain-eating birds (Ekotto Eboa et al. 1989).

Until 1989, consumption of pesticides in cocoa and coffee was substantial. Some farmers used herbicides for weed control. The cocoa industry was the major user of pesticides, with all inputs provided free of charge to growers. Ekotto Eboa et al. (1989) estimated pesticide consumption by crop to be divided as follows:

Cocoa	40%
Coffee	25%
Cotton	15%
Rubber, bananas, oil palms	15%
Migrant pests and food crops	5%

Demand for cocoa pesticides plummeted almost to zero, however, during 1991 and 1992. This was due mostly to the abrupt elimination of all subsidies and crop payments to growers, which was a result of low world market prices and the bankruptcy of state cocoa support institutions. While the elimination of subsidies on agricultural inputs did not affect coffee as much as it did cocoa, sales of pesticides for coffee also decreased substantially (Heureux, Kone, and Walla 1992). Until January 1994, coffee and cocoa prices were so depressed that plantations had been abandoned or even uprooted.

By 1991, Cameroonian pesticide market volume had shrunk greatly from previous levels. Gross sales for the ten largest importers and distributors declined from \$44 million in 1986 to \$16.8 million in 1991 and \$13.4 million in 1992 (Heureux, Kone, and Walla 1992; Szmedra 1994). The number of importers and distributors had declined to seven by 1994 (M. Chardet, personal communication, 1994). Market shares of the different types of pesticides were also altered. Fungicides accounted for 38 percent of the Cameroonian pesticide market, with insecticides constituting 47 percent in 1989. By 1991, insecticides, applied mainly to cotton and bananas, accounted for 55 percent of gross pesticide sales. Herbicides used on plantation crops

including maize accounted for 30 percent, and fungicides were about 14 percent. Table 1 shows the respective shares of treated crops in Cameroon's 1991 pesticide market.

Table 1. Cameroon's Use of Pesticides, by Crop and Type of Pesticide, 1991

Crop	Type of Pesticide	Percent of Market
Banana	Insecticide/Nematicide:Herbicide: Fungicide, 8:2:3*	30.9
Cotton	Insecticide:Herbicide, 11:1	28.5
Food Crops (mainly maize and vegetables)	Insecticide:Herbicide:Fungicide, 1:2:3	14.3
Coffee	Insecticide:Herbicide, 1:4	11.9
Oil Palm and Rubber	Herbicide	4.8
Sugar Cane	Herbicide	4.8
Cocoa		0.0
Miscellaneous (seed treatment, storage, wood preservatives)	Insecticide	4.8

Source: Modified from Exhibit 4 in Heureux, Kone, and Walla 1992.

* These numbers are ratios of the amounts of each type of pesticide used on the crop in question.

The value of pesticides purchased for banana production grew an estimated 50 percent between 1981 and 1992, but pesticide use on cotton is declining due to a program to reduce use (Box 1). A 1992 study of Cameroonian crop protection technology had to change its focus to cash crops from maize and other cereals because of the low demand for pesticides on cereals (Heureux, Kone, and Walla 1992). Herbicides are used in maize plantations, however, and insecticides are occasionally applied for maize borer control (P. Mbondji-Mbondji, personal communication, 1994).

Box 1. Edging Toward IPM for Cotton

In Francophone Africa it is normal for ultralow volume (ULV) pyrethroid/ organophosphorous insecticide mixtures to be applied to cotton on a calendar basis three to six times each season at a rate of one to three litres/ha. Recently, however, SODECOTON in Cameroon and similar parastatals in Chad and Senegal have been extending programs to reduce the use of insecticides for cotton to farmers. The International Cooperation Center for Agricultural Research for Development (CIRAD) in Montpellier, France, is providing technical guidance.

Water-based very low volume (WVLV) spraying of relatively inexpensive emulsifiable concentrate (EC) insecticide formulations at 10 litres/ha is replacing expensive ULV applications. WVLV gives better plant coverage, can be used with a wider range of insecticides (allowing a wider variety of combinations and greater insecticide specificity), and facilitates adjustment of dosages. In 1993, 35 percent of Cameroon's cotton crop came under an insecticide regime called "stage-and-target protection" (STP). Under STP, half the normal WVLV insecticide dose is applied on a calendar schedule and the complementary portion of the dose is added only when pre-application field checking finds that target pest numbers have exceeded a "threshold." (This program should not be confused with the IPM practice of using economic threshold levels to decide whether pesticides need to be applied at all.)

"Dose-frequency" spraying, a second method to reduce the use of insecticide, was used on 20 percent of Cameroonian cotton and all the area under cotton in Chad in 1993. Under this labor-intensive regime, twice as many spraying operations are carried out on a calendar basis but at only a third of the normal dose per application, for an overall insecticide savings of one-third.

These reduction methods have provided good pest control using 30–50 percent less insecticide at a great cost savings. Research is proceeding on host plant resistance, cultural pest control approaches, microbial insecticides, and protecting and augmenting cotton pests' complex of natural enemies. Researchers envision progress toward an even less pesticide-dependent crop protection system that can employ economic threshold levels for making decisions about insecticide application in regions where the endocarpal bollworms *Pectinophora gossypiella* and *Cryptophlebia leucotreta* are not a problem. Farmers are reportedly reluctant to collect green bolls for assessing infestations of these bollworms, a field-checking technique thought to be necessary for decision making about economic thresholds.

Sources: Ekukole 1992; Cauquil and Vaissayre 1993; Cauquil 1994.

Small-scale farmers' use of pesticides depends on location and the crops grown. A survey published in 1990 indicated that 47 percent of 426 Cameroonian farmers used pesticides, with use rates highest in the South and West Provinces (64 and 58 percent, respectively) and lowest in the North West Province (25 percent). Another survey reported in 1990 that 77 percent of 172 coffee growers in West Province used insecticides, 65 percent used fungicides, and 28 percent used herbicides. The survey reports cited shortages, late delivery, lack of credit facilities, and distance from selling points as the main constraints to pesticide use (Minot 1991). Agricultural credit is practically nonexistent at the farm level except through the cotton parastatal SODECOTON, through some cocoa buyers in the South West Province, and in Anglophone areas where the credit union movement has been successful (Heureux, Kone, and Walla 1992).

Cameroon's only sprayer manufacturer has discontinued operations, and the lack of spare parts is a major problem except where SODECOTON has standardized the spraying equipment

that farmers use (Heureux, Kone, and Walla 1992). Equipment available includes hand dusters (for locusts) and hand-operated knapsack sprayers; fogging machines; motorized sprayers; ultralow volume equipment; and mounted micronized spraying equipment (for locust and bird control) (Ekotto Eboa et al. 1989). Government-subsidized sprayers dominated the market (Elliot Berg Associates 1983).

Farmers and extension staff in West Province, a center for vegetable growing, say that maize, yams, squash, and local vegetables (including beans) have few pest problems. French beans and watermelon require some pesticide protection, and pesticides must be used intensively for Irish potatoes, cabbage, and tomatoes. In general, farmers consider diseases to be a more severe vegetable problem than insects are. Nematodes chiefly attack bananas, although one grower of French beans in Foubot is encountering increasing nematode problems (A. Dominguez, personal communication, 1994). In areas of intensive market gardening by smallholders, crop rotation is impossible because of land shortages and multiple cropping. Thus farmers generally know of no pest control option other than pesticides. Prophylactic, calendar-based treatments (e.g., fungicide treatments on tomato and potato) are the norm.

Crop protection researchers remark that crop diversification and export promotion programs are outpacing the availability of public information on pest management for vegetables, which were included in government research programs only recently. Research recommendations are still not available from the Ministry of Agriculture's Agricultural Research Institute (IRA) for many vegetable crops. Cosmetic requirements for export vegetables are exacting, and marketed crops are often treated intensively. Small-scale growers serving the domestic market sometimes apply pesticides with watering cans at haphazard dilutions. They confuse high dosages with effectiveness, use the wrong kind of chemicals, and mix "cocktails" of the same product sold under different brand names. Preharvest waiting periods after pesticide application are often ignored so that vegetables can be harvested continually (Ta'Ama 1990; University of Dschang faculty, and S. Oukumi, personal communications, 1994).

In contrast, PROLEG S. A., a large West Province commercial grower of French beans, is managed by a French firm and receives daily information from Paris about its beans' compliance with European MRL standards. Companies like PROLEG can make sure that their produce is in compliance by following strict guidelines for pesticide choice, timing of applications, and waiting periods before harvest (A. Dominguez, personal communication, 1994). Small-scale entrepreneurs who would be competitors of large firms are at a disadvantage because of unequal access to resources, technical support, and training for using pesticides correctly (and for other aspects of export crop and business management). Some donor-funded projects promoting NTE crops recognize this problem and try to "level the playing field" by focusing on small-scale producers and exporters (Matteson and Meltzer 1994).

b. Migratory Pests

Intensive pesticide spraying campaigns against grasshoppers and grain-eating birds are common in the northern region of Cameroon. The government's Aerial Treatment Unit

(UTAVA) previously dominated operations. Recently, however, due in part to the high cost of aerial spraying, efforts have been made to shift responsibility to farmers. The campaigns are pesticide-centered, with farmers organized into application teams (*Brigades Villageoises*) that work closely with government agencies and UTAVA. During a heavy pest outbreak in 1992, farmer applications covered 83 percent of the total area treated (Adesina 1994).

c. Vectors of Human and Animal Diseases

Pesticide use in Cameroon's public health and veterinary vector control programs has decreased sharply. The chief constraint has been expense, but environmental concerns may also have influenced decisions. Large-scale antimosquito treatments are a thing of the past. Mosquitoes are being controlled through habitat elimination and targeted measures such as the insecticide-impregnated bed nets that the United Nations Children's Fund is sponsoring in Douala. Human medication with the drug Ivermectin is now preferred over spraying rivers with insecticides for the control of onchocerciasis.

Pesticides have been used during the past decade to control tsetse flies, the vectors of trypanosomiasis, which invaded the northern part of the Adamaoua plateau in the late 1970s. The German Agency for Technical Cooperation (GTZ), and subsequently the Cameroon government, funded aerial spraying campaigns. The last campaign, funded under a World Bank-supported project, took place during January and February 1994. No more spraying campaigns are planned because current monitoring indicates that the aim has been achieved. Traps and screens used by herders are replacing aerial insecticide treatments for tsetse control, and have been effective so far in containing the flies outside the livestock rearing areas (D. Sibetcheu, N. Chabeuf, and T. Nkodo, personal communications, 1994).

Tick control, a major concern of herders, is increasingly achieved through the private use of "pour-on" pyrethroid acaricide formulations. These formulations are also effective against tsetse flies (N. Chabeuf and T. Nkodo, personal communication, 1994).

2. Status of Alternative Pest Management Approaches

Cameroonians remain dependent on pesticides for to manage agricultural pests. Research and development programs have not yet addressed two alternative approaches to pest control, organic farming and IPM, adequately. This situation is unlikely to change soon.

a. Organic Crop Production

The European market for foods grown organically (without agrichemicals) is already significant, and a few African farmers have begun to respond (Meltzer, Matteson, and Knausenberger 1994; Matteson and Meltzer 1994). Nonetheless, organic crop production is receiving almost no attention in Cameroon. Researchers at the University of Dschang knew of only one organic agriculture project, organized by a foreign volunteer in South Province. Farmers' groups there are producing organically grown fruit for the Italian market. In the West Province's

vegetable production region, the International Circle for Promoting Creation (CIPCRE), a West African nongovernmental organization (NGO), expressed interest in organizing organic farming groups but has so far not identified a market.

b. Integrated Pest Management

IPM safeguards human health and the environment by minimizing pesticide use. Emphasis is placed on growing a healthy crop in such a way that pest infestation is minimized. Nonchemical pest control measures are preferred, with the application of least-toxic pesticides reserved as a last resort to avert significant economic damage. Research priorities for developing IPM systems include the selection of pest-resistant crop cultivars (host plant resistance, or HPR), cropping practices that avoid pest problems, and the encouragement and augmentation of natural enemies that keep pests under control most of the time (biological control). Determination of the level of pest infestation at which pesticide application becomes profitable (the economic threshold level) helps avoid unprofitable treatments.

High-quality extension education is a necessary complement to research on IPM. Participatory field training to fill the gaps in farmers' knowledge about pest biology and ecology can equip them to manage field pests with confidence. Regular field scouting and need-based pesticide use can then replace routine pesticide applications. Farmers lacking correct information are not equipped to use pesticides rationally even when incentives to do so are strong (e.g., rising pesticide prices).

No IPM systems are in place for Cameroonian crops, though the management of cotton pests is evolving in that direction and insecticide use in cotton is decreasing as a result (Box 1). Crop protection still centers on routine pesticide applications, especially for disease control. The IRA once assessed crop losses with major pests of coffee and cocoa and established economic threshold levels for *Antestia* bugs and cocoa capsids, but these economic threshold levels are now out of date.

c. Research Capacity

Cameroon's agricultural research and development establishment is committed in principle to IPM but is disorganized and bereft of resources. The country has been in economic decline for almost a decade. The present severe economic crisis and high government deficit have resulted in inadequate public and private investment in agriculture, including research.

The government is unable to pay staff salaries or recurrent costs at the IRA and the University of Dschang, the two major institutions in what was once considered the most developed national agricultural research system in West and Central Africa (USAID 1993). Their programs are largely defunct except for a few, generally short-term, donor-funded activities (FAO 1993c). There is little prioritization or coordination of research either within the IRA or between the IRA and the university, perhaps because diverse donor agendas are defining programs. Topics chosen

for investigation often have little reference to local needs and resources, and neglect of economic evaluation has produced some ill-adapted recommendations (Roche 1993).

Until recently, agricultural research was confined to industrial crops such as coffee, cocoa, cotton, oil palm, rubber, and bananas (Etono 1993). Currently, emphasis has shifted to food crops, especially grain legumes, cereals, roots and tubers, and horticultural crops. This shift is consistent with a policy of national food self-sufficiency (Ekotto Eboa et al. 1989; Roche 1993).

Testing pesticide efficacy for registration was once a major activity of the IRA, but funding from companies for that purpose has sunk to about 20 percent of previous levels. IPM and biological control are major new research themes. Work in those areas has been confined to biological control for cassava mealybug, in collaboration with the International Institute of Tropical Agriculture (IITA), and agronomic aspects of pest management, investigated under cooperative varietal selection programs with International Agricultural Research Institutes such as IITA and the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) (P. Mbondji-Mbondji, personal communication, 1994).

The University of Dschang houses the Organization of African Unity's African Crop Protection Research and Training Center (CARFOP) and possesses a multidisciplinary team of crop protection specialists, who are working on cowpeas and beans. Virologists are participating in an IITA program to develop antisera for the identification of cowpea viruses. Mycologists are investigating the disease resistance of cowpea cultivars at various altitudes of cultivation. Entomologists are studying varietal resistance to insect pests and starting experiments to assess crop losses (the first Cameroonian study of the economics of protecting vegetable crops). The university also has a nematologist. Nevertheless, research activity is at a minimum for lack of resources; even the teaching program may have to be terminated (CARFOP scientists, personal communication, 1994).

The U.S. Agency for International Development (USAID) will close its Cameroon mission in 1995, and other donors have reduced or terminated selected aid activities (USAID 1993). New commitments for research support are unlikely to be made until the Food and Agriculture Organization (FAO) and the World Bank complete a restructuring of agricultural research in Cameroon (FAO 1993c). Thus significant progress in pest and pesticide management research cannot be expected for some years.

B. Procurement, Distribution, and Marketing of Pesticides

Agrichemical companies or industrial plantations import almost all pesticides used in Cameroon. Companies in the European Union (EU), notably France, are the most important suppliers (Heureux, Kone, and Walla 1992; Pierrard 1993).

Until recently, government parastatals purchased most pesticides and distributed them to farmers, often at a highly subsidized price. With the exception of the northern cotton area and some vegetable, cocoa, and coffee farmers in the West, cocoa and coffee farmers were given

inputs gratis, and the coffee and cocoa parastatal SODECAO treated against cocoa capsids free of charge. Farmers also used free and subsidized pesticides and fertilizers on other crops (e.g., vegetables). At the high point of pesticide subsidies in 1984, 96 percent of total national pesticide demand by volume was subsidized. This was reduced to 65 percent in 1988/89 and to 5.5 percent by 1989/90, due to lack of government funds. Officially, pesticide subsidies are being reduced stepwise toward elimination by 1995 (Heureux, Kone, and Walla 1992; Crop Protection Service (CPS) staff, personal communication, 1994).

The Islamic Bank for Development donated over 12,000 litres of locust control pesticides (lambda-cyhalothrin, deltamethrin and fenitrothion) to Cameroon in 1989, which were distributed gratis. From 1990 to 1992, Japan donated approximately \$4.8 million worth of pesticides for food crops under its program of Grant Aid for Increased Food Production, which the Japan International Cooperation Agency (JICA) administers (Table 2). The JICA chemicals are being sold by the CPS at slightly over cost price, much less than their price on the open market. JICA's pesticide donations to Cameroon have reportedly been discontinued at the request of other donors (S. Njomgue and W. Roeder, personal communications, 1994).

By March 1994, lack of demand due to severe depression of Cameroon's agricultural sector had left provincial CPS warehouses full of unused pesticides, many of them from JICA shipments. Cocoa pesticides could not be given away: any farmer who will pay for fuel and help with spraying water and labor can have the chemicals free, along with use of sprayers and supervisory support. Cocoa and coffee cultivation have been so unprofitable that there were few takers (CPS staff, personal communication, 1994).

SODECOTON claims to have phased out pesticide subsidies, but it continues to buy and distribute agricultural inputs (it is unclear whether prices paid by farmers cover distribution expenses). Insecticides are distributed in kind to village associations at the beginning of the growing season, and this represents a form of subsidy that can fuel demand. Quantities correspond to the crop area to be protected, and the associations must repay their cost (not just the cost of insecticide actually applied) out of proceeds from seed cotton. Because of this system, farmers sometimes sell insecticide in neighboring countries, overdose, or make more applications than they otherwise would (Cauquil and Vaissayre 1993).

SODECOTON imports its own cotton insecticides on a tender basis. According to a SODECOTON report, imported pesticides are 15–25 percent cheaper than the same chemical purchased from local sources (Cauquil and Vaissayre 1993). Similarly, banana plantations import 60 percent of their pesticide requirements directly, reportedly at half of local prices.

Private-sector importers and distributors have a small share of the domestic market. Three companies have formed the Central African Crop Protection Union (UPAC) of pesticide importers and distributors. The union considers inadequate applicator safety precautions to be one of Cameroon's worst pesticide management problems and is interested in providing information and training, perhaps through the creation of a pesticide toxicology and first aid center (M. Chardet, personal communication, 1994).

Table 2. Pesticides Donated to Cameroon with Japanese Grant Aid, 1990-92.

Item	Herbicides	Fungicides
fenitrothion 50 EC (29,979 l)	atrazine* + metolachlor (Primextra 500 FW) (60,935 l)	copper + metalaxyl (Ridomil plus 720 WP) (25,000 kg)
pirimiphos-methyl (Actellic 2%, 50 EC) (2,441 kg, 4,000 l)	glyphosate (Roundup 360 g/l) (7,000 l)	benomyl 50 WP* (10,000 kg)
isoprocarb (Mipcin 75 WP) (3,000 kg)	glufosinate-ammonium (Basta 200 g/l) (4,000 l)	
cyhalothrin (4,000 l)		
malathion 50 EC (5,000 l)		
oxamyl (Vydate 240 g/l) (6,865 l)		
profenofos 500 EC (3,840 l)		
propoxur 2D (7000 kg)		

Sources: Adesina 1994; S. Njomgue, Crop Protection Service, personal communication, 1994.

* Pesticides in special review or restricted by the U.S. Environmental Protection Agency for health or environmental reasons (see Appendix B).

The grim commercial outlook, inadequate public and private investment in agriculture, and government procurement and distribution of pesticides have prevented pesticide dealers from expanding their marketing operations even though government involvement in pesticide input provision is supposed to end (see §IV.D.). It is not clear how this lack of capability to distribute pesticides will be resolved in the event of a surge in demand for pesticides (Heureux, Kone, and Walla 1992).

There is a parallel market in outdated or substandard pesticides, often unrecommended or counterfeit formulations, which are imported illegally from neighboring countries at attractive prices. Presumably farmers who do not have access to subsidized supplies purchase these chemicals (Ta'Ama 1990; Cauquil and Vaissayre 1993; Etono 1993).

The Cameroonian government previously exempted farmer-imported pesticides from customs taxes and other duties (Ekotto Eboa et al. 1989). Import duties and complementary taxes on the various categories of pesticides were to have been readjusted in January 1994 in accordance with new guidelines to be adopted by the Customs and Economic Union of the Central African States (UDEAC) (Heureux, Kone, and Walla 1992).

Two pesticide formulation plants have closed because they did not obtain an "in bond" industrial status for exporting to other central African countries and because of an adverse customs tariff penalizing them on the domestic market. There is one domestic plant that repackages agricultural pesticides imported in large containers by ROUSSEL UCLAF (Heureux, Kone, and Walla 1992).

C. Cameroon's Ability to Regulate and Monitor Pesticide Use

1. Agricultural Extension

Cameroon has a patchwork of agricultural extension services at the moment. The government's Training and Visit (T & V) Extension System, instituted with World Bank funding in 1988, covers seven provinces and may be expanded. Two cooperative unions, the Central Agricultural Cooperative Union of the Western Province (UCCAO) and the North West Cooperative Association, provide some advisory services to growers of arabica coffee and help them diversify into food and horticultural crops. SODECOTON handles cotton rotation crops (cotton, maize, millet, groundnuts, and sorghum) in the three northern provinces—Extreme North, North, and Adamoua. SODECAO has been advising cocoa farmers in Center and South Provinces, as well as in the Sanaga Maritime Department of the Littoral Province. SODECAO's World Bank funding ends in 1995, and T & V extension may replace its farmer advisory service. Areas not served by these institutions fall under the "traditional" government extension system, which focuses on cocoa and coffee and has no operating budget now.

SODECOTON is reducing its extension staff and promoting farmer-to-farmer extension. Staff members of the Crop Protection Service (Ministry of Agriculture) in SODECAO areas are training and equipping farmer groups to do their own pesticide spraying in anticipation of next year's cutoff of subsidized chemicals and free pesticide applications (Heureux, Kone, and Walla 1992; E. Mezazem and S. Njomgue, personal communications, 1994).

No information was available about the quality of the various extension services. Crop protection extension, including pesticide-related training and IPM in particular, can be assumed to be a formidable challenge. The previous emphasis on free pesticide treatments by trained government teams made training on pesticide safety and application for farmers a secondary

concern. The IRA has never released extension recommendations for the management of pests associated with coffee and cocoa, nor any for some of the vegetable crops usually treated with pesticides. Composting is the main theme of extension staff in the West Province's vegetable growing area. Extension officers have no recommendations for meeting European MRL standards. The CPS recommends pesticides with short preharvest intervals in order to minimize potential residue problems (P. Mbondji-Mbondji, S. Njomgue, and West Province Ministry of Agriculture staff, personal communications, 1994).

Pesticide importers and distributors are another possible source of pesticide-related training for farmers. Interest is growing in coordinating technology development and transfer with the private sector and in strengthening farmers' associations that may hire their own extension staff (Abt Associates 1992; Schwartz 1992). At present, chemical dealers' farmer training in Cameroon is limited to sales promotion (M. Chardet, personal communication, 1994).

2. Pesticide Legislation and Regulations and Their Enforcement

A "Pesticide Law" No. 90/013 of August 10, 1990, was followed by an application Order No. 92/223/pm, which was broadcast on Cameroon radio on May 25, 1992 (Heureux, Kone, and Walla 1992). The order conforms with the *International Code of Conduct on the Distribution and Use of Pesticides*, an important reference point for pesticide regulation, which was adopted unanimously at an FAO conference in 1985. The order established a National Pesticide Registration Commission and the guidelines by which pesticides can be registered for import and use. The order also governs packaging, storage, and distribution (Lynch 1993, cited in Szmedra 1994). Cameroon has signed the international Prior Informed Consent agreement, under which governments can register a refusal to allow the import of certain particularly hazardous pesticides (S. Njomgue, personal communication, 1994).

An earlier order, No. 0002/MINAGRI/DIRAGRI/SDPV of January 17, 1989, had prohibited the importation and use of any pesticide formulation of nine active ingredients: captafol, dinoseb, dinoseb acetate, binapacryl, cyhexatin, dieldrin, aldrin, heptachlor, and 2-4-5 TCP. Large government-owned plantations can waive these restrictions and import banned pesticides (Szmedra 1994).

Two chemicals are unofficially restricted through agreements with chemical companies. Aldicarb (Temik) and ebufos (Ruby), insecticides/nematicides used in banana plantations, are applied only by specially trained company employees and cannot be sold on the open market. Those chemicals require special application tools that deliver an exact dose (CPS 1994; S. Njomgue, personal communication, 1994).

The Pesticide Registration Commission has not started work yet, although about 200 application dossiers had been submitted by March 1994. The Commission first met in early March 1994 in the context of a workshop for practicing dossier screening and registration decision making. The workshop was organized by an FAO project, "Support for the Implementation of the International Code of Conduct," the main goal of which is to make the Registration Committee

functional (FAO 1993a). The Commission is to produce a list of registered pesticides as well as lists of banned and restricted ones. Cooperation with health and veterinary ministries has not been secured and the current registration program covers only pesticides for application to crops.

Registration applicants must pay for several years of testing within Cameroon. The IRA conducts two to three years of dose/efficacy trials. Pesticides that meet efficacy standards and that are not banned in the country of origin then undergo one to two years of wider-scale research and extension field testing for phytotoxicity and hazard to applicators. Health and environmental information from other countries will be considered during the registration decision-making process (P. Mbondji-Mbondji, S. Njomgue, and G. Pierrard, personal communications, 1994).

Pesticide marketing and use are not under effective control in Cameroon now. Crop Protection Inspectors must be trained to man points of entry and for attachment to provincial Crop Protection Service (Ministry of Agriculture) centers. The Crop Protection Service is requesting further donor assistance for this purpose (G. Pierrard and S. Njomgue, personal communications, 1994). Pesticide laboratory services are another pesticide management requirement that is lacking. Cameroon has no functional pesticide laboratories for quality control or residues. Currently, samples are sent for analysis to Europe or the United States, usually to CIRAD. As a result of this lack of regulation, farmers often purchase ineffective, adulterated, or fraudulent pesticides on the open market (Heureux, Kone, and Walla 1992; V. Balinga, Ministry of Agriculture staff, J. N. Ngatchou and University of Dschang staff, personal communications, 1994).

A regional Pesticide Management Network for West Africa was established in 1989. The objectives of the network include the exchange of information of mutual interest and regional cooperation for registration, pesticide quality control, and training (Adesina 1994).

3. Pesticide Disposal

There are no facilities in Cameroon for the disposal of pesticide containers or obsolete pesticides. Used pesticide containers, from drums to small plastic bottles, are widely sold for household and farm storage, including for food and drinking water (Ekotto Eboa et al. 1989). Obsolete pesticide stocks are of special concern in tropical countries where heat hastens deterioration and improper storage practices and inadequate storage facilities are common (Jensen 1991, Pierrard 1993). Major improvements are needed in some Cameroonian storehouses to ensure human and environmental safety (Ekotto Eboa et al. 1989).

The UPAC considers obsolescence to be one of Cameroon's most pressing pesticide management problems. The organization is proposing a review of old stocks and a search for means of disposal. Where possible, old stocks are being reconditioned and ways are being studied to use some of them under the best possible conditions (Pierrard 1993; M. Chardet, personal communication, 1994).

D. Health and Environmental Impacts

Hazardous pesticides have been used in Cameroon for many years. Like most African countries, Cameroon depended on organochlorine insecticides (e.g., DDT, aldrin, dieldrin, lindane) in agriculture and disease control programs for at least three decades. For example, in the 1950s and 1960s organochlorines were the standard chemicals used against bollworms in cotton (Ekukole 1992). Lindane is still in general agricultural use. Large stocks purchased by the government for *Antestia* control on coffee in 1988/89 remain in government warehouses. Organochlorine insecticides bioaccumulate, and the carcinogenic, reproductive, and other chronic effects associated with a high body burden of these chemicals are of concern with reference to humans as well as to wildlife.

Methyl bromide, a fumigant for killing fungi, insects, and other pests in soil, perishable agricultural produce, and stored commodities, is used in Cameroon. It is a highly toxic acute poison and also depletes the ozone layer. This chemical is thought to be responsible for approximately 10 percent of global ozone losses, which have reached alarming levels in many parts of the world. The resulting increased levels of UV-B radiation are expected to harm human health and natural ecosystems (Schonfield, Wamukonya, and Glendening 1994).

Many of the pesticides widely used now in Cameroon with the Ministry of Agriculture's approval have been canceled or designated as restricted-use chemicals in the United States because of health or environmental hazards. Appendix B summarizes hazards presented by pesticides applied in bananas, cotton, maize, vegetables, coffee, and cocoa. Much of the pesticide use in Cameroon is undoubtedly dangerous in view of the pesticide misuse, hazardous and substandard chemicals, smuggling of illicit products, and lack of regulation described above.

Recent aerial applications of pesticides for tsetse control, however, appear to have been an exception (see §II.A.1). The chemicals used were chosen according to international standards regarding environmental safety. Impacts on micro- and macrofauna were monitored in collaboration with the University of Göttingen, Germany (N. Chabeuf and T. Nkodo, personal communication, 1994).

According to the 1981–90 Technical Consultant and Study Officer for Cameroon's National Committee for Man and the Biosphere, pesticide pollution was never monitored in Cameroon (except for the recent antitsetse campaign) even when pesticide use was at its zenith. The public health impacts of pesticide use in Cameroon are also unknown. No records of accidental pesticide poisonings have been kept (Pierrard 1993). Neither food nor mother's milk has been sampled for residues. The single pesticide-related health initiative at the moment is a proposed Ministry of Public Health investigation of residues in fish resulting from the common practice of fishing with pesticides (D. Sibetchu, personal communication, 1994).

The recently created Department of Environment and Forests is responsible for environmental oversight now (Pierrard 1993). That agency and environmental NGOs have more pressing concerns than pesticide pollution, especially now that pesticide use has declined. Burning heaps

of garbage dot urban areas, and urban water supplies are unsafe. Northern Cameroon is experiencing desertification and soil degradation. Donors are focusing their environmental programs on wildlife and biodiversity, especially in Cameroon's dwindling forests. Thus it is not surprising that citizens are not well informed about the potential dangers of pesticides. Even if they were, their poverty leaves them with few choices and many greater worries (A. Youmbi, personal communication, 1994). Environmental researchers and other informants volunteered the remark that the authors were the first consultants ever to ask about this topic.

Another problem is that Cameroon does not possess expertise or facilities for environmental monitoring. There are several chemistry laboratories (e.g., at the University of Yaoundé's Faculty of Science and the Centre Pasteur), but they need new equipment and have no budget to cover recurrent costs (V. Balinga and J. N. Ngatchou, personal communications, 1994).

III. Pesticide-related Donor Policies

Donor policies, including environmental policy, influence patterns of pesticide use and thus pesticide impacts on public health and the environment. In 1992, USAID commissioned an overview study of Cameroon's agricultural sector to identify sectoral constraints as well as opportunities for USAID policy support (Shapiro, Tollens, and Wyeth 1992). A donor-supported Agriculture Sector Adjustment Program embodies many policies and policy reforms that will affect pesticide use in Cameroon (see also §IV) (World Bank 1993, Amegbeto 1994).

Except for the aforementioned short-term FAO pesticide registration project, there are currently no donor-funded crop protection, IPM, or pesticide management projects in Cameroon (J. McMahan and W. Roider, personal communications, 1994). Therefore, donor policies affect pesticide use indirectly—for instance, through the promotion of certain crops.

A. Crop Promotion

Crops promoted by government and donor programs are likely to be cultivated more widely or intensively or both. Unless farmers implement IPM, organic farming, or other systems to reduce the use of pesticides, demand for the pesticides customarily used in these crops can be expected to increase. There are, however, no readily available data to indicate whether such an increase has occurred.

1. Plantation and Parastatal-supported Crops

European donors, particularly France, are providing technical assistance and other forms of support to most of the crop-centered parastatals such as SODECOTON, SODECAO, and the rice, rubber, and oil palm parastatals. For instance, the Caisse Française de Développement (French Development Fund) is supporting the rehabilitation of cocoa and coffee (CIRAD 1993), and French researchers are guiding SODECOTON's initiative to reduce pesticide use. The EU gave 500 million CFA to SODECOTON's revolving fund for pesticides in 1993. Informants were not aware of any guidelines governing the procurement of pesticides but said that specialist experts choose appropriate chemicals and that parastatals supervise pesticide use closely (M. Tissier and B. Baldwin, personal communications, 1994).

The World Bank funded pesticide subsidies for SODECAO's cocoa starting in the early 1980s. Now, however, the bank supports abolition of subsidies. Cocoa pesticide subsidies have been decreased stepwise, and the last subsidized supplies are currently being exhausted (W. Roider, personal communication, 1994).

2. Nontraditional Export Crops

Donors are supporting government promotion of the diversification of export crops (Government of Cameroon 1993, 1994). The World Bank's Promotion and Diversification of Agricultural Exports Project, implemented by the Canadian company Geomar International, began

pilot activities in 1992. The project's objective is to give commercial, technical, and financial support to producers and exporters of fruit, vegetables, flowers, and spices. A research and development program is investigating new fresh and processed products and testing products on foreign markets. A private professional association, AGROCOM, has been created to promote the economic interests of producers, processors, packaging manufacturers, shippers, distributors, and insurers by networking them for the dissemination of commercial and technical information, collaborative research and development, and lobbying (Geomar International 1993).

The NTE crop sector is not yet well developed in Cameroon. The number and scale of enterprises appear to be increasing slowly. Onions are exported to the Central African Republic, and some tomatoes (2000–5000 tons/year) to Gabon. French beans grown under irrigation for export to Europe are a major cash crop in West Province. Two-year-old PROLEG S.A. in Foubot airships 6 to 12 tons of French beans to Paris daily. The UCCAO has exported vegetables for the last several years, and acreage is growing (Ta'Ama 1990; Ministry of Agriculture staff, and A. Dominguez, personal communications, 1994).

B. Marketing and Input Supply

There is strong support within the donor community for the privatization of parastatals, the liberalization of cooperatives, and the establishment of free markets in inputs and agricultural commodities. For instance, USAID has fielded several agricultural marketing and agribusiness projects during the last decade: the Fertilizer Subsector Reform Program, the Program of Reform of Agricultural Marketing, the Program for Policy Reform in the Export Processing Sector, and the North Cameroon Seed Multiplication Project (Holtzman et al. 1992). USAID also commissioned a study of constraints to food production, processing, and marketing in Cameroon, with a view to strengthening the sector (Nkwain, Ayissi Mballa, and Numfor 1993). Donors are not, however, unanimous on some of the issues. Reforms achieved so far that have a bearing on pesticide use, as well as prospects for further reform, are discussed below.

C. Availability of Credit to Purchase Inputs

A rural credit vacuum has existed since 1986, when the National Rural Development Fund (FONADER) went broke. The government and donors are discussing the possibility of making additional credit available to smallholder farmers for the purchase of agricultural inputs (Government of Cameroon 1994). This appears to be more urgent now that the devaluation of the Cameroonian currency (the Communauté Financière Africaine franc, or CFA) and an increase in world market prices have made the farming of coffee and cocoa attractive. Destitute smallholders need cash to buy the first tranche of inputs for crop rehabilitation and production. Better credit availability would support an earlier and greater revival of demand for coffee and cocoa pesticides. As of March 1994, no new initiatives had been accepted (B. Baldwin, S. Dominic, and M. Tissier, personal communications, 1994).

D. Environment

A broad-based Donor Working Group on the Environment is supporting environmental activities in Cameroon. Soil conservation, biodiversity, agroforestry, and forest management are major themes. USAID supported a national network of environmental NGOs through an umbrella grant administered by CARE International. CIPCRE coordinates a 40-member Federation of Cameroon Environmental NGOs (FONGEC) (USAID 1993; S. Dominic, D. Flaubert, J. McMahon, and W. Roider, personal communications, 1994).

Noting that the poorest people and countries are most often affected by environmental degradation and pollution, the International Development Association (IDA) has a stated commitment to ensure that economic development is complementary to sound environmental management and that potentially adverse environmental impacts from association-financed projects are addressed. Therefore borrowers from the International Development Association are asked to formulate a national environmental action plan (NEAP) in order to set environmental priorities and map investment and other strategies for achieving them (World Bank 1993).

This process is just starting in Cameroon, with the United Nations Development Programme (UNDP) as lead agency. In March 1994, the NEAP Coordinating Committee designated technical working groups that will be responsible for collecting and analyzing information and preparing the NEAP. The formulation process is reasonably inclusive so far, with NGOs represented on the coordinating committee (S. Dominic, S. Gartlan, J. McMahon, W. Roider, and A. Youmbi, personal communications, 1994).

If the NEAP includes monitoring of pesticide pollution, and if it is implemented and enforced, the NEAP could eliminate some hazardous pesticide use and pesticide management patterns. Moreover, an effective NEAP would be economically beneficial by supporting a more rational and efficient use of agricultural inputs. It is important to note, however, that the environment is chiefly a donor priority and that virtually all environmental initiatives are donor-driven and -financed. Interviews with government officers and environmental NGOs make it clear that Cameroonians themselves are preoccupied with, and give precedence to, basic human needs.

IV. Agricultural Trade and Policy Reforms Affecting Pesticide Use

Many recently enacted agricultural, economic, commercial, and environmental reforms will affect pesticide use in Cameroon. Although the donor policies described above have been influential, they do not unilaterally determine the actual course of events. There have been delays in the implementation of policy reforms. Political interference and the shortage of investment capital have derailed efforts to change, liquidate, or privatize public enterprises (USAID 1993).

A. The CFA's Devaluation

The CFA is pegged to the French franc and guaranteed by the Bank of France. It had become overvalued, diverting resources from export crops for which farmers were receiving low prices and supporting commerce in cheap imports that often evade tariff and other barriers. The concentrated use of agricultural inputs was unattractive, favoring extensive, low-input cultivation. Cameroon was losing market share for its major export crops, and their quality was declining (Amegbeto 1994).

The CFA was devalued by 50 percent on January 12, 1994: previously one French franc was worth 50 CFA; now it is worth 100 CFA. Prices received for Cameroonian exports doubled overnight, and imports doubled in price as well. Prices of domestically produced goods, including food, are rising in accordance with this inflation (J. McMahon and W. Roider, personal communications, 1994).

The devaluation can be expected to stimulate production of both export crops and domestically marketed crops because of higher prices (Amegbeto 1994). The price of imported inputs including pesticides will have risen at least as much. For cotton, at least, the outcome appears to be favorable: the higher crop price is expected to more than compensate for dearer imported inputs, raising profit per hectare by 44 percent (Iya 1994). Much depends on how effectively higher output prices are transmitted to farmers and how much increased distribution costs influence retail pesticide prices.

B. Privatization of Parastatals

Cameroon is the recipient of a World Bank loan for structural adjustment of the agricultural sector (World Bank 1993), and the privatization of parastatals is a high-priority condition for World Bank funding. The government is reported to have agreed in principle, but some donors do not support privatization of all parastatals (M. Tissier, personal communication, 1994). The outlook for this policy initiative is uncertain.

Parastatals' purchase, distribution, sale, and extension of agricultural inputs commonly influence patterns of pesticide use. Examples discussed above include implementation of programs for IPM and the reduction of pesticide use, pesticide subsidies in various forms, and credit programs that distribute pesticides in kind to satisfy inflexible pesticide application require-

ments. SODECOTON's program to reduce pesticide use is a salutary initiative, though its pest-management approach retains calendar-based insecticide applications that IPM systems for cotton have discarded elsewhere (Bottrell and Adkisson 1977; Hansen 1987). The subsidy and credit policies are more typical of parastatals. To the extent that they subsidize pesticides, the privatization or dismantling of Cameroonian parastatals should be a positive step toward rationalizing pesticide use.

C. Liberalization of Cooperatives

A donor consortium is funding the restructuring of the cooperative sector. A liberalized Cooperative Law was enacted in November 1992, and in 1993 the implementing decree was promulgated. The new measures liberalize and privatize cooperatives by abolishing geographic monopolies and requiring the return of civil servants from cooperatives to government. Strong government control is being replaced by informal groups that enjoy flexibility with regard to membership, functions, and relationships (USAID 1993; S. Dominic, personal communication, 1994).

Credit and group purchasing offered by revitalized cooperatives may be able to help members afford agricultural inputs including pesticides, thus increasing pesticide consumption. If IPM or organic farming programs existed, these cooperatives could also function as participatory research and training groups helping to develop and implement cheaper and less toxic pest control technology.

D. Free Markets in Inputs

A number of donors are intervening to privatize markets for agricultural inputs. For instance, private-sector provision of agricultural inputs is promoted in areas served by the World Bank's T & V extension system. Since 1988 USAID's Fertilizer Subsector Reform Program has liberalized and privatized the fertilizer market, with all fertilizer subsidies to end in June 1994 (Abbot and Dey 1993, USAID 1993; E. Mezazem, personal communication, 1994). USAID also commissioned a study of agribusiness and public sector collaboration in agricultural technology development and use in Cameroon (Abt Associates 1992).

If alternative pest-management technologies were available and farmers were taught about them, liberalization and privatization of input and commodity markets would favor the rationalization of pesticide use. Farmers who had to pay full market price for pesticides would be motivated to weigh the costs and benefits of pesticides, and might be receptive to cheaper alternatives.

The Ministry of Agriculture has agreed to liberalize and privatize the pesticide sector (Government of Cameroon 1992). It has not yet done so, however, and the devaluation of the CFA has revived support in some quarters for input subsidies to hasten recovery of production of crops for export (Amegbeto 1994). Consequently, the outlook for privatization of the pesticide market is uncertain (FAO 1993b; J. McMahon and W. Roider, personal communications, 1994).

V. Impact of Donor Policies and Reforms on Pesticide Use, the Environment and Public Health

Cameroon's political situation is tense, and further deterioration of the economic and security situation is possible. The pace of economic reforms and structural adjustment is uncertain. International commodity markets are volatile as well. Under these circumstances one cannot make confident predictions about trends in the use of pesticides or their health and environmental consequences. The following is a "best guess" for the short to medium term (five years) based on background information collected for this study and on interviews.

A. Projected Changes in Pesticide Use by Crop

1. Bananas

The pesticide market for bananas has been growing slowly, but the level of banana production and export depends greatly on the EU's import policies for Associated Country Partners. Since the banana market is stabilized by regulation, expansion of the market for banana pesticides is likely to be moderate at best (Heureux, Kone, and Walla 1992; M. Chardet and H. Fosso, personal communications, 1994).

2. Cotton

Cotton growing is not expected to expand much, partly because of Asian competition for world markets. Moreover, the value of insecticides used is declining as the hectareage covered by SODECOTON's program to reduce pesticide use increases. This pesticide market will probably decline slightly (M. Chardet, K. Dip and H. Fosso, personal communications, 1994).

3. Maize and Vegetables

There is a substantial domestic market in maize for food, animal feed, and beer, but cheap imports have flooded the market in the past. The CFA's devaluation should spur import substitution and regional trade. Devaluation should also favor expanded vegetable exports to Europe. This sector appears to be expanding slowly and has the World Bank's project support (see §III).

On the negative side, the economic climate and services appear to be unfavorable for the production and export of vegetables. Vegetable farmers who are not outgrowers for large, expatriate-managed farms do not have access to good quality seed or technical support. Jardin de Foubot, formerly Foubot's largest French bean producer, has ceased operations because of prohibitive Cameroonian customs duties on equipment. Airfreight is problematic because the international airport at Douala is not a main hub, the national airline has a monopoly on shipments, and freight rates are higher than in competing countries such as Kenya. Finally, there is the question of who will distribute and sell pesticides in some regions (see §II.A.I). Growth in demand for pesticides for food crops will probably be moderate (M. Chardet, K. Dip, J. McMahon, Ministry of Agriculture staff, and W. Roider, personal communications, 1994).

4. Coffee and Cocoa

At this writing (August 1994) severe frosts in Brazil and civil unrest in cocoa-producing Nigeria are raising international coffee and cocoa prices (*The Economist* 1994a, 1994b; *New York Times* 1994). Prices had already risen for Cameroonian producers because of January's CFA devaluation. It remains to be seen what proportion of these increases will be transmitted to farmers.

The impact of such price increases can be dramatic. The increase in output prices due to the devaluation caused fresh weeding in previously abandoned plantations. At least a short-term revival of coffee and cocoa and of demand for appropriate pesticides appears likely, though it is questionable whether either will attain past levels. Demand for pesticides will manifest itself soon if credit is made available. Otherwise, it will take about two years for farmers to re-invest profits from these price increases. A value-added tax proposed by the International Monetary Fund on windfall devaluation profits adds to uncertainty. Lack of capability to supply and distribute pesticides can also pose problems (see §II.A.1.) (K. Dip, H. Fosso, and Ministry of Agriculture staff, personal communications, 1994).

B. Incentives for Integrated Pest Management

Any measure that makes pesticides more expensive and difficult to obtain or restricts the use of hazardous pesticides for health or environmental reasons could act as an incentive for appropriately trained farmers to minimize pesticide dependency and to practice IPM or organic farming. The CFA's devaluation created an incentive for implementing IPM by doubling pesticide prices. Elimination of pesticide subsidies through market liberalization and parastatal privatization is also an important incentive. Enforcement of NEAP measures to mitigate pesticide pollution could also encourage the use of alternatives to pesticides. With the exception of devaluation, however, the outlook for realization of these proposed reforms is uncertain.

Even if the incentives described above materialize, one great obstacle will prevent implementation of IPM in any Cameroonian crop for the foreseeable future: with the possible exceptions of large-scale export vegetable production and of cotton, IPM technology and extension support is not available to farmers. Thus policy reform incentives will not change pesticide dependency. Under these circumstances, the promotion of intensively treated cash crops such as coffee, cocoa, and vegetables simply promises to maintain pesticide dependency and expand pesticide use. Any provision of credit to purchase inputs facilitates the process.

C. Environmental and Health Impacts

1. The Key Role of Policy Implementation

Over the medium to long term, the impacts of projected pesticide use in Cameroon will depend greatly on whether government policies and regulations concerning pesticides are implemented. The Crop Protection Service's regulation of pesticides and implementation of a NEAP with due attention to pesticide pollution would be mutually supportive. Collaboration between

ministries covering the health, agricultural, education, and environmental sectors would facilitate effective pesticide management.

Due to a lack of resources and expertise, little is likely to happen without substantial outside influence and support. Cameroon does not have funds to pay for the operations of its government agencies. The NEAP effort is donor- and international bank-driven, whereas government commitment to environmental matters appears to be minimal. The necessary infrastructure and trained personnel for pesticide and environmental management are not now available in Cameroon.

2. Environmental and Health Concerns

Appendix B summarizes the health and environmental hazards presented by current patterns of pesticide use in Cameroon. The potential problems described below emerge when that information is linked to possible increased pesticide application to maize, vegetables, coffee, and cocoa.

Hazards will be greatest where pesticides are used intensely, in association with heavily treated crops, and where particularly toxic, persistent, or mobile pesticides are customarily applied. Where potential problems are recognized, it is wise to monitor for their occurrence. The geographic extent and degree of pesticide pollution and poisoning, as well as changes over time, must be known to policy makers if they are to produce sound plans for remedial action.

There is a strong case for an in-depth study of the negative externalities and health hazards of pesticides in Cameroon. Such studies attract the attention of policy makers and provide a basis for constructive decision making (e.g., Rola and Pingali 1993). Cameroon's public health system and its NEAP should mandate appropriate monitoring programs. Some suggestions are given below.

a. Acute Poisoning

Acute poisoning of farmers and other people who handle or apply pesticides regularly will continue to be an issue, particularly if export horticulture expands. Vegetable production employs some highly toxic pesticides that are hazardous to applicators. Many commonly applied pesticides that are reasonably safe for applicators are acutely toxic to fish, birds, bees, and other beneficial insects, or other desirable nontarget species. The pyrethroid insecticides used on cotton and vegetables are an example.

Good-quality, regular training for farmers in the correct and safe application of pesticides is important. Farmers, storekeepers, and other people who frequently apply cholinesterase-inhibiting pesticides should have regular blood tests and reduce their exposure if their cholinesterase levels are depressed significantly. Prompt and appropriate treatment of pesticide poisoning should be available through the public health system. Systematic record keeping should reveal

the number and distribution of people poisoned, the severity of poisoning and work days lost, and the pesticides and use patterns most commonly involved.

b. Chronic Poisoning of Applicators and Consumers

Many pesticides that do not present much risk of acute poisoning are believed to have chronic deleterious effects on human health. Examples from Cameroon include the widely used fungicides benlate and the ethylenebisdithiocarbamates as well as triazine herbicides applied in maize plantations. If lindane, an organochlorine insecticide, remains in use it can cause health and reproductive disturbances (see Appendix B).

Stockpiled supplies of lindane are likely to be used on Cameroonian coffee soon. Unless the national pesticide registration scheme and regulations are implemented promptly, the sales and use of lindane and perhaps other organochlorine insecticides will continue. Where organochlorines are used, monitoring should include organochlorine residues in human and animal milk and tissues and other foodstuffs as well as populations and reproductive success of vulnerable wildlife species (elsewhere, birds and other predatory species high on the food chain are known to have been affected).

Improper pesticide choice and application practices often cause excessive residues to remain on marketed agricultural produce. Government health and agriculture agencies as well as Cameroonian growers and exporters should have access to analytical laboratories capable of measuring residues of all pesticide products in frequent use. Produce destined both for the domestic market and for export should be screened routinely for excessive residue levels. The results of the screening should be shared between agriculture and public health officials so that appropriate training, regulation, and enforcement can mitigate the problem.

c. Water Pollution

Certain agricultural pesticides are persistent and move in soil and water such that they can contaminate ground water, wells, and other water sources. Among the pesticides used in Cameroon, the herbicide atrazine, used on maize plantations, and the insecticide and nematicide aldicarb, used in banana production, fall into this category. Water samples should be collected regularly in banana and maize growing areas in order to monitor for pesticide residues.

d. Toxicity to Nontarget Species

Some commonly applied pesticides that are reasonably safe for human applicators are acutely toxic to fish, birds, bees, other beneficial insects, and other desirable nontarget species. Many pesticides used in Cameroon fall into this category (Appendix B).

Applicator training should stress the importance of safety measures that lessen risk to nontarget species. Among them are the avoidance of spraying flowering crops (bees), observing buf-

fer zones around bodies of water, and not washing sprayers or discarding pesticide containers into streams or lakes.

e. Ozone Depletion

Developing countries need funding for the identification and adoption of environmentally sound alternatives to the use of methyl bromide. In 1990, an Interim Multilateral Ozone Fund was established to help countries comply with the global phaseout schedule proposed by the Montreal Protocol of 1987. The usefulness of the fund is being compromised, however, because several industrialized nations are not meeting their financial obligation to support it (Schonfield, Wamukonya, and Glendening 1994).

VI. Agricultural Trade and Policy Recommendations

The most important of the recommendations that follow involve the identification and extension of least-toxic pest management practices and the enforcement of pesticide and environmental regulations. Without alternatives to pesticide dependency, farmers are unable to respond to incentives created by an economic and policy environment meant to favor safer and more sustainable pest management. The enforcement of regulations is a powerful incentive for pesticide management practices that will protect public health and the environment.

A. Economic and Policy Environment

1. Privatization and Liberalization of Markets Should Be Pursued, Ending Pesticide Subsidies

A free private market in agricultural inputs and commodities entails the dismantling of parastatals and the abolition of subsidies. Provided that alternatives exist and that farmers are taught about them, farmers who pay full market price for pesticides will constantly re-evaluate the cost-benefit ratio. Pesticide use will be more rational and efficient. Farmers will be motivated to use chemicals sparingly and practice IPM.

2. Pesticide Grants from Donors Should End

International donors should stop donating pesticides to developing countries, except in strictly defined, extraordinary emergencies. Pesticide grants are a subsidy that encourages greater, unsustainable, and inefficient use of pesticides. Thus, grants act as a disincentive for the implementation of IPM. Moreover, pesticides are commonly used unsafely in recipient countries such as Cameroon. These "gifts" are not accompanied by commensurate resources for monitoring or mitigating adverse health and environmental impacts.

3. Credit and Pesticide Consumption Should Not Be Linked

Pest infestations fluctuate, and therefore so do pesticide requirements. Farmers practicing IPM treat their crops only when field monitoring indicates that treatment will be profitable. Agricultural credit programs that require farmers to buy or apply fixed amounts of pesticide encourage unnecessary pesticide use, with all the negative health and environmental impacts that follow. Cheap credit for buying pesticides subsidizes their use, with the same consequences. Such credit programs are a disincentive for practicing IPM. Moreover, farmers often resell or divert unneeded or subsidized pesticides for unsuitable purposes.

4. The Equity of Nontraditional Export Crop Projects Should Be Examined

Only large export growers with sophisticated expatriate technical support are sure to moderate their use of pesticide and to rely on IPM to meet European MRL requirements. Small-scale entrepreneurs often do not have access to the information or expertise to do so. This is one of

the inequalities that can hand already wealthy Cameroonians or foreign owners a disproportionate share of the benefits of donor projects promoting nontraditional export crops and result in the expatriation of a large proportion of the profits (World Resources Institute 1993).

Small-scale producers and exporters should be targeted for support and services. Donors and government agencies should monitor project beneficiaries and try to maximize the equitable distribution of program benefits. If evaluations show that, on balance, nontraditional export crop projects are "aid to the rich," donors should invest in more appropriate development initiatives.

5. International Environmental Initiatives Should Be Supported

Donors should honor their environmental commitments for the benefit of developing countries, such as the Interim Multilateral Ozone Fund. The regional and national programs of governments, donors, and international lending agencies should monitor and support the implementation of those initiatives at all levels.

B. Pest and Pesticide Management

1. Least-toxic Pest Management Should Be a Priority

In order to assure safe, effective, and sustainable crop protection, and to capture its economic advantages, government and donors should place great importance on the development and extension of least-toxic pest management measures in Cameroon. When the climate for investment in agricultural development becomes attractive, long-term support should be pledged for IPM, organic farming, and other pesticide use reduction measures. The capacity of Cameroon's national agricultural research system to conduct research in these areas must be revived. High-quality extension training is needed to teach farmers management principles, as well as providing the motivation, confidence, skills, and knowledge necessary to apply them.

In Cameroon, extension problems appear to be preventing the SODECOTON program to reduce pesticide use from abandoning calendar-based pesticide application in favor of a need-based IPM approach (see Box 1) (Cauquil and Vaissayre 1993). The solution of this problem should be the object of international study, discussion, and collaboration. IPM for cotton has been implemented in many countries (Bottrell and Adkisson 1977, Hansen 1987). The recent application of participatory nonformal education methodology to IPM training for farmers has improved the effectiveness of extension (e.g., Matteson, Gallagher, and Kenmore 1994).

Brigades Villageoises, which have been organized to apply subsidized pesticides against migratory pests in northern Cameroon, should be given a less pesticide-dependent and more sustainable orientation. The current focus on pesticides may foster the attitude among farmers that pesticides are the only viable possibility for crop protection, a notion that will be counterproductive when attempts are made in the future to extend less toxic alternatives. Moreover, these pesticide applications are unsustainable without subsidy. Alternative control methods for some pests (e.g., grasshoppers) are not yet available, but the *brigades* should be

reoriented as strongly as possible toward IPM (favoring economically sustainable nonchemical control methods) and toward other aspects of integrated crop management.

2. Donors Must Support the Enforcement of Pesticide and Environmental Regulations

International donors must make a major commitment of funds, training resources, and expertise in order to implement pesticide regulations and environmental measures that will ensure effective pesticide management in Cameroon. For years donors have urged that pesticide legislation and regulations be enacted and enforced in developing countries. Donors have funded technical assistance projects to put such legislation and regulations in place and have made the formulation of NEAPs a condition of funding. Unfortunately, most African countries do not have the resources to enforce these paper measures. Among the essential items needed in Cameroon are: training; recurrent expenditures such as appropriate salaries; an operating budget for monitoring pesticide management and pollution, and for enforcement; and access to pesticide formulation and residue laboratories.

The pesticide registration program should be broadened to include veterinary pesticides and those used to control vectors of human disease. The requisite interministerial cooperation has significant potential benefits. For example, in many countries certain exceptionally safe and effective pesticides have been reserved for controlling vectors of human disease, so that their long-term utility for that purpose will not be diminished by pest resistance arising from broad-scale agricultural application.

3. Regional Collaboration for Pesticide Management

Regional collaboration among neighboring countries facing similar pesticide regulation problems should be broadened and strengthened. One possibility is the exchange of information about unwanted but unexpired pesticide stocks (FAO 1993b).

References

- Abbott, R. D. and E. K. Dey. 1993. Privatization of fertilizer marketing in Cameroon: A fifth-year assessment of the Fertilizer Sub-sector Reform Program. October. Moscow, Idaho, USA: University of Idaho College of Agriculture, Postharvest Institute for Perishables.
- Abt Associates. 1992. Agribusiness and public sector collaboration in agricultural technology development and use in sub-Saharan Africa: A synthesis of field studies. Annexes, Cameroon: A study of crop protection technology. November. Bethesda, Maryland, USA: Abt Associates, Inc.
- Adesina, A. A. 1994. "Pesticide Use and Policy in West Africa: An Overview." In *Proceedings of the Göttingen Workshop on Pesticide Policies, 28 February–4 March, Göttingen, Germany*, edited by S. Agne, G. Fleischer, and H. Waibel. Rome: Food and Agriculture Organization..
- Amegbeto, K. 1994. Potential agricultural supply response in Cameroon. Report prepared for the World Bank, January. Charles Steedman Associates in Rural Development, Inc.
- Bottrell, D. G. and P. L. Adkisson. 1977. "Cotton insect pest management." *Annual Review of Entomology* 22: 451–481.
- Cauquil, J. 1994. "The movement towards IPM in cotton growing in Francophone Africa." *IPM Working for Development* No. 2 (March): 8.
- Cauquil, J. and M. Vaissayre. 1993. The implementation of IPM on cotton in Sub-Saharan Francophone Africa. Paper presented at the IPM Working Group East/Central/Southern African IPM Implementation Workshop, 19–24 April, Harare, Zimbabwe.
- CIRAD. 1993. Relance regionalisee de la production paysanne de café et de cacao au Cameroun. Étude de faisabilité. Phase 2, Stratégie et Programme de relance. July. Yaoundé: Republic of Cameroon Ministry of Agriculture.
- CPS. 1994. List of pesticides used in Cameroon. Yaoundé: Crop Protection Service, Ministry of Agriculture.
- Ekotto Eboa, F., A. Ndikontar, R. Asa'ah, S. Njomgue, S. Njinyam, and A. Youdeowei. 1989. Republic of Cameroon draft country paper for the FAO TCDC-Oriented Subregional Workshop on Pesticide Management, 4–8 September, Accra, Ghana. July. Rome: Food and Agriculture Organization.
- Ekukole, G. 1992. Integrated pest management in Cameroon: The case of cotton. Background paper for the Workshop on Implementation of Integrated Pest Management in West Africa, 27 April–1 May, Accra, Ghana.
- Elliot Berg Associates. 1983. Agricultural input supply in Cameroon. Report prepared for the World Bank, June. Alexandria, Virginia.
- Etono, N. A. 1993. Les nouveaux défis de la protection des végétaux au Cameroun. May. Yaoundé, Cameroon.
- FAO. 1993a. Project Agreement TCP/RAF/2377(A), "Support to the Implementation of the International Code of Conduct." Rome: Food and Agriculture Organization.
- . 1993b. Report of the Subregional Workshop on the Implementation of the International Code of Conduct for the Distribution and Use of Pesticides in Africa, 25–30 January, Brazzaville, Congo. Regional Project RAF/90/001, "Safe and Efficient Use of Pesticides in Africa." Accra, Ghana: FAO Regional Office.

- . 1993c. Cameroun, restructuration de la recherche agricole (Phase interimaire). Rapport de preparation, December. Rome: Centre d'Investissement Programme de Cooperation FAO/Banque Mondiale.
- Geomar International. 1993. Projet de Promotion et Diversification des Exportations Agricoles au Cameroun—Phase Pilote. Rapport final de la phase pilote se terminant le 30 Juin 1993. December. Yaoundé: République de Cameroun Division des Projets Agricoles.
- Government of Cameroon. 1992. Programme de reforme du sous-secteur pesticides. January. Yaoundé: Subdirectorate of Crop Protection, Ministry of Agriculture.
- . 1993. Relance de l'activité économique dans le secteur agricole. Synthèse des travaux des Commissions sur la Dynamisation de la Production et la Distribution des Produits Agricoles a l'Interieur et a l'Exterieur du Cameroun. August. Yaoundé: Ministry of Agriculture.
- . 1994. Lettre de politique de développement rural. January. Yaoundé.
- Hansen, M. 1987. *Escape from the pesticide treadmill: Alternatives to pesticides in developing countries*. Mount Vernon, New York: Institute for Consumer Policy Research, Consumers Union.
- Heureux, C. J., S. Kone, and K. Walla. 1992. Agribusiness and public-sector collaboration in agricultural technology development and use in Cameroon: A study of crop protection technology. Report to the USAID Africa Bureau (AFR/ARTS/FARA) through the USAID Agricultural Marketing Improvement Strategies Project, November. Bethesda, Maryland: Abt Associates Inc.
- Holtzman, J. S., R. D. Abbott, C. Adoum, P. Kristjanson, T. Wittenberg, C. J. D. Stathacos, I. Ouedraogo, C. Erbacher, N. Kulibaba and K. M. Aldridge. 1992. Agribusiness development in sub-Saharan Africa: Suggested approaches, information needs, and an analytical agenda. Agricultural Marketing Improvement Strategies Project, September. Volume II: Country annexes. Bethesda, Maryland: Abt Associates.
- Iowa State University. 1991. *Restricted-use pesticides*. Brochure. Ames, Iowa: Iowa Cooperative Extension Service.
- Iya, M. 1994. January 18 letter to the Delegate of the Commission of the European Union from the Director-General of SODECOTON, concerning expected field budget changes after devaluation of the CFA. Yaoundé, Cameroon.
- Jensen, J. K. 1991. Pesticide donations and the disposal crisis in Africa. Poster presentation, American Chemical Society Fourth Chemical Congress, 26–30 August, New York.
- Jourdain, D., E. Hermouet, C. Maire and N. Du Pasquier. 1990. *Regional agro-pesticide index. Vol. 3, Africa*. Bangkok: French National Center for Agronomic Studies in Warm Areas (CNEARC), French International Cooperation Centre of Agricultural Research for Development (CIRAD).
- Laclavere, G., ed. 1979. *Atlas de la République Unie du Cameroun*. Paris: Editions Jeune Afrique.
- Lynch, M. 1993. Memo from Worldwide Fund for Nature Prior Informed Consent consultant to Peter Hurst, Prior Informed Consent Project Coordinator, April 23, Cameroon.
- Matteson, P. C., K. D. Gallagher, and P. E. Kenmore. 1994. "Extension of Integrated Pest Management for Planthoppers in Asian Irrigated Rice." In *Ecology and Management of Planthoppers*, edited by R. F. Denno and T. J. Perfect. London: Chapman and Hall.

- Matteson, P. C. and M. I. Meltzer. 1994. Environmental and economic implications of agricultural trade and policy reform programs in Kenya: Pest and pesticide management. Arlington, Virginia: Winrock International Environmental Alliance.
- Meister Publishing Co. 1992. *Farm chemicals handbook*. Willoughby, Ohio, USA.
- Meltzer, M. I., P. C. Matteson, and W. I. Knausenberger. 1994. Environmental and economic implications of agricultural trade and policy reform programs in Uganda: Pest and pesticide management. Arlington, Virginia: Winrock International Environmental Alliance.
- Minot, N. 1991. Incidence du programme de réforme du sous-secteur des engrais sur les producteurs agricoles: resultat de trois enquêtes au niveau des exploitations agricoles. Abt Associates, Inc., Washington, D.C., and the University of Idaho/Postharvest Institute.
- New York Times*. 1994. "Futures markets: Troubles in Nigeria send oil and cocoa up sharply." July 30, p. 26.
- Nkwain, S. J., J. P. Ayissi Mballa, and F. A. Numfor. 1993. Problems and constraints of Cameroon's food crop subsector. September. Yaoundé: CAPP/NCRE/USAID.
- Pierrard, G. 1993. Rapport de synthèse sur la gestion des pesticides dans 15 pays d'Afrique centrale et autres régions d'Afrique. Accra, Ghana: FAO Regional Office.
- Roche, P. 1993. Audit scientifique de la recherche agricole au Cameroun. Synthèse de l'audit. Rapport general. Yaoundé: Ministère de la Recherche Scientifique et Technique.
- Rola, A. C. and P. L. Pingali. 1993. *Pesticides, rice productivity, and farmers' health, an economic assessment*. Manila: International Rice Research Institute and the World Resources Institute.
- Schonfield, A., L. Wamukonya, and S. Glendening. 1994. Under African skies: Methyl bromide use and alternatives in Africa. Review draft, October. San Francisco, California: The Pesticide Action Network.
- Schwartz, L. 1992. Analysis of private-sector technology transfer methods. Report to USAID, June. Gainesville, Florida: Tropical Research and Development, Inc.
- Shapiro, D., E. Tollens, and P. Wyeth. 1992. Cameroon agricultural sector overview. Prepared for the Agricultural and Rural Development Office, USAID Cameroon. December. Yaoundé.
- Szmedra, P. 1994. Pesticides and the agrichemical industry in Sub-Saharan Africa. Arlington, Virginia: Winrock International Environmental Alliance.
- Ta'Ama, M. 1990. Integrated pest management on vegetables in the humid zone of West Africa: Cameroon. Paper prepared for the FAO Regional Office, Accra, Ghana.
- The Economist*. 1994a. "Economic indicators: Coffee commodity price index." July 2, p. 96.
- . 1994b. "Roasting." July 16, p. 70.
- Tobin, R. J. 1994. Bilateral donor agencies and the environment: Pest and pesticide management. Arlington, Virginia: Winrock International Environmental Alliance.
- USAID. 1993. Assessment of program impact (API), USAID/Cameroon. FY 1993. November 15, Yaoundé.
- U.S. Environmental Protection Agency. 1990. *Suspended, cancelled and restricted pesticides. Pesticides and toxic substances (EN-342), 20T-1002*, February. Washington, D.C.: Office of Compliance Monitoring, Office of Pesticides and Toxic Substances.

- . 1993. *Status of pesticides in reregistration and special review*. Washington, D.C.: EPA 738-R-93-009, June.
- . 1994. *Pesticide reregistration progress report*. Washington, D.C.: EPA 738-R-94-001, January. Washington, D.C.
- World Bank. 1993. Cameroon. First Agriculture Sector Adjustment Program. Draft initiating memorandum. March. Yaoundé.
- World Resources Institute. 1993. Challenges and opportunities for sustainable agriculture: Environmental and equity dilemmas of agroexport growth. Project Overview, Sustainable Agriculture Program. Washington, D.C.: Center for International Development and Environment.

Appendix A: Persons Contacted in Cameroon

USAID/Cameroon (Yaoundé)

P.O. Box 817, Yaoundé
Tel.: (237) 230581; Fax: 221890

John P. McMahon, Director, Agriculture and Rural Development
Kifle Negesh, Supervisor, Economic Program
Ambe A. Tanifum, Agricultural Economist
Rostand J. Longang, Economist, Operations Research
Daniel C. Moore, Fertilizer Subsector Reform Program

Commission des Communautés Européennes (EC)

B. P. 847, Yaoundé
Tel.: (237) 201387; Fax: 237 202149

Bob Baldwin, Economic Counsellor

Caisse Française de Développement

B. P. 46, Yaoundé
Tel.: (237) 220015; Fax: (237) 235707

Jose Tissier, Agriculture Officer

United Nations Development Programme (UNDP)

B. P. 836, Yaoundé
Tel.: (237) 224149, 225035; Fax: (237) 224369

Sam N. Dominic, Program Officer

World Bank

P. O. Box 1128, Yaoundé
Tel.: (237) 210836, 293157; Fax: 210722

Werner Roider, Senior Agricultural Economist
Yovan Grouitch, on mission from Washington, D.C., NTE Crops Project

Government of Cameroon

Ministry of Agriculture

Direction de l'Agriculture, Yaoundé
Tel.: 304074, 223187

Benjamin Nami, Director

Eduard Mezazem, Extension Coordinator
Seraphin Njomgue, Assistant Director, Crop Protection Service
Moïse Medjo Me Nkembe, Head of Crop Protection Legislation Section
Gaston Pierrard, FAO Technical Consultant, Pesticide Management

Direction des Etudes et Projets, Division de la Statistique Agricole
Tel: 21-22-50, 20-79-49

Paul Pierre Pouansi, Deputy Director, Studies and Projects

Bafoussam, Western Province

Elie Sani Tonga, Provincial Director
Emmanuel Toze, Statistician
Jean Fengueng, Head, Provincial Agricultural Extension Service
L. Djiegoue Tchoussi, Chief, Western Province Crop Protection Center

Ministry of Livestock Services, Services Veterinaires, Yaoundé
Tel: 31-60-48

Alexandre Ngatchou, Assistant Director, Veterinary Services

Ministry of Scientific and Technical Research, Yaoundé
B. P. 1457, Yaoundé
Tel.: 224813, 213026

Jean Nya Ngatchou, Researcher, Agriculture
Victor Sunday Balinga, Researcher, Natural Resources

Institute de Recherche Agonomique (IRA) de Nkolbisson
P. B. 2067, Yaoundé

P. Mbondji-Mbondji, Assistant Director of Planning and Coffee and Cocoa
Entomologist, Nkolbisson Agricultural Research Institute

National Cereal Research and Extension Project/IRA
P. B. 2067, Yaoundé
Tel.: 22-30-22; Fax: 22-18-73

Charles The Tadiesse, Maize Breeder

Ministry of Higher Education

University of Dschang, Organisation de l'Unite Africaine Centre African de Recherche et de Formation Phytosanitaire (CARFOP)
P. O. Box 409, Dschang, Cameroun
Tel.: 451975

Jacob Foko, Plant Pathologist
Richard Ghogomu, Entomologist

Department of Agricultural Economics

Francois Kamajou
Joseph Nkwain Sama

University of Yaoundé

Esthrine Embelle Lisinge, Ph.D. student of environmental law, Faculty of Law

Ministry of Public Health, Yaoundé

Directorate of Preventive and Rural Medicine

Abdoulaye Djabari, Chief, Public Hygiene and Sanitation Service
Richard Njouke, Technician, Sanitary Engineering
Dr. Mvondo, Vector Control

Directorate of Family and Mental Health

Daniel Sibetcheu, National Coordinator, Nutritional Education Pilot Project

SODECAO (Cocoa and coffee parastatal), Yaoundé

B. P. 1651, Yaoundé
Tel.: 304544, 301712; Fax: 301395

Daniel Audebert, Director, Planter Support NGOs

Federation of Cameroon Environmental NGOs (FONGEC)

B. P. 1256, Bafoussam
Tel.: 446267; Fax: 446669

Djateng Flaubert

Enviro Protect (Association Internationale pour la Protection de l'Environnement en Afrique)

B. P. 13623, Yaoundé

Tel.: 235435

Augustin Youmbi, Secretary-General

Worldwide Fund for Nature (WWF)

B. P. 6776, Yaoundé

Tel/Fax: 201291

Steve Gartlan, Country Representative

CARE International—Cameroon

B. P. 422, Yaoundé

Tel.: 211714, 212054; Fax: 215187

Jean-Jules Riopel, Assistant Director, Planning

Farmers

Samuel Oukumi, vegetable farmer, Bafoussam

Antoine Dominguez, Crop Director, PROLEG S. A., Foumbot

Ciba-Geigy Trading & Marketing Services Co., Ltd.

B. P. 1397, Douala

Tel: 422433, 423270; Fax: 433535

Michel Gasseau, Central Africa Region Marketing and Technical Director and President of the Central African Crop Protection Union (UPAC), a GIFAP affiliate

Rhone-Poulenc Afrique Centrale

Marc Chardet, Commercial Director and Treasurer of UPAC

FIMEX International

Henri Fosso, Director

Agrochem

Karim Dip, Director General

Appendix B: Summary of Hazards of Pesticides Used in Cameroon

This is an illustrative list (not an exhaustive one) of hazardous pesticides recommended or widely used in Cameroon for the use patterns shown. The commercial name of some pesticides is written after the common name, e.g. benlate/Benomyl. Pesticides in special review, cancelled or only for restricted use in the United States for health or environmental reasons are marked with an asterisk (*).

Use Patterns	Pesticides	Main Hazards
General use, coffee against <i>Antestia</i> bugs, in banana plantations in combination with the soil sterilant aldicarb (Temik Brand)	Organochlorine insecticides (lindane*)	Carcinogenicity, developmental toxicity, reproductive effects, other chronic effects. Acute toxicity.
General use	Some organophosphate and carbamate insecticides (e.g., carbofuran/Furadan* fenitrothion oxamyl/Vydate L propoxur/Undene*)	Acute and/or chronic toxicity and/or toxic to nontarget species.
Cotton, general use	Synthetic pyrethroid insecticides (e.g., alpha-cypermethrin/Fastac, Nurelle D cypermethrin/Cymbush* deltamethrin/K'Othrine lambda-cyhalothrin/Karate*)	Toxic to nontarget species. Acute toxicity (lambda-cyhalothrin).
General use, bananas	Some fungicides (e.g., benomyl/Benlate* EBDCs—mancozeb, maneb*)	Chronic health effects and/or hazardous to nontarget species.
Maize	Triazine herbicides (e.g., alachlor/Lasso, Primextra*, atrazine/Primextra*)	Can leach to ground water (atrazine). Can cause tumor growth or birth defects (alachlor, atrazine).

Bananas, cocoa, coffee, general use	Paraquat herbicide/Gramoxone, Gramuron*	Skin irritation, irreversible lung damage or fatal if swallowed.
Banana, vegetables	Insecticide/nematicide soil sterilants (e.g., aldicarb/Temik* ethoprop/Mocap* fenamiphos/Nemacur* terbufos/Counter*)	Acute toxicity and/or chronic health effects. Hazardous to nontarget species. Can leach to ground water (aldicarb).
Soil sterilization, storage, shipment of perishable produce	Fumigants (e.g., methyl bromide*)	Acute inhalation toxicity. Hazardous to nontarget organisms. Ozone depletion.

Sources: *Pesticide use patterns*—Ta'Ama 1990; Crop Protection Service 1994; K. Dip, A. Dominguez, P. Mbondji-Mbondji, West Province Ministry of Agriculture staff, and S. Njomgue, personal communications, 1994. *Registration information and hazards*: Jourdain et al. 1990; Iowa State University 1991; Meister Publishing Co. 1992; U.S. Environmental Protection Agency 1990, 1993, 1994.