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Pesticides and the Agrichemical Industry in Sub-Saharan Africa

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by

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Preface and Acknowledgements

A previous version of this report was sent to many individuals with possible interest in the topic of pesticide use and pest management in sub-Saharan Africa. Special thanks are due to many persons who helped to improve this subsequent version of the report with provision of important proprietary data as well as insightful comments. In addition to the individuals mentioned on the list of "Individuals and Agencies Contacted," the project is especially indebted to: Claude Pretot of GIFAP; Georges Bruge of Rhône-Poulenc; Alberto Genrich of Ciba-Geigy; Hermann Waibel and Gerd Fleischer of Göttingen University; Sandra Marquardt of Greenpeace; Anne Schonfield of the Pesticide Action Network North America; Patricia Matteson of Iowa State University; Martin Meltzer of the University of Florida; Barbara Dinham of The Pesticides Trust; G.G.M. Schulten of the FAO's Plant Protection Service; Jean Cauquil of the Centre de Coopération Internationale en Recherche Agronomique pour le Développement; Kofi Amuti of the DuPont Stine-Haskell Research Center; Malcolm Iles and the staff of the Natural Resources Institute; Catharina van Oers of the Food and Agriculture Organization's Regional Office for Africa; Richard Tobin of the Institute for International Research; Didier Chavatte of the Compagnie Française pour le Développement des fibres Textiles; Janice King Jensen of the U.S. Environmental Protection Agency; and Walter Knausenberger of USAID's Bureau for Africa.

All these individuals graciously provided comments, suggested changes, and relevant data. Despite their generosity, these individuals do not necessarily subscribe to the views and recommendations included in this report. As most readers will readily acknowledge, the issue of pesticide use is problematic, and widespread consensus is not easily achieved.

The significance of the information provided was key to improving this report. There exists no single repository for data describing the use of pesticides in sub-Saharan Africa and such related issues as exports of pesticides to the region, imports of pesticides by specific countries, or national pesticide production and formulation capacity. Included are data purchased from Landell Mills Market Research describing pesticide use in Kenya, Côte d'Ivoire, and Zimbabwe. Many people in the agrichemical industry consider these data to be reasonably accurate and definitive given the collection and verification constraints extant in sub-Saharan Africa. Included also in this version are data that Ciba-Geigy provided from its Ciba/Basic Market Information databook for specific pesticide use in Cameroon, Côte d'Ivoire, Ghana, Kenya, Mali, and Uganda.

In addition, the report utilizes data from the U.S. Customs Service and European Union describing exports of pesticides to gauge the magnitude of pesticide stocks arriving in sub-Saharan Africa from the Western developed nations. Other data were, in general, mined from specific country reports presented at regional conferences by country nationals representing respective ministries of agriculture or environmental protection agencies. Data describing the global agrichemical market and market structure and performance are from Wood MacKenzie & Co. Ltd., the market research arm of National WestMinister Bank in London. In each instance the report attempts to include data and information in the body of the report that are politically neutral so as to be objective in treating so politically charged a topic.

Executive Summary

This report marks the initiation of a broad effort to consider the environmental implications of policy reform initiatives in sub-Saharan Africa, particularly as they relate to the procurement, use, and management of pesticides and the potential impact these activities have on the adoption of integrated pest management. Specifically, this report examines the issues of pesticide use in sub-Saharan Africa, the agrichemical companies that have a major regional presence and their markets, products, and target commodities; it offers short country reports describing patterns of pesticide use and related issues; and the report discusses the problems associated with the international trade of pesticides and toxic substances in general and how they relate to Africa. The report emphasizes nations in the region that are or have been traditional recipients of donor assistance. For this reason, the use of pesticides in the Republic of South Africa is discussed only briefly. Lack of information on other countries prevented attention to them.

Pesticide use in Africa is concentrated on high-value cash crops intended for export. The leading pesticide users in sub-Saharan Africa are, therefore, nations with a well-developed cash-crop sector such as Cameroon, Côte d'Ivoire, Kenya, Sudan, Tanzania, and Zimbabwe.

The use of chemical pesticides has increased in nations with expanding agricultural sectors, stable political situations, and economies not linked directly to world markets for raw agricultural commodities. In nations where the production and export of cotton, coffee, cocoa, tobacco, or other raw cash crops generate a major portion of national income, pesticide use is linked directly to the variability of world prices for the crop. Levels of insect infestations also directly affect pesticide use because insecticides are the principal pesticides used in the region.

Nations in the region receive pesticides through direct importation of ready-to-use formulations by the governmental crop protection services, in the form of agricultural development aid packages, and as part of emergency control methods for migratory pest outbreaks. The Japanese government supplies large quantities of pesticides as aid-in-kind grants to many of the region's countries. The active ingredients for pesticides are not manufactured in the region, but imported product is formulated in more than a dozen African nations. The pesticide formulation industry in a number of the more developed nations in sub-Saharan Africa provides pesticides to neighboring countries. In addition, the Republic of South Africa supplies much of the technical material from which formulated products are produced for nations in southern Africa.

Data about pesticide use are weak. Multinational agrichemical companies consider the market for pesticides in Africa to be thin. Therefore, they have little interest in extensive market analysis and collection of the requisite data. Additionally, there is a significant unrecorded market for pesticides, including products illegally imported and sold without moving through proper pesticide registration channels, where extant.

Insecticides made up about 45 percent of the total pesticide market in sub-Saharan Africa whose use has been banned or severely restricted in Europe and North America, are still used in Africa. The market for agrichemicals to all African nations was estimated to be between US$500 million and US$1 billion in 1992. Sales to sub-Saharan Africa were perhaps 50 percent of total African sales or $250 to $500 million in 1992.

Cotton is grown extensively in sub-Saharan Africa, and for many nations in the region cotton provides the bulk of foreign exchange earnings. The trend in cotton production is upward. Land area devoted to cotton has increased at about 10 percent per year. This warrants concern because pesticides, mainly insecticides, are intensively applied to cotton. Some estimates indicate that large percentages of cotton growing regions are treated regularly. Large portions of individual nations' pesticide markets are composed of chemicals used in cotton production.

The importance of cotton in the foreign trade of many nations in sub-Saharan Africa obliged governments to offer input subsidies, particularly for pesticides. In many instances subsidy schemes have been responsible for the widespread use of pesticides in cotton culture.

The problem of pest resistance and phytotoxicity have become significant in a number of nations. In Kenya, as an example, the extensive use of copper fungicides in coffee production has resulted in increased resistance to these fungicides. In Côte d'Ivoire, a cotton parastatal has encouraged widespread pesticide use. In fact, prior to 1990-91, insecticides were dispensed without charge to cotton growers, but insect resistance to the materials applied has been observed recently. Throughout the region insect resistance to DDT has been documented as a result of the pesticide's overuse.

The use of pesticides in cash crops has some spillover effects on food crops in Africa. The availability of chemicals and application equipment, the presence of cooperative societies that provide credit for pesticide purchases, and the general familiarity with pesticide technology and its effectiveness have led to increasing use on staple crops.

At least 1,900 metric tons of banned, canceled, or voluntarily suspended pesticides manufactured in the United States were exported in 1991, including mirex, captafol, dinoseb, and DDT. In the same year, 4.5 percent of pesticide compounds exported from the United States classified as banned, unregistered, or restricted use were shipped to Africa. Exports to Africa made up 6 percent of the total exports of formulated pesticides from the European Union in 1990. While the proportion is small, the quantities and value are significant, particularly in relation to other imports for most nations in Africa.

Most Africa nations lack pesticide control statutes. Among the 10 countries of the Southern African Development Community (SADC), only Tanzania, Mozambique, and Zimbabwe have pesticide regulation schemes. In West Africa, neither comprehensive pesticide legislation nor registration and control schemes exist in most nations. Exceptions include Benin, Burkina Faso, Côte d'Ivoire, Cape Verde, Gambia, Niger, and Senegal. Several more countries are actively pursuing the development of pesitcide registration systems.

The United Nations' Prior Informed Consent (PIC) framework provides guidelines to prevent unwanted imports. Under PIC, the major agrichemical companies have agreed not to export contrary to a government's decision. Despite the PIC framework, many of the formally listed PIC materials remain in use in sub-Saharan Africa. Illegal shipment and use of banned products takes place. Residue sampling of marketed food products indicates that misuse and overdosing occur. The full extent of the problem is difficult to discern, however, without extensive residue sampling programs. More data are needed.

Insufficient knowledge of specific guidelines limits the capacity of some African nations to implement the International Code of Conduct on the Distribution and Use of Pesticides, which the United Nations' Food and Agriculture Organization (FAO) adopted in 1985. Enforcement is a chronic problem. Most African nations require strengthening of their technical, physical, and administrative facilities including laboratories for quality control and residue analysis to allow them to monitor and enforce the Code of Conduct effectively.

The agrichemical industry's response to the concern of many organizations, including nongovernmental organizations and private voluntary organizations, as well as many governments, about the use of pesticides in agriculture has been the promotion of safe procurement, transport, handling, and use of pesticides in both the developed and developing world. Through national organizations and through membership in the Groupement International de Fabricants de Produits Agrochemiques (GIFAP), an international association of national associations of companies involved with pesticides, agrichemical companies argue that pesticides are manageable poisons necessary for the successful production of agricultural commodities. Dangers arise when materials are mishandled, are used incorrectly, or are not applied according to label directions. The influence of the extranational organizations such as GIFAP has been to attempt to establish a perfunctory order in a disorderly environment.

Pest management and control problems in the region vary considerably despite similarities in the kinds of cash crops that are grown. Unfortunately, many national agricultural extension services are understaffed and lack the resources and technical expertise to advise on alternative pest management practices. The universal alternative to good cropping system information is attempts at pest eradication with chemical pesticides.

Many African nations accept integrated pest management as an important aspect of national agricultural policy. Without region-specific data collection and research focused on describing the biological interaction of multipest, multicrop environments, however, little progress in alternative pest management techniques will occur.

I. Introduction

Most people in sub-Saharan Africa are agriculturists and depend on subsistence farming for their livelihoods. Most farms provide little more than subsistence with the land area that can be cultivated by hand restricting their size. Traditional methods of crop production, which have in the past used sustainable methods, are practiced and, depending on environmental conditions, produce as much as 80 percent of the food consumed in sub-Saharan Africa (Youdeowei 1987). In contrast, cash crops grown for export typically are produced on plantations or large estates and use modern inputs including pesticides, chemical fertilizers, and sophisticated machinery. Farm incomes generated beyond the subsistence sector in many nations are to a large extent dependent on the cultivation of these cash crops, including banana, cocoa, coffee, cotton, groundnut, maize, pineapple, oil palm, sugarcane, and tobacco.

Improved agricultural productivity and the economic well-being of the region are objectives of national economic development programs and international donor organizations. Programs have focused on enhancing the production of both cash and subsistence crops. Agricultural development projects have involved the introduction of new seed varieties combined with intensified use of pesticides and chemical fertilizers. The use of pesticides in particular has allowed farmers who have traditionally relied on mechanical pest control measures, including removal of insects and egg masses from crop stalks and leaves, hand-weeding, and destroying crop residues, to kill pests en masse quickly and efficiently.

There are, however, negative human health and environmental consequences of progressively greater use and misuse of chemical pesticides. Farmers, farm workers, and rural populations experience both the acute and chronic health effects of pesticide exposure (Rosenstock and Keifer 1991). Excessive pesticide residues on food and feedstuffs lead to instances of human and animal poisoning (Jeyarathnam 1990). Although the environmental impact of long-term pesticide persistence is difficult to assess in Africa due to the lack of resources and infrastructure, wildlife is affected and some species have become extinct because of pesticides (Igbedioh 1991). Indiscriminant pesticide applications have harmed soil vitality by eliminating beneficial micro and macro organisms. Both point and nonpoint source of pollution have contaminated water supplies (Natural Resources Institute 1991).

The issue of pesticide use in sub-Saharan Africa is especially troublesome due to the absence of effective regulatory implementation and enforcement in many nations and the general lack of regulatory structures in others. Recently donor agencies, international organizations, industry groups, and nongovernmental organizations have attempted to establish guidelines for the distribution and use of agrichemicals that would afford the degree of information and safety common in the developed world.

The larger objectives of this study are to consider the environmental implications of policy reform initiatives in Africa as they relate to the procurement, use, and management of pesticides and the potential effect these initiatives may have on incentives to use integrated pest management (IPM).[1] This report specifically looks at pesticide use in sub-Saharan Africa; it analyzes the markets, products, and target commodities of the major agrichemical companies in the region; it offers short country reports describing patterns of pesticide use and domestic issues, including what is known of the status of integrated pest management; it describes trends in cotton production and pesticide use in a number of African nations; and it discusses the problems associated with the international trade of pesticides and toxic substances in general and how they relate to Africa and the developing world.

II. The Agrichemical Industry[2]

A. World View

European-based firms supplied approximately 61 percent of agrichemical products to the world market in 1992 with market leaders unchanged from the previous year. The global market was valued at $25.2 billion, a 6-percent decrease over the $26.8 billion in sales recorded in 1991.[3] When couched in real terms, the market declined 5.[illegible] percent from the previous year marking the first two consecutive years of real market decline since 1980 (Wood MacKenzie & Co. Ltd. 1993b). The largest agrichemical markets in 1992 were North America with 29 percent of the global market, Western Europe with 27 percent, and Japan with 14 percent.

European and American corporations dominate the global pesticide market (Figure 1). Ciba-Geigy, a Swiss firm, is the industry leader with agrichemical sales in 1992 of $2.83 billion, followed by DuPont, an American firm, with $1.96 billion, Bayer (Germany) with $1.87 billion, and Rhône-Poulenc (France) with $1.84 billion. Together the top ten corporations account for about two-thirds of the market.

Pesticide markets in the northern hemisphere are generally stable. Fluctuations are usually due to sporadic pest outbreaks, unusual weather patterns (e.g., floods in the United States; cool and wet conditions in Northern Europe), or changes in governmental agricultural programs (such as set-aside, land retirement, or Payment-in-Kind programs in the United States and changes in agricultural policies, including decreased price subsidy levels and set-aside programs in the European Union). The market for herbicides, the most extensively used class of pesticides, is generally saturated in Europe and the United States. For this reason much of

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[1] For purposes of brevity, references to Africa mean sub-Saharan Africa unless noted otherwise. USAID's Bureau for Africa defines sub-Saharan Africa to include all nations in Africa except those bordering the Mediterranean Sea. Other organizations define the region somewhat differently. Ciba-Geigy, for example, includes Sudan in its North African marketing group.

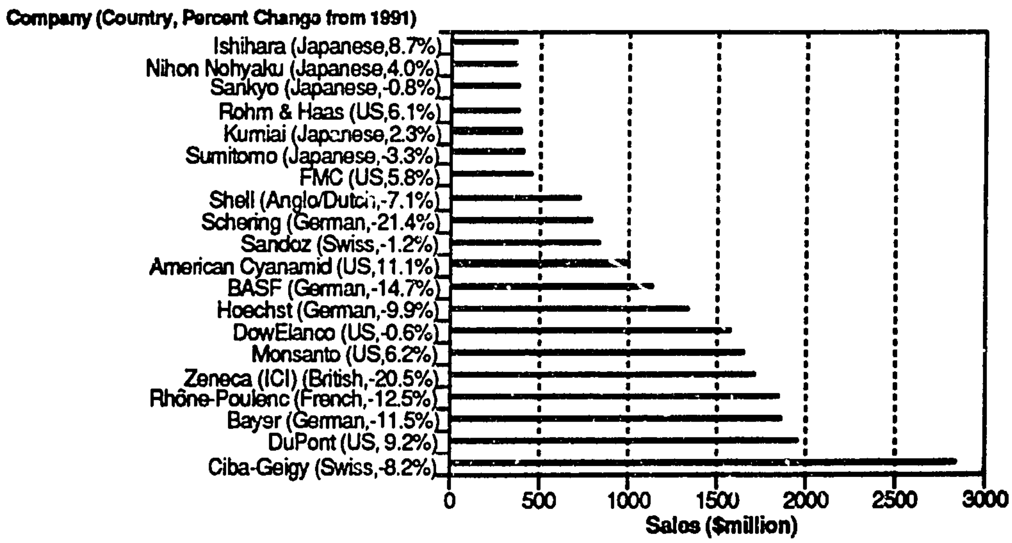
[2] In addition to pesticides, which are the subject of this report, the agrichemical industry produces fertilizers, veterinary pharmaceuticals, and pesticide application equipment.

[3] Unless otherwise noted, all currencies are in U.S. dollars.

the agrichemical industry looks to the developing world for market expansion. Between 1972 and 1985, for example, imports of pesticides increased by 261 percent in Asia, 95 percent in Africa, and 48 percent in Latin America (Postel 1987). Analysts of the industry expect the market for pesticides in the developing nations to double by 2000 (Pesticide Action Network 1991). Table 1 gives geographical market shares.

Most agrichemical companies see Latin America and Southeast Asia as prime market opportunities with lesser although important exploitable markets in China, Eastern Europe, Western Asia, and the Asia-Pacific region. Few companies expect the market in Africa to become strategically important for the foreseeable future. This is due to the poor prevailing economic conditions and depressed markets for traditional African commodities. The market for pesticides in the Republic of South Africa, which has a large, modern agricultural sector as well as a more primitive subsistence one, is expected to increase when the political situation stabilizes.

Figure 1. Worldwide Pesticide Sales by Company, 1992



Source: Wood MacKenzie & Co. Ltd. 1993b

Global sales of pesticide increased at an average annual rate of 11.2 percent between 1960 and 1992, as shown in Figure 2. Herbicides are the most important. The use of herbicides has been extensive in developed nations where agricultural labor is either difficult to obtain or expensive relative to developing countries. The use of herbicides expanded rapidly after 1960. Global market growth averaged 14.1 percent a year between 1960 and 1992. Farmers in the developed world have so enthusiastically adopted these products that virtually all major row crop hectarage is treated with some type of chemical herbicidal product (Osteen and Szmedra 1989). Trends for herbicide use in Africa appear also to be on the rise. Estimates by analysts of the agrichemical industry indicate that herbicides composed about 28 percent of the total pesticide market in Africa in 1990 (Figure 3), second in prevalence after pesticides.

Organochloride insecticides made up approximately 6 percent of total insecticide sales worldwide in 1992 and were marketed principally in developing nations (Table 2).

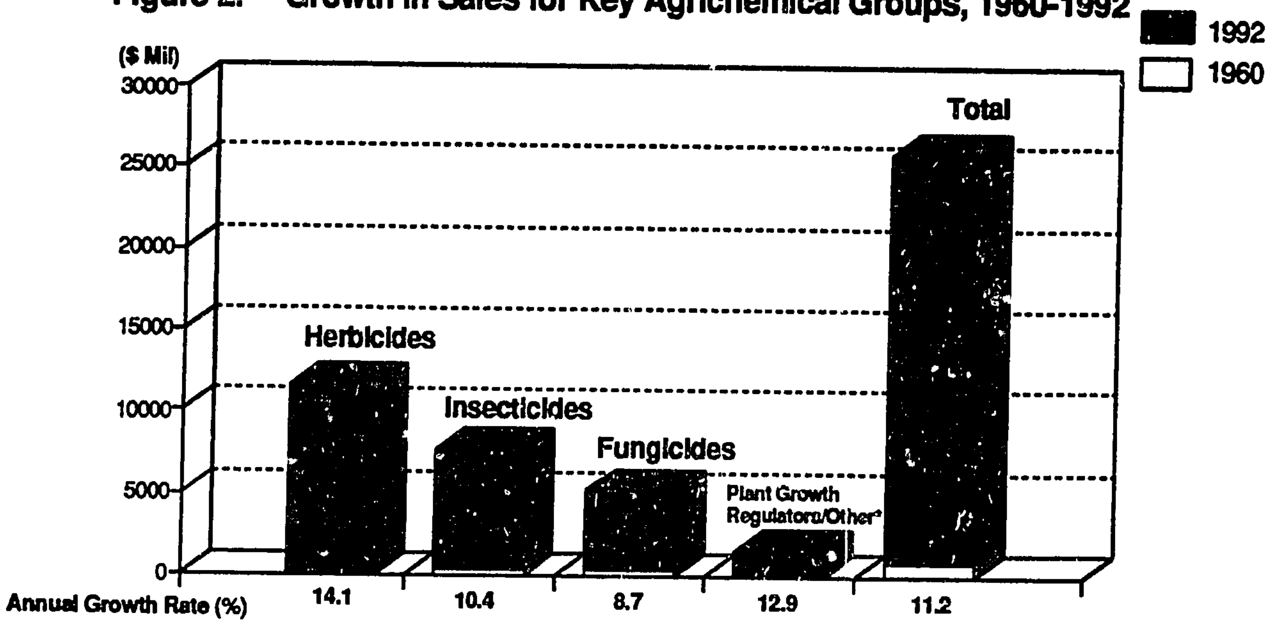
Table 1. Regional Market Shares, $ Million, 1992

	Herbicides	Insecticides	Fungicides	Others	Total
W. Europe	2,921	1,180	2,030	597	6,728
E. Europe	440	450	210	60	1,160
N. America	4,825	1,600	554	368	7,347
L. America	1,140	710	460	100	2,410
Japan	1,095	1,200	1,170	80	3,545
Far East	801	1,250	359	190	2,600
Rest of World*	218	1,010	117	65	1,410
Total	11,440	7,400	4,900	1,460	25,200

* Includes all nations in Africa, South Asia, and the Middle East.

Source: Wood MacKenzie & Co. Ltd. 1993b

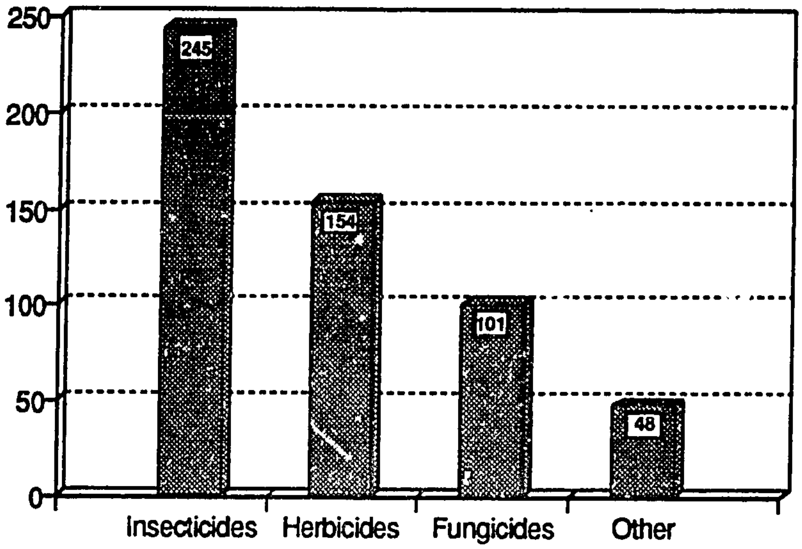
Figure 2. Growth in Sales for Key Agrichemical Groups, 1960-1992



Source: Wood MacKenzie & Co. Ltd. 1993a

*Other Category includes fumigants and nematicides

Figure 3. African Plant Protection Market
by Pesticide Category 1990
Total Market: $548



Source: Ciba-Geigy communication to USAID ARTS/FARA 1991

Table 2. The Global Insecticide Market, 1992

Group	Estimated Mkt Size $ Mil	% of Total Market
Organophosphates	2,880	38.9
Pyrethroids	1,360	18.4
Carbamates	1,510	20.4
Organochlorides	450	6.1
Benzoyl Ureas	150	2.0
Others	1,050	14.2
Total	7,400	100.0

Source: Wood MacKenzie & Co. Ltd. 1993a

Insecticides are, in general, the most widely used pesticides on both cash and food crops in the developing world, although expenditures for herbicides dominate in Latin American. The world market for chemical insecticidal products has increased more than 10 percent per year in value since 1960, due principally to the replacement in the developed world of older, broad-spectrum organochloride compounds with modern, more selective, and more expensive products. Fungicides are used extensively in fruit and vegetable production to control fungal disease that is prevalent in damp growing areas. Of interest, the need for control of fungal disease is as prevalent in colder northern climates as it is in the tropics.

B. Pesticide Markets in Sub-Saharan Africa

There is little data on the use of pesticides in Africa. The agrichemical industry considers the market for pesticides in Africa to be thin, and there is, therefore, limited interest in extensive market analysis and collection of the requisite data. Moreover, much of the pesticides that are imported into Africa are part of omnibus aid packages and therefore not included in official market transactions. In addition, there exists a significant informal and unrecorded market for pesticides, including products illegally imported and sold without moving through proper pesticide registration channels where extant. Another reason for the industry's disinterest is the chronic financial difficulties that afflict much of the region. The industry generally regards the African market developed to the extent that older, broad spectrum, off-patent products can be sold there profitably (Wood MacKenzie & Co. Ltd 1993a). In the developed world these products have been replaced in use by more sophisticated, generally pest-specific pesticides, at significantly higher costs to the farmer, or have experienced sanctions because of human health or environmental concerns.

> It should be noted that correspondents representing major agrichemical manufacturers declare equitable standards for developed and developing nations with regard to the marketing and sales of pesticides. Ciba-Geigy will introduce a new pesticide product in an African market if it can solve a crop problem and if the product has been registered in a country that is a member of the Organization for Economic Co-operation and Development (OECD) (A. Genrich, personal communication, 1994). Additionally, signatories to the Food and Agriculture Organization's (FAO) International Code of Conduct on the Distribution and Use of Pesticides (FAO 1989b) have agreed not to sell banned pesticides. Nevertheless, sufficient technical product of banned pesticides remains in use to cause genuine concern about harm to the environment and to human health (Environnement et Développement du Tiers Monde 1992).

In Africa, insecticides made up about 45 percent of the total pesticide market in 1990 with older organochloride compounds still prevalent in both agricultural and public health uses (Wood MacKenzie & Co. Ltd. 1993a). Insecticide use in some of the region's nations composes a greater portion of the market. In Côte d'Ivoire in 1992, as an illustration, 85 percent of the pesticide market consisted of insecticides (Landell Mills Market Research, personal communication, 1993). In many nations the heavy use of insecticides can be attributed to the extensive use of pesticidal fumigants. Fifty years ago ethylene dibromide (EDB) and methyl bromide were introduced primarily as fumigants for use against pests of stored products. These elementary products continue to be used widely against pests of stored products and for space and soil fumigation in Africa, although both have been the target of health and environmental concern in the developed world, EDB for its carcinogenicity and methyl bromide for its potential to deplete stratospheric ozone.

Though the majority of insecticides (e.g., organophosphates, pyrethroids, and carbamates) in use in Africa reflect use patterns in other parts of the world, many of the organochloride pesticides, such as DDT, toxaphene, lindane, chlordane, and heptachlor, which have been banned or whose use has been severely restricted in Europe and North America, are still marketed and used in Africa and much of the developing world.[4] Their advantages include low cost, relative ease of manufacture, broad spectrum control, generally low handling hazard, and strong residual effectiveness. The majority of these products continue to be used in the developing world in cotton culture as a foliar application and in maize to control soil insects (Wood MacKenzie & Co. Ltd. 1993a). Manufacture of the cyclodiene group (aldrin, dieldrin, endrin, chlordane) is confined to a number of small operations in the developing world. The Royal Dutch Shell Group dismantled its dieldrin production facilities in 1991, and as of the end of 1992, stopped selling remaining stocks (USAID 1993). An exception is the Velsicol Chemical Company's continued manufacture of chlordane and heptachlor, mainly for subterranean termite control, at a plant in Memphis, Tennessee (S. Marquardt, personal communication, 1994). Rhône-Poulenc is the major producer of lindane (BHC).

Estimates of the chemical pesticide market in Africa vary considerably, ranging from $500 million according to estimates supplied by Ciba-Geigy (Table 3) to 4 percent of global sales (Agrow 1991), or $1 billion.[5] Ciba-Geigy estimates that its sales to Africa (and the Republic of South Africa) are perhaps 50 percent of total sales in Africa. Using that guideline, pesticide sales in Africa in 1992 were perhaps $250-500 million.

Information describing pesticide use in Africa is generally collected at occasional regional pest control/management conferences and represent estimates of government functionaries or field extension workers, or the occasional report of organizations concerned with human exposure or environmental degradation that attempts to estimate use in a particular region or on a specific crop. In rare instances, actual data are collected for market research.

Landell Mills Market Research of Bath, England, collects information on a three-year cycle for five African nations: Côte d'Ivoire, Kenya, Nigeria, Sudan, and Zimbabwe. Data collection methods include interviews of farmers, extension agents, and other government officials by resident and visiting investigators. Field checks are conducted to assess specific pest problems, crop conditions, and products used. Survey techniques utilize farmer panels to ensure consistency and access to information sources. The data are considered reliable, therefore, and major agrichemical multinationals, including Ciba-Geigy, Bayer, DuPont, Zeneca, Monsanto, Hoechst, Shell, Sumitomo, and Rhône-Poulenc, subscribe to the information that Landell Mills provides.

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[4] According to industry sources, the use of lindane is now limited to pest control in cocoa production and as a treatment for cotton seed (G. Bruge, personal communication, 1994).

[5] Rhône-Poulenc estimates the total African pesticide market to be about $600 million (G. Bruge, personal communication, 1994).

Table 3. Ciba/BMI African Pesticide Market Estimates ($ Million), 1990-92

Country	1990	1991	1992
South Africa	163	172	155
Egypt	65	54	59
Morocco	39	48	42
Sudan	30	21	26
Algeria	34	26	26
Tanzania	18	14	18
Nigeria	-	16	15
Ethiopia	14	14	14
Kenya	13	12	13
Tunisia	9	11	13
Côte d'Ivoire	40	44	47
Cameroon	13	-	4
Other nations	60	60	60
Total	498	492	490

Source: A. Genrich, personal communication, 1994

Among the five African countries mentioned above, data on pesticide use for the 1992 harvest year were available for all except Nigeria, where data collection problems hampered completion of a report. Sudan is not a focal country for this report. Consequently, regional patterns of pesticide use for Africa for this report are based on Landell Mills' data for the 1992 harvest year for Côte d'Ivoire, Kenya, and Zimbabwe. Financial constraints for data acquisition limited project data purchases to these three countries. Data describing pesticide use in other nations in the region, including Southern and Western Africa, are based on reports from regional conferences, the FAO (1992), country reports, and other cited sources. The following section characterizes the pesticide use situation in the sub-Saharan region and in particular the three nations for which the greatest amount of information is available.

III. Pesticide Use in Sub-Saharan Africa

A. Historical Perspective

The control of migratory and perennial pests in agricultural production has been a singular priority of governments and donor agencies for years. Human population growth in Africa and the subsequent expansion in food requirements have raised the demand for pesticides for cash crop production, to earn more foreign exchange, and for food crop production, to minimize the need to purchase food on world markets.

Pesticide use in Africa is largely concentrated on high-value cash crops for export. The leading pesticide users in Africa are, therefore, nations with a well-developed cash-crop sector, including Sudan, Tanzania, Zimbabwe, Cameroon, Côte d'Ivoire, and Kenya. Agricultural development philosophies of donor groups influenced many African nations in establishing subsidy structures, which promoted the use of pesticides, at least until recently. Until 1989, for example, all governments in West Africa provided subsidies for growers of industrial and export crops, and, in some instances, for large-scale food production, which allowed easy access to pesticides for most farmers (Farah 1993). Subsidy schemes for food crops operated in many of the nations in the region. With the introduction of structural adjustment programs, however, many of the direct and indirect subsidies for pesticide have been eliminated and replaced with producer incentives in the form of higher product prices. The prices of pesticide inputs increased concurrently. In some instances the purchase of pesticides decreased in response to these higher input prices, Tanzania being a case in point (A. Genrich, personal communication, 1994). In most nations, however, pesticide consumption continues to rise in spite of the increase in pesticide prices because of the apparent compelling production advantages of chemical pesticides over alternative pest control methods. In addition, governmental policies encouraging pesticide use have been common in the region including price subsidization, preferential credit terms for purchases of pesticides and, in many instances, the free distribution and application of pesticide materials on important cash crop hectarage. Plant protection services in many nations have evolved from a focus on centralized control operations to working mainly to increase the efficiency of farmers' use of pesticides and to train extension cadre in safe handling and application methods.

Expenditures for pesticide imports in West Africa, for example, increased steadily between 1970-1989, although growth slowed markedly in the 1980s (Table 4). The FAO estimates an increase in pesticide use of 10 percent per year in the region in the 1990s (FAO 1990).

Nations in the region receive supplies of pesticides mainly through direct importation of ready-to-use formulations by governmental crop protection services, in the form of agricultural development aid packages, and for the emergency control of migratory pest outbreaks. As an illustration, the Japanese government, through its "Grant Aid for Increased Food Production," provides pesticides to more than 20 countries in sub-Saharan Africa (Tobin 1994). Benin has also received substantial pesticide aid-in-kind from the German government (Knausenberger and Schaefers 1992; Youdeowei and Alomenu 1989).

With the exception of the Republic of South Africa, active ingredients are not manufactured in Africa. In contrast, the formulation of imported product is undertaken at existing facilities in Angola, Burkina Faso, Burundi, Côte d'Ivoire, Ghana, Kenya, Mali, Mozambique, Nigeria, Sénégal, Tanzania, Zaire, Zambia, and Zimbabwe. The leading consumers of pesticides in Africa in 1981 and 1992 are listed in Table 5.

Table 4. Pesticide Imports in West Africa, 1970-89

Country	Expenditure $000 (1987-89)	Annual Growth Rate (%) 1970-89	1970-79	1980-89
Cameroon	25,590	13.9	27.6	-2.0
Nigeria	13,900	2.7	23.2	-22.0
Côte d'Ivoire	12,000	11.6	26.8	-3.4
Ghana	10,830	8.5	21.5	-3.8
Burkina Faso	8,530	17.5	26.4	6.0
Togo	7,830	13.7	16.3	12.0
Chad	6,630	10.0	21.1	0.8
Mali	5,820	12.9	6.0	16.1
Sénégal	3,560	10.9	31.5	-1.9
Benin	3,230	6.6	13.9	-0.6
Liberia	1,950	8.3	15.4	3.0
Niger	1,830	10.9	33.4	5.0
Gambia	950	12.6	24.1	2.8
Sierra Leone	870	6.3	-8.4	8.0
Guinea-Bissau	170	4.3	8.0	8.0
Guinea	140	1.6	11.4	0.0

Source: Adesina 1994

Few pesticide substances are sold commercially without being mixed with other ingredients (e.g., carriers, diluents, solvents, wetting agents, emulsifiers, etc.). The chemicals are usually too concentrated and immiscible with water to be prepared directly for the purchaser's use. The prepared, or formulated, mixture concocted to give proper results is spoken of as a formulation. The process of preparing a pesticide for practical use is also called formulation. The pesticidal substance is referred to as an active ingredient or as a technical product (Meister Publishing Co. 1993).

Judging changes in use patterns from expenditures may not be a good barometer of actual pesticide use and availability in Africa. As mentioned previously, much of the material available to African farmers arrives in the form of donations from bilateral donors. In addition, large private commercial growers often buy directly from manufacturers or distributors in neighboring nations without involving domestic governmental agencies. Informal or illegal trade in pesticides also occurs, and record keeping is less than meticulous.

Table 5. Pesticide Expenditures in Selected African Nations, 1981 and 1992

Country	Expenditures ($ Millions) 1981	1992	adj* 1992	real % change
Tanzania	31.8	18.0	13.0	-59
Zimbabwe	29.4	51.0	36.2	+23
Cameroon	24.2	12.4	8.8	-64
Côte d'Ivoire	19.4	43.4	30.8	+59
Kenya	12.0	40.0	28.4	+137

* Deflated to reflect 1981 prices

Sources: 1981: Bryant, 1984; 1992: Landell Mills Market Research, personal communication 1993; Heureux et al. 1992; 1992 Tanzania: A. Genrich, personal communication, 1994

In real terms, pesticide expenditures have increased significantly in three of the five nations charted above. Significant growth in Kenya (+137 percent) and Côte d'Ivoire (+59 percent) probably underestimate the actual growth in use of pesticides because of unquantified donor aid-in-kind and informal or unrecorded trade. Declining pesticide expenditures in Cameroon can be attributed to the depressed world market for coffee and cocoa, a shortfall of hard currency stocks, and the subsequent inability to purchase manufactured inputs as well as the price-inflating effects of structural adjustment programs. In addition, structural adjustment in the Tanzanian agricultural sector and its resultant effects on input and output prices contributed to the decline in pesticide expenditures. Once this market gets prices "right," pesticide expenditures are likely to increase with increased cash crop hectarage. Clearly, the use of pesticides in nations with an expanding agricultural sector shows growth that warrants close attention.

Brief country descriptions of pesticide use practices and related issues follow. In nearly all countries pesticide use is concentrated on cash crops for export, pesticide regulatory structures exist but monitoring and enforcement capabilities are inadequate, and there are few established alternative pest management programs. Appendix A provides a synopsis of some important national characteristics of pesticide use and related issues for the 25 countries described in this report.

B. Country Reports

1. Zimbabwe

Commercial agriculture in Zimbabwe consists of large-scale private and state enterprises farming about one half of Zimbabwe's arable land area. There are about 4,500 large-scale private farms encompassing about 39 percent of total area (Schaefers 1992). The communal sector is composed of about 900,000 farm families (4.5 million people), occupying almost half of the country's arable land area. The average farm size is 2.5 hectares.

The use of pesticides is considered important in Zimbabwean agriculture to maintain historically high levels of productivity. Large-scale commercial tobacco and cotton production and, to some extent, maize, consumed 82 percent of pesticides used in 1992 (Figure 4). The country's pesticide market totaled 2,424 MT and had an estimated value of $51 million. Other commercial crops include tea, wheat, coffee, soybean, and sugarcane. Smallholder crops include maize and vegetables. More than half the pesticides used were insecticides, and tobacco growers were the largest users of insecticides. Zimbabwe ranks third in worldwide exports of tobacco, which is the country's principal source of foreign exchange. The Tobacco Marketing Board, which exports neariy all of tobacco grown in Zimbabwe, is the major pesticide user (Schaefers 1992). The herbicide market is divided among cotton, maize, soybean, and tobacco (Figure 5).

Prices of quality flue-cured tobacco on world auction markets have dropped since 1991. At 1993 auctions, for example, Zimbabwean tobacco was sold for $1.05/kg, two-thirds of the 1992 price and one-third of the 1991 price of $3.25/kg (Wood MacKenzie & Co. Ltd. 1993a). Only a small portion of the expected 200,000 MT crop was sold, severely affecting growers and stocks of hard currency. Should this situation endure, tobacco culture may decline along with the associated heavy use of pesticides.

The major pesticide formulator and distributor is Zimbabwe Fertilizer Company, which recently gained the number one position from Agricura (Figure 4). Zimbabwe Fertilizer controlled 27 percent of the pesticide market in 1992, and Agricura had 23 percent.

Appendix B, Tables 1 through 6, provides breakdowns of active ingredients of pesticides used by important use commodities in Zimbabwe for the 1992 harvest year. Significant characteristics to note include:

* the relatively heavy use of two fumigants, EDB and methyl bromide, which constituted almost 80 percent of total insecticide use by volume in 1992, and 51 percent of all pesticide use by volume in 1992.[6] The U.S. Environmental Protection Agency (USEPA) canceled all uses of EDB in 1983, and the pesticide is no longer registered in the United States because of its carcinogenic and mutagenic properties. In addition, the production and use of methyl bromide in all applications will be canceled in the United States effective January 1, 2001, due to the chemical's ozone-depleting effects.

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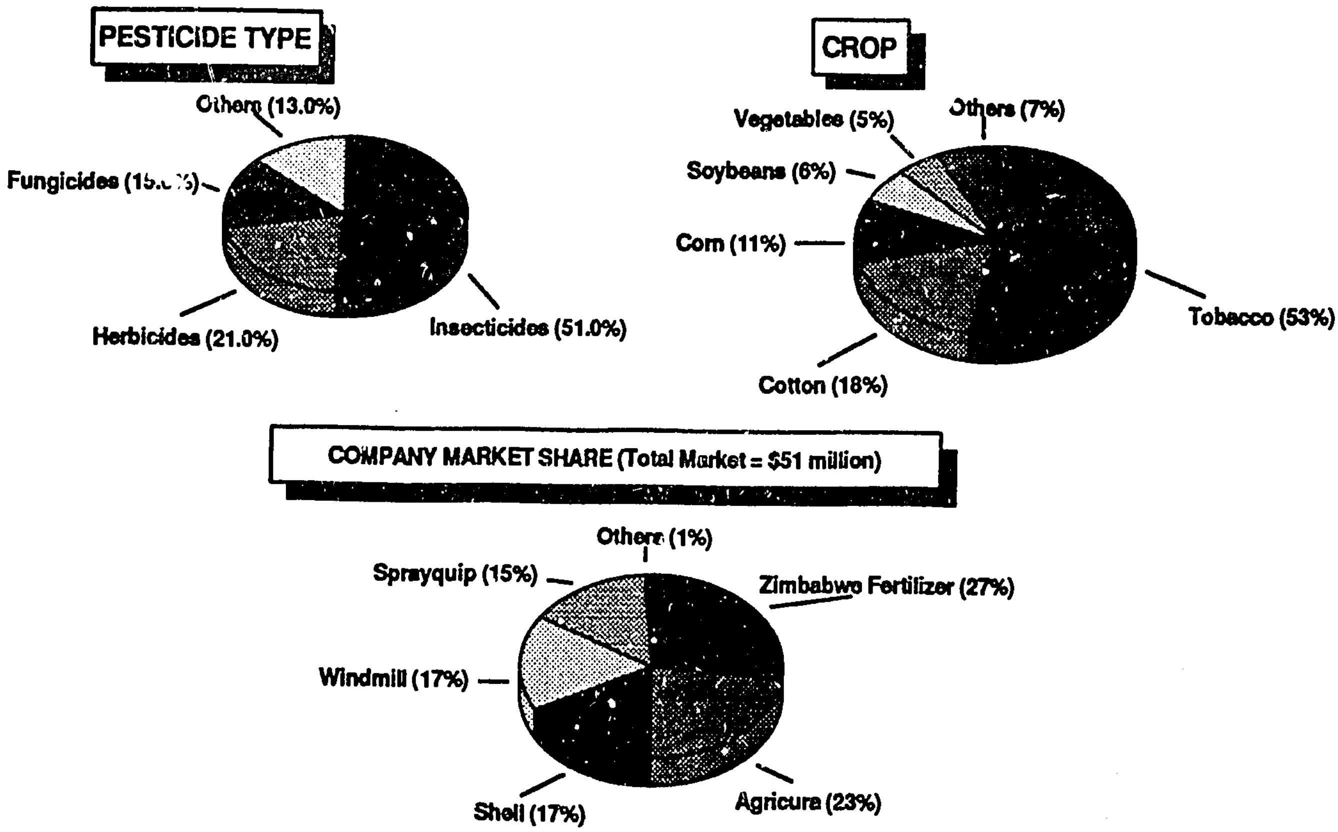
[6] Dzemwa (1993) estimates that 963 MT of EDB and 156 MT of methyl bromide were used in the country in 1992.

* the herbicides used most extensively--alachlor, atrazine, and metolachlor--are products that find extensive use in North American and European agriculture where they have caused environmental concern by percolating into and contaminating groundwater aquifers and rural water sources.[7]

* tobacco growers are the heaviest users of fungicides. Copper compounds account for more than half of use. (Dzemwa (1993) estimates that 417 MT of copper oxychloride was used as a fungicide in 1992).

* Mancozeb, one of the most frequently used fungicides, is an ethylenebisdithiocarbamate (EBDC) that has caused concerns about food safety in the United States because of possible carcinogenic effects.

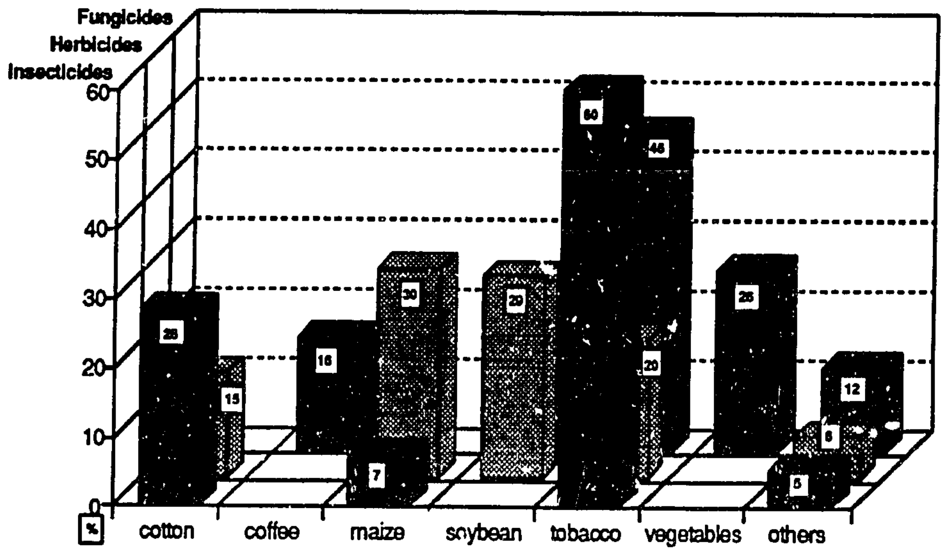
Figure 4. Zimbabwe's Pesticide Market, Harvest Year 1992



Source: Landell Mills Market Research, personal communication, 1993

[7] Dzemwa (1993) estimates the following consumption of herbicides in 1992: 304 MT of atrazine, 172 MT of alachlor, and 123 MT of metolachlor; other major herbicides in use included paraquat (79 MT) and glyphosate (29 MT).

Figure 5. Zimbabwe's Pesticide Use by Crop, 1992 Harvest Year

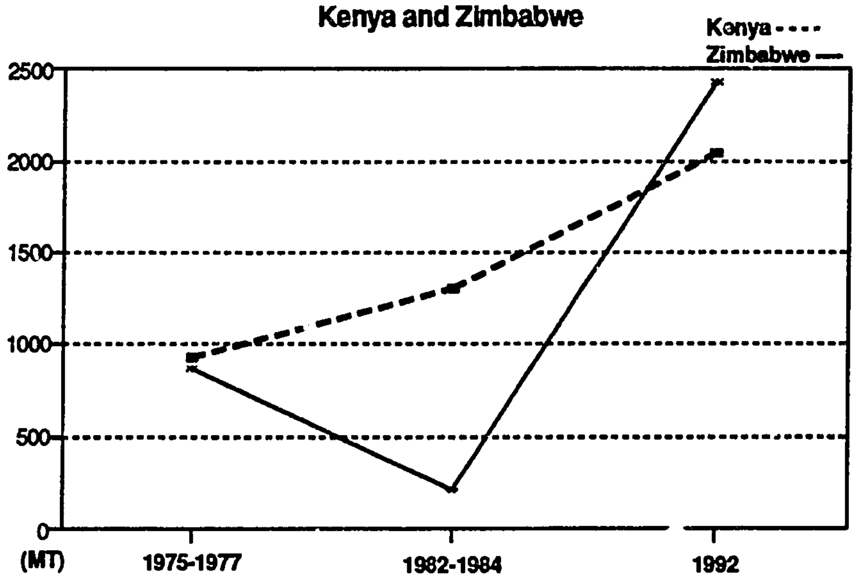


Source: Landell Mills Market Research, personal communication, 1993

FAO data (see Figure 6) reveal that pesticide use decreased significantly between 1975-1977 and 1982-1984 due in part to the unstable political and security situations, which disrupted agricultural production prior to 1980. The institution of land tenure reforms after Zimbabwe's independence in 1980 contributed to instability in the agricultural sector. The agricultural sector has since reestablished itself. Pesticide use surged between 1982-84 and 1992, from 250 MT to 2,424 MT, in spite of severe drought in the region in the last three production years. These changes underscore the notion that assessing changes in dollar-value expenditures over time for pesticides in a particular country in Africa can offer insights into trends but can also underestimate substantially the magnitude of pesticide use. Although there was an increase of only 23 percent in real-dollar expenditures for pesticides in Zimbabwe between 1981 and 1992 (Table 5), survey-based estimates indicate that the tonnage of pesticides applied increased 1,000 percent. Either the real price of pesticides decreased over the 1981-92 period or much of the material used was provided through donor aid-in-kind programs, especially after independence. The latter most likely describes the Zimbabwe's situation. The intensification of use on cash crops has increased as has the use on food crops as agricultural production systems have developed.

Pesticides are formulated in Zimbabwe with imported active ingredients. Repackaging of imported bulk commodities is also undertaken because of the existence of a sizeable internal market for small-scale use. The capacity of the five plants currently in operation to formulate pesticides is 12,000 MT of formulated product per year. These plants were operating at 25-percent capacity in January 1994 (C. Pretot, personal communication, 1994). The private sector distributes pesticides. A number of companies have exclusive retail outlets throughout the country. The main distributors are Agricura, Windmill, ZFC, Shell, Spraying Equipment for agrichemicals, and Cooper for veterinary and household chemicals.

Figure 6. Pesticide Active Ingredients Used, 1975 - 1992



Source: FAO 1992; Landell Mills Market Research, personal communication, 1993

Most of the pesticides available in Zimbabwe (and in southern Africa) originate from German, Swiss, British, American, or Japanese manufacturers. A large percentage of pesticides are offered through affiliated agents based in the Republic of South Africa. Approximately half of the total pesticides used are formulated locally. Less than 10 percent of the pesticides imported are in ready-to-use packages. Obsolete stocks of pesticides are not a problem. Zimbabwe allocates foreign exchange to ensure the targeting of priority crops for applications.

The Agricultural Chemical Industry Association, an association of agrichemical formulators/distributors, was formed in 1960. It became affiliated with the International Group of National Associations of Pesticide Manufacturers (GIFAP) in 1987 and has agreed to adhere to the FAO's Code of Conduct.

Pesticide legislation exists (van der Wulp 1991; Schaefers 1992). No agricultural or veterinary pesticides may be sold or distributed unless they are registered according to the Pesticide Regulations of 1977, under the provisions of the Fertilizer, Farm Feeds, and Remedies Act of 1952, and placed in Group II or III of the Hazardous Substances and Articles Act (Schaefers 1992). Registration involves assurance of efficacy and degree of toxicity. Officially, pesticides that are suspected carcinogens, based on information from the USEPA or any other reliable source, are banned or their use severely restricted. All the pesticides in use must be registered with the Plant Protection Research Institute in the Ministry of Lands, Agriculture, and Rural Resettlement. Once registered, pesticides are classified into one of four categories depending on their mammalian toxicity. Pesticides classified as dangerous or very dangerous are sold only to large-scale farmers or estates that have staff familiar with safe handling practices. Zimbabwe is phasing out the use of the organochloride compounds, namely DDT, aldrin, and dieldrin. The legislation also deals principally with types of protective clothing required for the application of various categories of products.

The smallholder sector produces about half the total agricultural output but uses only about one-quarter of the pesticides. Large-scale farming enterprises consume about 70 percent of total pesticides used (Muchena 1991). Recent observations indicate that many farmers are unconcerned about rates of pesticide use and, in fact, believe that increased use of pesticides is necessary if Zimbabwean agriculture is to intensify production successfully (Mudiumu 1994). Persistent drought conditions and the ongoing realignments in land tenure (a current resettlement plan involves 40,000 families on 8 percent of the agricultural land) constrained pesticide use in Zimbabwe in 1992.

The extent of alternative pest control investigations include biological control of defoliating pests and whiteflies, cultural controls such as the use of trap crops and alternative cropping sequences in cotton, and experimentation with pest resistant crop varieties (Schaefers 1992). All these approaches can be considered experimental. There is little commercially inspired work on alternative pest control methods (C. Pretot, personal communication, 1994).

IPM is not yet a policy goal. The Plant Protection Service remains skeptical of the long-term viability of alternative pest management methods. To the extent that IPM methods are used, the primary goal is decreased input costs for large-scale plantation operators (Mudiumu 1994).

If tobacco markets recover, if Zimbabwe's tobacco export markets are maintained, if some stability emerges in resettlement activities and in the land tenure situation in general, and if normal amounts of rainfall return to the region, then pesticide use in Zimbabwe can be expected to increase at a rate at least as great as the 10-percent annual growth predicted for the region as a whole.

2. Kenya[8]

In Kenya, as in other countries in the region, most pesticides are most heavily used on cash crops for export. Due to the country's rapid rate of population growth, of 3.5 to 4 percent per year, however, continual pressures exist to increase agricultural productivity in both cash and food crops to earn foreign exchange to finance domestic projects and to feed the population.

The FAO's data indicate that pesticide use in Kenya grew to 1,300 MT in 1982-84 from approximately 935 MT in 1975-77. Data from Landell Mills Market Research (personal communication, 1993) suggest that total use in 1992 was about 2,032 MT with a market value of $40 million. Consequently, use increased 220 percent in the 16-year period since the initial

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[8] For a more detailed discussion of pesticide use in Kenya, readers may wish to read a companion study (Meltzer and Matteson 1994) of this project.

estimate, and 56 percent since 1982-84. Despite the increase in the use of pesticides over that period, other data indicate that pesticide use, especially that of fungicides, has dropped precipitously since 1986 (Table 6).

Table 6. Importation of Pesticides (MT) into Kenya, 1986-1991

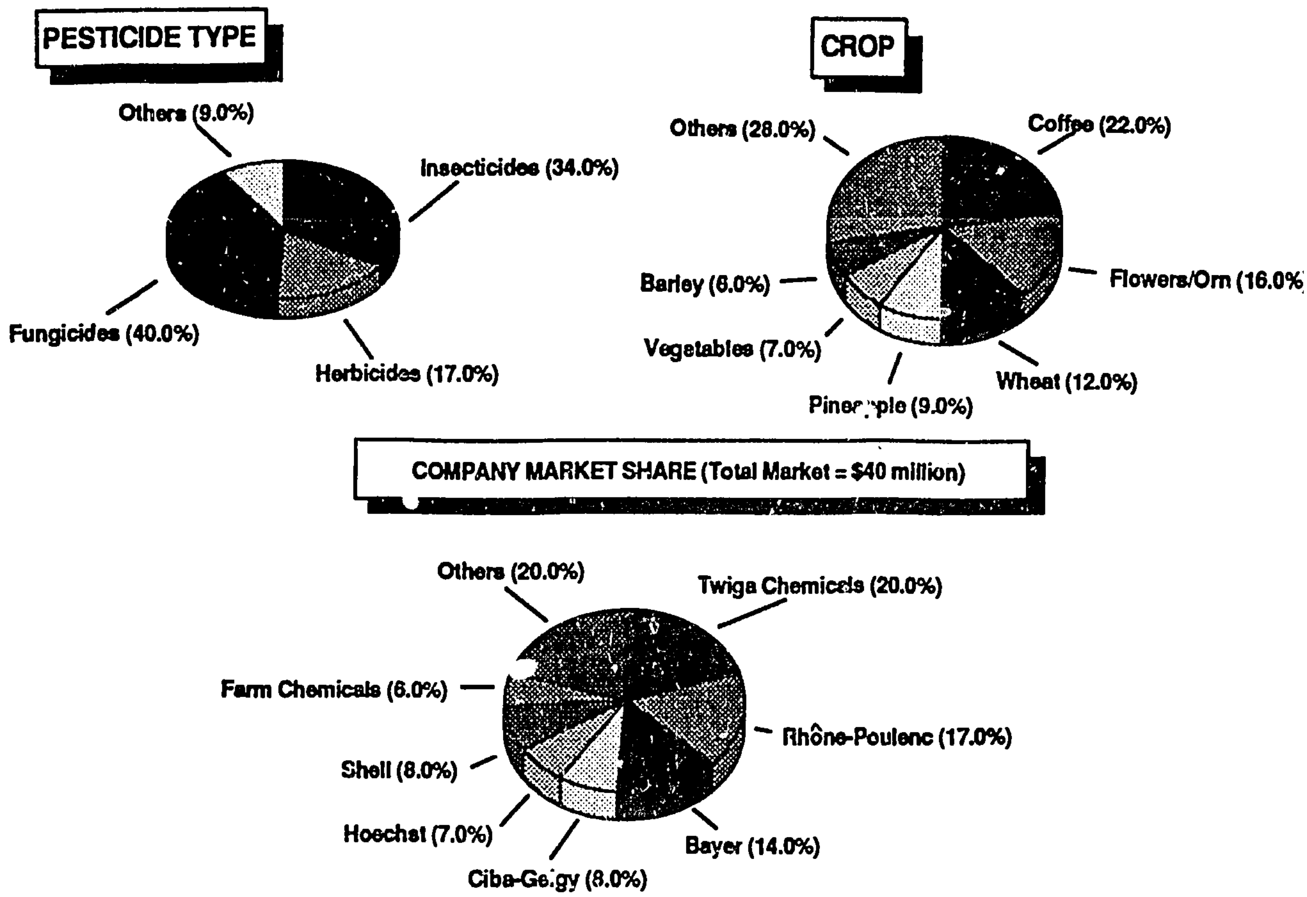
	1986	1987	1988	1989	1990	1991
Insecticides/ Acaricides	1,076	1,206	1,089	1,571	1,572	1,072
Herbicides	1,129	1,311	2,108	1,148	1,134	844
Fungicides	6,584	7,157	4,259	4,327	1,330	1,568
Others	808	697	801	665	857	570
Total	9,597	10,371	8,257	7,711	4,893	4,054

Source: "Country Report on Pesticide Management." Report prepared for Subregional Workshop on the Implementation of the International Code of Conduct on the Distributic and Use of Pesticides. 7-12 December 1992, in van Oers 1994

Pesticides are used principally in coffee production. Approximately two-fifths are fumigants (Figure 7). Overall, coffee consumed 22 percent of the entire pesticide market with flowers and ornamental plants second with 16 percent of the market. According to industry estimates, less than 20 percent of the available pesticides arrived through tender offers and aid programs (C. Pretot, personal communication, 1994).

Heavy pesticide use in the production of cash crops, particularly coffee and to a lesser extent cotton, is attributed to the large pest complexes that affect these crops and buyers' low tolerance for pest damage. The price for second-grade cotton is, for example, half that for first grade. Lower quality coffee receives severely reduced prices and, in some instances, prospective buyers refuse to buy it (Goldman 1987). Although analogous damage occurs in food crops, farmers can cope more flexibly because a market exists for lower grade foodstuffs for either human or animal consumption. Herbicides are used extensively in wheat production (see Figure 7 and Table 7), while flowers, vegetables, and cotton production consumed slightly more than half of insecticides used in agriculture.

Figure 7. Pesticide Market in Kenya: Harvest Year 1992



Source: Landell Mills Market Research, personal communication, 1993

Copper fungicides have been used extensively in coffee production for many years to the extent that resistance and phytotoxicity have developed (Landell Mills Market Research, personal communication, 1993). Organic fungicides such as captafol and dithianon are also used, although at much greater expense. DDT was one of the first and principal insecticides used in Kenya. Despite pest resistance, adverse environmental consequences, and a ban on DDT's use in agriculture, small amounts of DDT reportedly remain in use on coffee. The pesticide's main use is , however, for the control of stalkborers in maize production (Schaefers 1992). Most insecticides are concentrated in the organophosphate materials, particularly fenthion and fenitrothion, for cotton, coffee, pineapple, vegetables, and flower/ornamentals.

Stimulated by the rising costs of hired labor, the use of herbicides (particularly paraquat) has increased. In addition, problems with controlling persistent weeds (perennial grasses and sedges) has led to the increased use of glyphosate, a systemic herbicide. With costs of labor continuing to increase, herbicide use can be expected to increase concurrently. At the same time, however, there are countervailing pressures that may lead to reduced dependence on pesticides. Flowers and vegetables intended for export markets, primarily in Europe, must not exceed maximum residue levels. To the extent that the products exceed such levels, the exports will be subject to rejection at ports of entry. For this reason, many Kenyan growers are concerned about potentially excessive use of pesticides.

The use of pesticides in cash crops has some spillover effects on food crops. The availability of chemicals and application equipment, the presence of cooperative societies that provide credit for pesticide purchases, and the general familiarity with the technology and its effectiveness have led to the increased use of pesticides on food crops. Goldman (1987) found that 90 percent of the farmers growing potatoes for household consumption in the Kigumo region were using fungicides that were purchased for application to coffee. Farmers sprayed both crops during the same sweep to save the expense of hired labor and rented equipment. Similarly, chemicals intended for cotton were used on pigeon peas and cowpeas in the Makueni region.

Table 7. Kenya's Pesticide Usage by Crop, 1992 Harvest Year

Commodity	Fungicides (%)	Herbicides (%)	Insecticides (%)
Coffee	37	11	9
Flowers/Ornamental	15	-	29
Wheat	10	32	-
Potatoes	7	-	-
Barley	7	7	-
Pineapple	5	7	9
Maize	-	11	-
Sugarcane	-	17	-
Sisal	-	7	-
Cotton	-	-	9
Vegetables	-	-	13
Others	19	8	31
Total	100	100	100

Source: Landell Mills Market Research, personal communication, 1993

Most of the large European multinational agrichemical companies held appreciable market shares in 1992. Rhône-Poulenc held 17 percent of the market, Bayer, 14 percent, and Shell and Ciba-Geigy, 8 percent each. Twiga Chemicals, a large independent formulator and marketer held 20 percent of the market (Figure 7). Formulating facilities are currently operating at about 20 percent capacity (C. Pretot, personal communication, 1994). Appendix B, Tables 7 through 12, provide more details on the use of pesticides in Kenya. A review of these tables indicates the following:

* Herbicides represented only 17 percent (348 MT) of the market in Kenya in 1992. Individuals in the Kenyan agrichemical industry predict an increase in both herbicide and fungicide use (C. Pretot, personal communication, 1994).

* The most popular herbicide in terms of volume of product applied and area treated is 2,4-D, a class of phenoxy products that has been in widespread use since the early 1950s, generally to combat broadleaf weeds in the production of cereals. In the United States, this herbicide was once considered for Special Review because of concerns about possible chronic health effects among farm workers.[9] Pending verification of toxicological data, 2,4-D has been removed from priority consideration for such review.

* In pineapple production, an average of 376 kg of insecticides is used per hectare. This includes 368 kg per hectare of the fumigant dichloropropane used on 1,000 of the 10,750 hectares in pineapple production. Insecticide use on pineapples represents 45 percent of all insecticide use in agriculture by volume, an intensive use even considering the heavy dose rates usually associated with the use of fumigants in agriculture.

* Methyl bromide constituted 60 percent of the insecticides used in production systems for flowers and ornamentals and 19 percent of all insecticide use. The chemical was used as both a soil fumigant and as a quarantine application for agricultural products intended for export.

The status of pesticide legislation in Kenya is relatively advanced when compared with most other African nations. The country ascribes to the FAO's Code of Conduct. The Pest Control Products Act of 1982 requires registration, through a registration board, of all imported products and defines standards for packaging, labeling, and data needed for registration. Since 1982, however, only about 150 of 400 products sold in Kenya have been fully registered and, in general, enforcement appears to be weak (Schaefers 1993). Existing or planned subsidiary regulations address issues such as licensing of premises, registration regulations, import and export regulations, and labeling. Obsolete pesticide stocks total about 100 MT and are residual from prior locust control campaigns.

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[9] The USEPA can initiate a Special Review process when a determination is made that a chemical compound has exceeded a threshold for unreasonable adverse effects to humans and/or the environment. Risk criteria include the possibility of serious acute injury to humans or domestic animals and/or risk of oncogenicity, mutagenic, teratogenic, or fetotoxic effects. Other considerations involve a judgment that a pesticide can lead to possible hazardous residue levels in the environment, can create a risk to endangered or threatened species, can destroy habitat critical to the existence of endangered species, or can otherwise pose a risk to humans and/or the environment that outweighs the benefits of the continued use of the chemical.

The IPM concept has not yet become established as an agricultural policy goal. In a survey of developing country representatives conducted at a global IPM meeting in Bangkok, Thailand in August and September 1993 (Fleischer and Waibel 1994), the Kenyan representative indicated that IPM programs are at the research development stage with no national IPM guidelines in place. When developed, national priorities will focus on farmer training in effective pest management methods using decreased pesticide rates as well as instruction in safe handling and use procedures.

3. Côte d'Ivoire

Data from Landell Mills Market Research (personal communication, 1993) describing pesticide use in Côte d'Ivoire were available in a preliminary form, that is, by formulated product rather than as active ingredients. This reporting procedure differs from the reports on Kenya and Zimbabwe but constitute the extent of available information. The actual amount of active ingredients included in a formulated pesticide product varies according to specific formulation. Active ingredients typically comprise between 5 percent (e.g., for dusts) and 95 percent (e.g., for ultralow volume products) of the total product. Active ingredients are approximately 40 percent of a formulated quantity.

Approximately 5,330 MT of formulated pesticides were used in agricultural production activities in Côte d'Ivoire in 1992, and were valued at $43.4 million, 67 percent of which were insecticides used for cotton. No data were located to compare these figures with use in earlier periods. In addition, many of the insecticidal products used are not listed in standard catalogues of pesticides and related products (e.g., Meister Publishing Company's (1993) *Farm Chemicals Handbook 1993* or John Wiley & Sons (1992) *Crop Protection Chemicals Reference*). Some information presented at a regional conference on the disposal of pesticides (Anon., "Communication de la Côte d'Ivoire devant la conférence sur l'élimination des pesticides Périmés et de leurs Emballages" 1990) indicates that 6,000 MT of pesticides were used in 1988 in agricultural production. Of this amount, 73 percent were insecticides and acaricides, 11 percent were herbicides, 5 percent were growth regulators, 4.6 percent were nematicides, and 2.1 percent were fungicides. These estimates are of total tonnage of formulated product rather than of active ingredient.

Pesticide use is concentrated in cotton production. Traditional cash crops such as coffee, cocoa, banana, pineapple, and sugarcane also receive applications. Few pesticides are applied to domestic food crops. Accordingly, future pesticide use hinges on the dynamics of the world market for cotton, which has recently experienced surplus production and depressed prices. Population pressures do not exist in Côte d'Ivoire to the extent experienced in some East African nations and, therefore, marginal arable land will probably not be used to grow food. Current production capacity for food crops is sufficient barring any sort of natural calamity. Pesticide use may flatten or actually decrease depending on world market conditions for exported crops, especially cotton.

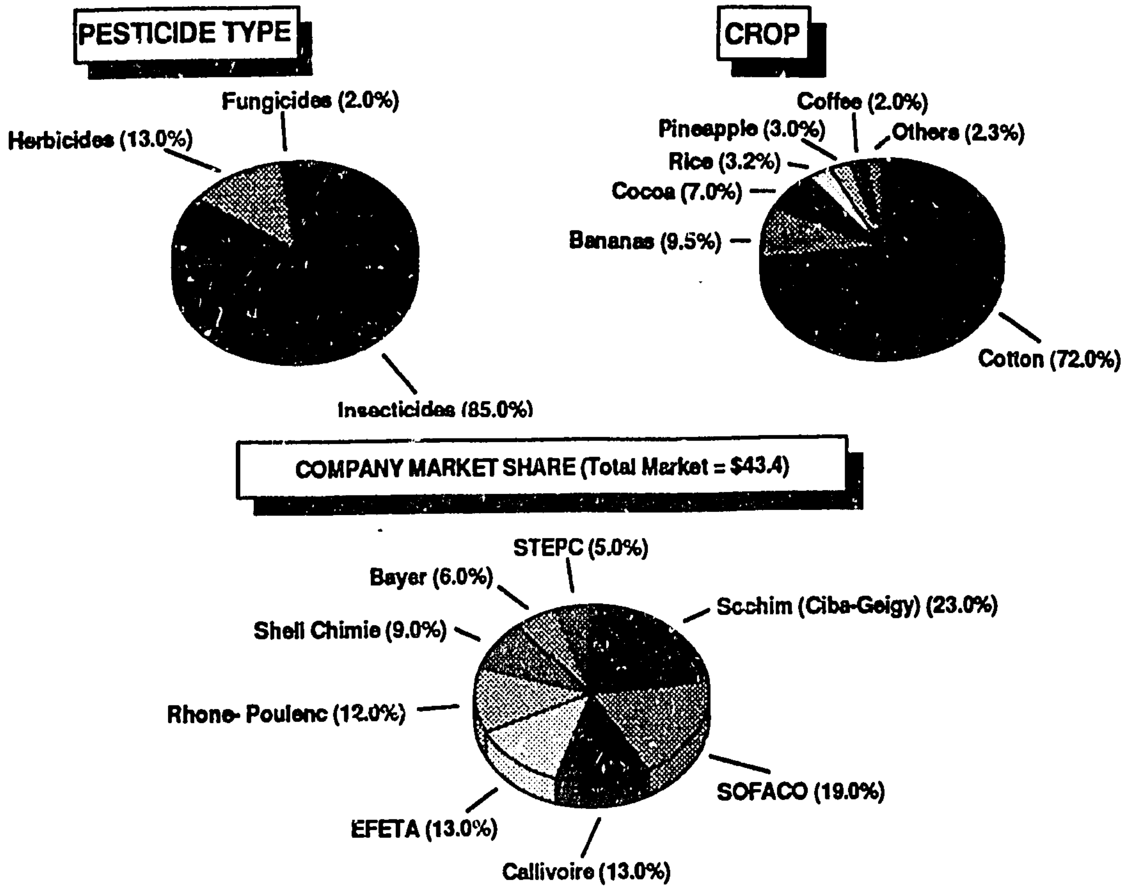
About 4,000 MT of formulated products (or 67 percent of total use) were used in 1988 in the production of cotton. These figures correspond closely with the Landell Mills' data from 1992 and can, therefore, be considered reliable. Overall, insecticides comprised 85 percent of the pesticide market and herbicides, 13 percent in that year. Fungicide treatments are currently uncommon in Ivoirian agriculture. Of all pesticides used in 1992, cotton production consumed 72 percent (versus 67 percent in 1988), banana production, 9.5 percent (versus 5.3 percent in 1988), cocoa, 7 percent (versus 3.6 percent in 1988), and pineapple, 3 percent (see Figures 8 and 9). When compared with 1988 figures, pesticide use on cotton now commands an increased market share, up from 67 percent. Coffee production, which accounted for 4.2 percent of all pesticides used in 1988, accounted for only 2 percent of the market in 1992. This shift may reflect the effect on Ivoirian production of an extended period of depressed world prices in the coffee market.

In northern Côte d'Ivoire, a cotton parastatal extensively encourages the use of pesticides in cotton production. Prior to 1990-91, the parastatal dispensed insecticides free of charge to its growers to minimize potential crop losses to insect pests and to maintain the quality of cotton grown primarily for export markets. Insect pest resistance has recently been noted due to pesticide overuse (Adesina 1994). The parastatal also provides indirect subsidies by offering credit for herbicide purchases at below-market interest rates. Beginning in 1991, the parastatal discontinued free provision of insecticides due to decreased world prices for the other principal commodity exports, coffee and cocoa, limiting available resources to support input subsidization in general.

Appendix B, Tables 13 through 15, provide more detailed information on the use of pesticides in Côte d'Ivoire. Examination of the data in these tables reveals that approximately four-fifths of total pesticide consumption was composed of organophosphorus compounds and synthetic pyrethroids, characteristically used in the production of cotton. Ammonium compounds and carbamates are also widely used. A number of active ingredients are banned for use in agricultural production in Côte d'Ivoire, including DDT, HCH, and dieldrin, all of which are organochloride products whose use has been banned completely or severely restricted for most applications in many countries.

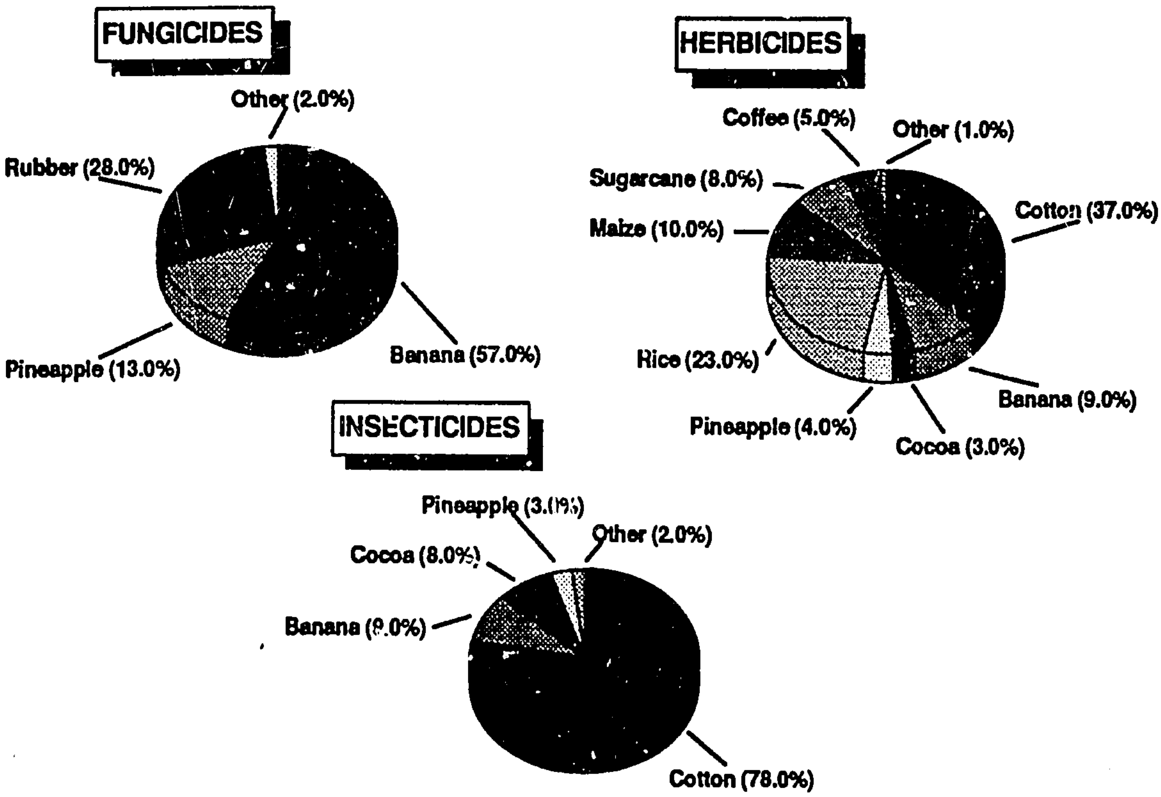
Eighty percent of the pesticides used in Côte d'Ivoire are formulated locally with the remainder imported as ready-to-use formulations. The government sets prices for pesticides, and users benefit from a reduced tax rate that effectively encourages consumption. The country has an active national association of agrichemical producers and distributors (Union de la Profession Phytosanitaire en Côte d'Ivoire), which is a member of GIFAP. The agrichemical industry is sufficiently developed to produce for export to neighboring nations (Youdeowei and Alomenu 1989). Pesticide legislation currently in force was revised in 1989 and is consistent with the FAO's Code of Conduct.

Figure 8. Côte d'Ivoire's Pesticide Market, 1992 Harvest Year



Source: Landell Mills Market Research, personal communication, 1993

Figure 9. Pesticide Use in Côte d'Ivoire by Pesticide Type, 1989/90 Season



Source: Landell Mills Market Research, personal communication, 1993

C. Pesticide Use in Other African Nations

Data describing pesticide use in other African nations are, in general, less comprehensive than those that Landell Mills Market Research attempts to collect in a systematic manner. Comparatively thin markets and limited interest in market research account for the shortage of good sources of data. Despite these problems, many individual nations do collect data on pesticide production and use. Unfortunately, many of these data are not readily available or well publicized. Data that are available are reported periodically at regional conferences on IPM or pesticide use. The brief country descriptions that follow were mined from papers presented at such conferences, other contributions to reports dealing with pesticide use or environmental issues in the region, and data from Ciba-Geigy's database for specific countries.

1. Angola

Although the ongoing civil war has partially disrupted agriculture in Angola, the smallholder farming sector in Angola continues to utilize virtually all available agricultural land; commercial holdings are minuscule. The principal crops are maize, cassava, coffee, cotton, sugarcane, banana, oilseed, sisal, and oil palm. Pesticide use was estimated to be about 518 MT in 1987, with insecticides comprising two-thirds of the total; herbicides, 4 percent; fungicides, about 10 percent; and others, 18 percent (Jose n.d.). The largest share of pesticides are used on coffee (glyphosate), cotton (cypermethrin), cassava (malathion and dicofol), maize (diazinon and atrazine), potato (propanil and mancozeb), banana (benomyl and carbofuran), vegetables (propanil and endosulfan), and fruit crops (fenthion).

Some pesticides are used in migrant pest control. The last severe locust outbreak occurred in 1981 and was treated with lindane. Armyworms are an occasional pest, but the government does not apply any treatments. Quelea grain-eating birds occasionally cause serious grain losses, but no centralized actions have been taken.

The government, through the parastatal DINAMA, is the sole importer of all formulated materials and active ingredients. AGRAN and Shell produce formulated products from imported active ingredients and market their products through a system of distributors located throughout the country.

Pesticide regulations are based on Portuguese rules, which governed pesticide transactions in its overseas territories. These rules are being revised to bolster their effectiveness to include requirements for the registration of pesticides and guidelines on labeling, packaging, and distribution. Angola prohibits the import of aldrin, dieldrin, DDT, fluoracetamide, and HCH but permits that of dinoseb and dinoseb salts. Enforcement is a significant issue due to a lack of inspectors and laboratory facilities.

2. Botswana

The principal crops in Botswana include sorghum, maize, cotton, pulses, fruits, and vegetables. Quantities of pesticides used in agricultural production are not known since no records are kept. Commercial farmers import ready-to-use products directly, usually from Zimbabwe or South Africa. Nincty-five percent of Botswana's pesticide stocks are imported from the Republic of South Africa through representatives of European or Japanese chemical firms. About 5 percent of pesticides used are from European donor agencies. Smallholders do not make much use of pesticides because of the limited supplies available from the Ministry of Agriculture's Plant Protection Division, which sells products at cost. More important, alternative pest management practices are as effective and are less expensive to implement. The market for all pesticides was estimated to be between $3.5 and $5 million in 1988 with the bulk used for animal health and migratory pest control (locust and Quelea birds). Approximately 12 MT of DDT were used in vector-control programs for malaria.

The largest private importer and distributor is Clover Chemical Industries (representing Bayer, ICI, Ciba-Geigy, and Agricura), which supplies about one-third of the pesticides used in the country. Others are DeeKay Chemicals, Pan-African Agro Services, and Stockman Products, which collectively supply about one-third of the market. The government imports the remainder from companies based in South Africa that have won tenders. Private large-scale farmers, who deal directly with chemical companies in South Africa or Zimbabwe, also import pesticides. At the request of the Botswanan government, the FAO prepared draft legislation in June 1989, to establish a registration scheme and a Registry of Pesticides within the Ministry of Agriculture (FAO 1990). As of 1993, however, the FAO (1993a) indicated that the proposal had not yet been enacted.

3. Burkina Faso

Approximately 85 percent of Burkina Faso's population is involved in agricultural production. Productivity levels are characteristically low due to poor soils, recurring drought, and lack of technological improvements. The southwestern portion of the country is fertile but has been affected by endemic onchocerciasis. Somewhat successful governmental programs to control this parasite has caused a reintroduction of agricultural development activity in the region.

Cotton production represented 37 percent of total revenue from exports in 1988-89. The Société Burkinabé des Fibres Textiles (SOFITEX), the country's cotton parastatal, controls approximately 150,000 hectares. A pesticide formulating facility recently began operations in Bobo Dioulasso in the southwest portion of the country. Most pesticides are destined for application in cotton production. Important formulations include dimethoate, prophenphos, isoxathion, fenvalerate, cypermethrin, and deltamethrin. About one million liters of pesticides were used in cotton production in 1990. SOFITEX distributes treated cotton seed to farmers in cotton-producing regions without charge (Environnement et Développement du Tiers Monde 1992).

About 235 MT of powdered formulations and 144,000 liters of liquid products were used against grasshoppers in 1989. The products used included fenitrothion (diverse formulations), malathion (diverse formulations), propoxur, deltamethrin, pyridaphenthion, and lambda-cyhalothrin. Between 1986-87 and 1990-91, the area treated for locusts and grasshoppers varied dramatically, a pattern also found in other Sahelian countries confronting these pests. Much of this variation can be attributed to fluctuations in the amounts of pesticides that international assistance agencies provided.

In irrigated rice-producing regions, ongoing campaigns against Quelea birds use fenthion, phosdrin, and parathion. Prior to the use of chemical control methods, yield loss from bird infestation was dealt with using noise and whistles created by children guarding fields. In some instances no control methods were used against birds.

Pesticides currently encountered in the markets of Ouagadougou or Bobo Dioulasso are phosdrin, maneb, thioral (heptachlor+thiram), HCH, actellic, pyrimiphos-methyl, and lindane. These are generally marketed in small plastic sacks without labeling or application instructions (Environnement et Développement du Tiers Monde 1992).

The development of resistance to organochloride compounds by the *Anopheles* mosquito has caused a shift to organophosphate and carbamate materials. The cost of these pesticides as well as their growing ineffectiveness has led to the abandonment of large-scale treatment programs. Other chemical treatment approaches are being tested including spraying interior walls of dwellings, but little impact has been demonstrated in decreasing endemic rates of malaria. Nonchemical methods of mosquito control are being tried, including drainage of standing water and eliminating aquatic plants to help accelerate water flow.

Biological methods are being used to control onchocerciasis. Specifically, *Bacillus thuringiensis* (Bt) applications are being made in an attempt to decrease the amount of chemical pesticides used each year to control the disease vector. The World Health Organization's Onchocerciasis Control Program in West Africa (Le programme de lutte contre l'onchocercose en Afrique de l'Ouest), which is comprised of eleven member nations, uses approximately 600,000 liters of pesticides each year. A total of 350,000 liters of Bt formulation were applied in those nations in 1989.

Burkina Faso enacted pesticide-related legislation and regulations to implement the legislation in 1986. Regulations describing conditions of sale of pesticides have been established along with a list of banned products (Environnement et Développement du Tiers Monde 1992). A formal regulatory structure for the distribution and use of pesticides is not yet in place, but as of June 1993, the government had reached an interim decision to prohibit the importation of aldrin, dieldrin, DDT, and dinoseb. A total of 20 pesticides are banned (FAO 1993a).

The principal distributors of pesticides in Burkina Faso include the DPV, Bayer, SACOF, SPIA (Sénégal), SSEPC (Sénégal), Calliope, Saphyto, Dow (Côte d'Ivoire), Celamerck (Sénégal), Agri Service Plus (Ciba-Geigy), and Rhône-Poulenc (Côte d'Ivoire).

4. Burundi

Pesticides are used in Burundian agriculture in the export sector. The major users are the commodity organizations for coffee, cotton, tobacco, and the Ministry of Agriculture (Knausenberger and Schaefers 1992). Coffee production, the small farmer's principal access to the cash economy, occupies 4 percent of cultivated land and accounts for 80 percent of agricultural export value. Population growth pressures are considerable. Increasingly, the production of coffee is in competition with food crops, leading to intensified use of pesticides as the production of food crops increases. Other cash crops, including tea and cotton, are less competitive with food crops. Nontraditional cash crops include quinine, green beans, passion fruit, vegetables, and flowers and ornamentals. Virtually all land suitable for production is currently under continuous cultivation. Export earnings from coffee have been decreasing recently, although earnings from tea and cotton have increased, leading to speculation that future demand for inputs, including pesticides, in the production of these export crops will increase. The use of pesticides on food crops is negligible.

Essentially all pesticides used in Burundi arrive via donation or tender from the commodity export crop organizations, mainly OCIBU (coffee), COGERCO (cotton), and BTC (tobacco). Japan is the principal pesticide donor. Between 1983 and 1991, the Japanese donated about 110 MT of pesticides per year, in addition to application and safety gear.

A substantial portion of the finished bulk pesticides applied to crops is reformulated in Burundi from imported technical material. Approximately 4,000 MT of formulated dry pesticides (dusts, granules, wettable powders) and about 100,000 liters of product in liquid formulations have been used for crop protection in a typical recent year suggesting an approximate market value of $2 to 3 million (Table 8).

Table 8. Burundian Pesticide Use in 1991 (or available to MINAGRI in 1991-92)

Agency	Insecticides	Fungicides	Herbicides	Total	Percent
	(Measurement in metric tons)				
COGERCO (cotton)	86.6	-	-	86.6	2.1
OCIBU (coffee)	3,800.0	-	-	3,800.0	93.9
BTC (tobacco)	13.0	21.1	-	34.1	0.8
MINAGRI	82.4	20.1	25.1	127.7	3.2
Total	3,982.0	41.2	25.1	4,048.3	100.0
Percent	98.4	1.0	0.6	100.0	

Source: Knausenberger and Schaefers 1992

The production of rice, vegetables, flowers and ornamentals, and white potato is likely to increase, thus requiring interventions to control pests. In addition, sugar, oil palm, and quinine all display potential for growth in production and requisite pesticide inputs.

The government of Burundi drafted proposed legislation in 1991 that would establish a legal basis for pesticide control and plant protection. The draft decree addresses the issues of importation and registration of pesticides and enables the establishment of a registration and control committee to advise the government on pesticide issues. Additional articles of the draft decree define the requirements for registration, describe the registration process, allow for registration fees, and address marketing, packaging, labeling, storage, testing, and monitoring disposal procedures. Implementation of the draft legislation had not as yet occurred by 1993, but the government has prohibited the importation of aldrin, dieldrin, chlordane, cyhexatin, DDT, fluoracetamide, HCH, and heptachlor on an interim basis. Once the pending legislation is approved, the "interim" status is likely to be removed.

Research on crop protection is not extensive or well funded. Existing research programs are focused on tea, coffee, and cotton. IPM programs will probably be established in these cash crops if alternative pest management programs are to be established at all. Nonetheless, the potential for the development of IPM programs is not great. Constraints include an indifferent knowledge base, lack of trained extension workers, and inadequate financial resources.

5. Cameroon[10]

Agricultural production in Cameroon is primarily smallholder as large plantation estates supply 6 percent of total output (Heureux, Kone, and Walla 1992). The major commercial crops include cocoa, coffee, banana, cotton, rubber, oil palm, groundnut, sugarcane, and tobacco. Large plantations provide most of the oil palm, rubber, banana, and sugarcane. The principal food crops include cassava, cocoyam, maize, millet, sorghum, plantain, and groundnut. About half of all arable land is intercropped with cash crops while the remainder is devoted to the production of food crops.

Pesticide use is directed toward the production of cash crops. One estimate indicates that four-fifths of all pesticides that are used are devoted to cash crops while only 5 percent are used for food crops (van Oers 1994). Approximately 56 percent of all pesticides are used for cotton and banana production. Fungicides comprise 14 percent of the market and are used mainly in cocoa, but use has declined dramatically in recent years because of the depressed world markets for cocoa and coffee. The most extensively used pesticide active ingredients are: cypermethrin, monocrotophos, and chlorpyrifos for cotton; lindane, endosulfan, diazinon, and propoxur for cocoa; and chlorpyrifos and endosulfan for coffee (C. Pretot, personal communication, 1994).

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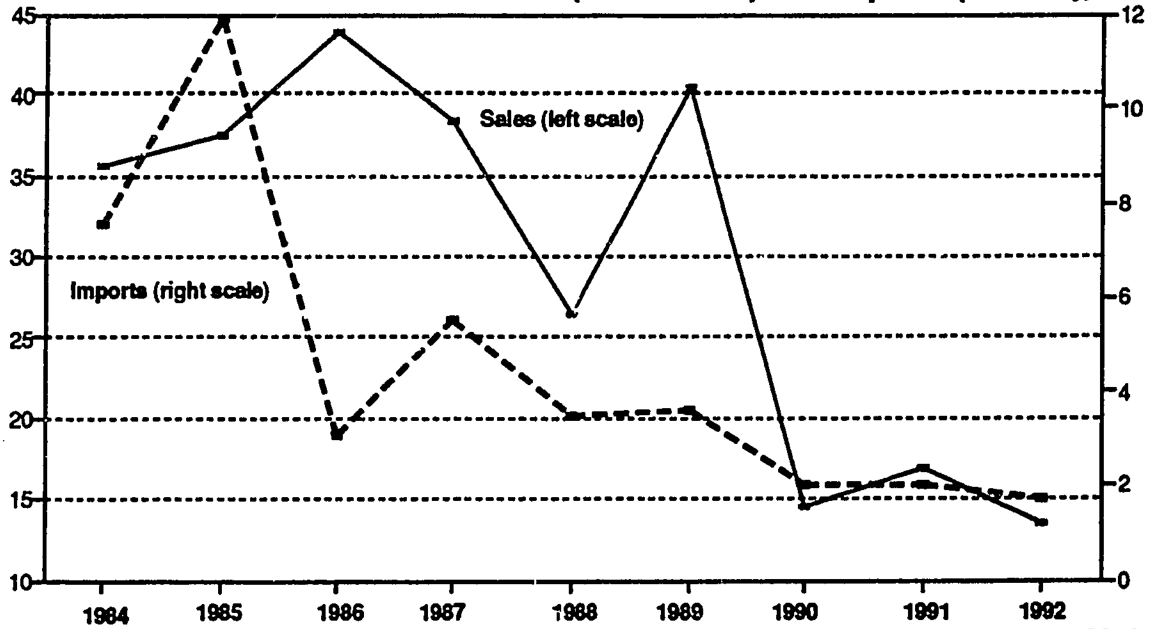
[10] For a more detailed discussion of pesticide use in Cameroon, readers may wish to read a companion study (Matteson and Meltzer 1994) of this project.

Gross sales for the ten largest importers/distributors have declined to $13.4 million in 1992 from $44 million in 1986 (see Figure 10). Pesticide sales in Cameroon represents about 2 to 3 percent of total sales in Africa. Aggregate demand for pesticides now ranks behind Côte d'Ivoire, the market leader in francophone Africa, and Sénégal. Approximately 1,700 MT of pesticides were imported as ready-to-use material in 1992. Of these products, nematicides (598 MT) and insecticides (547 MT) were the most common, followed by fungicides (348 MT) and herbicides (218 MT) (A. Genrich, personal communication, 1994).

Figure 10. Cameroon's Pesticide Sales (in $millions) and Imports (000 MT), 1984-1991



Source: Heureux, Kone, and Walla 1992; A. Genrich, personal communication, 1994 for 1992 data

Agrichemical manufacturers in the European Union shipped 65 percent of total volume, one half from France, while U.S. corporations (DowElanco, DuPont, and Cyanamid, represented by French and German multinationals) supplied 19 percent (Heureux 1992). Of the ten importers/distributors comprising the market in Cameroon, seven are affiliated with European agrichemical multinationals. Centrachim, an affiliate of Ciba-Geigy, had 30 percent of the market share in Cameroon in 1992 (A. Genrich, personal communication, 1994). Other major suppliers included Rhône-Poulenc, with a 20-percent share; SOREDI/SOCAMADI with 15 percent; CFPA, Senchim, with just less than 11 percent; and, Agrochem, an affiliate of ALM, Bayer, and ICI with 10 percent.

The local pesticide manufacturers' association, Union Phytosanitaire d'Afrique Centrale (UPAC), represents the major pesticide suppliers, is a member of GIFAP, and abides by the FAO's Code of Conduct.

The government has a regulatory scheme in place to control the flow of trade in pesticides. Cameroon bans the importation and use of captofol, dinoseb, dinoseb acetate, binapacryl, cyhexatin, dieldrin, aldrin, heptachlor, 2,4,5-DCP, and aluminum phosphide. Decree No. 92/223M, enacted in May 1992, established a National Commission for Approving Pesticides and the guidelines by which pesticides can be approved for import and use (Lynch 1993). The decree also governs packaging, storage, and distribution. Requirements for registration include chemical analysis, two-year trials of effectiveness, and data describing pharmacological and toxicity effects on humans and the environment. The commission processed 183 registration applications in 1992, its first year of operation (Adesina 1994).

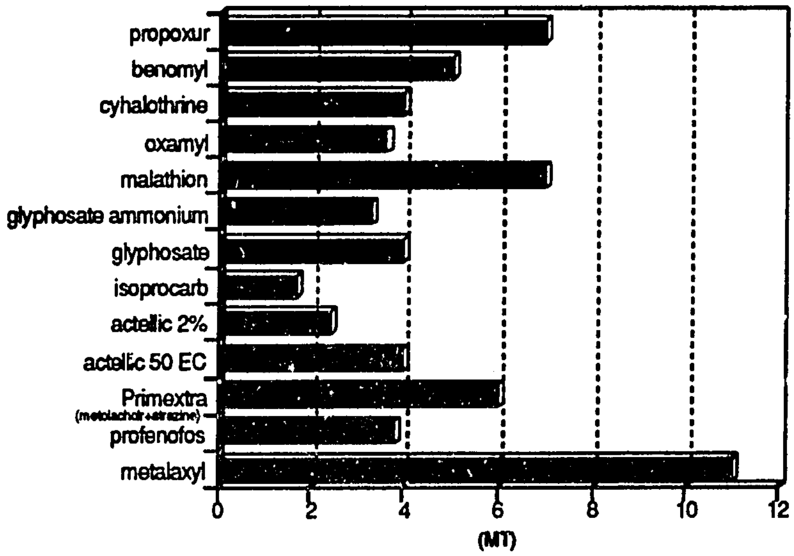
In spite of bans on certain substances, large government-owned plantations, such as the Cameroon Development Corporation, can waive these restrictions and import banned pesticides. Recent examples include the importation of captafol and aldrin. In general, large parastatal estates have increased their use of pesticides.

In the past, an important feature of the pesticide market in Cameroon was the 100-percent subsidy rate for agricultural inputs used by smallholders growing export crops, except cotton. Pesticide subsidies reached a peak in 1984-85 of 96 percent of total input demand, but declined to 5.5 percent in 1989-90 (Heureux 1992). Subsidies have now been eliminated in the cotton- and cocoa-growing districts. Despite the removal of subsidies, pesticide use surged in 1991-1992, when compared to the previous growing season. For example, 1,776,000 liters of liquid fungicides were imported in 1991-1992, and this represented a 4500-percent increase over the previous season. Similarly, the importation of nematicides more than doubled, to 417 MT, between 1990-1991 and the following season (van Oers 1994).

As part of the current privatization program in the agricultural sector, the government is encouraging farmers to purchase pesticides through government-owned distributorships. This has caused a decrease in pesticide use because smallholders have financial difficulties and are unable to afford pesticides. A market for pesticides has not yet effectively established itself because of the previous subsidy structure (Heureux 1992).

Cameroon formerly received aid-in-kind in the form of donated pesticides from a number of nations including the United States. The United States no longer engages in this practice, but the Japanese government continues to provide pesticides. In 1992, 13 pesticides were received as aid-in-kind from Japan (Figure 11). Despite such donations, Cameroon has in the past obtained pesticides it could not use. In 1993, as an example, approximately 300 MT of obsolete pesticides were in warehouses or in some other type of storage facility (C. Pretot, personal communication, 1994).

Figure 11. Pesticides Received from Japan as Aid-In-Kind to Cameroon in 1992



Source: Ministry of Agriculture, Republic of Cameroon, 1994, cited in Adesina 1994

In the Northern Province extensive use of pesticides occurs for the control of grasshoppers and grain-eating birds. Working closely with local farmers organized into "Brigades Villageoises," the Unité de Traitement par Voie Aérienne (UTAVA) sprays for avian control. In combatting a bird and grasshopper infestation in the Northern Province in 1992, the brigades sprayed 83 percent of total area treated (11,786 ha of 80,204 ha infested). In so doing, Adesina (1994) estimated that they used 3.1 MT of fenitrothion. 1.3 MT of lambda-cyhalothrin, .6 MT of deltamethrin, and .3 MT of chlorpyrifos.

IPM has not yet been declared a national agricultural policy goal, and IPM guidelines have not been established. Research on economic threshold levels is deemed a high priority for plant protection investment (Fleischer and Waibel 1994).

6. Gambia

Gambia relies heavily on pesticides to protect its agricultural economy. About 85 percent of the population is involved in agricultural production. Agricultural export revenues derive strictly from the exportation of groundnut. There is no agrichemical formulation or manufacturing in the country. Pesticides are imported and arrive as aid-in-kind from Japan and several nations in the European Union; through government tender offers; by purchases by the Gambia Production Marketing Board and the Gambia Cooperative Union; and, through illegal channels (Environnement et Développement du Tiers Monde 1992). There is little information on quantities of pesticides sold through commercial channels or the actual amounts used. The Department of Agricultural Services of the Ministry of Agriculture governs the import and use of pesticides through the Agricultural Pest Management Unit within the Department of Extension Services. One hundred metric tons of formulated products were officially imported in 1992, including formulations of fenvalerate, fenitrothion, dichlorvos, and bendiocarb (Gaye-Njie 1993). Significant perennial pests include grasshoppers and grain-eating birds, particularly weaver and Quelea. Approximately 21,000 hectares were treated to control these and other pests in 1993 (Adesina 1994). An FAO fertilizer project imports herbicides and fungicides for its designated dealers. There is a substantial private and undocumented trade of pesticides (Environnement et Développement du Tiers Monde 1992).

There exists a considerable stock of donated pesticides for which no use currently exists. Disposal of donated though inappropriate pesticides is a recurrent problem. The Ministry of Agriculture offers few alternative pest control techniques to farmers. Chemical pesticide techniques are emphasized.

No pesticide registry is in place, and apart from materials that the Ministry of Agriculture imports, no official records are maintained. In an attempt to control the distribution and use of pesticides, with the assistance of FAO, the government has revised the Pesticide Control and Management Act of 1983 and is establishing a pesticide registration scheme. The 1983 act lacked regulations and guidelines and was never implemented. The revised act is known as the Hazardous Chemicals and Pesticides Control and Management Act (N. Ndeylsaton, personal communication, 1994). The FAO provided legal, registration, and chemistry expertise (Environnement et Développement du Tiers Monde 1992), but is unclear whether the importation of any pesticides is prohibited.

7. Ghana

Pesticides are used on all major export crops including cocoa, cotton, tobacco, and pineapple. Use of pesticides has increased significantly in spite of price increases (FAO 1990). In cocoa production, until recently, products such as lindane, bufencarb, and propoxur were used extensively, with the government subsidizing their procurement. DDT is available though insect resistance is increasingly compromising its effectiveness for pest control. Propoxur and dibromochloropropane were used in the control of locusts, grasshoppers, and mealy bugs, at least according to Nyarku (1983). No information concerning current use of these compounds was discovered for this report.

The Environmental Protection Authority regulates the importation of formulated products. No pesticide legislation, as such, existed in 1990, but draft legislation was prepared in 1991 to authorize the licensing of distributors, pest control operators, formulators, and others involved in the use and distribution of pesticides. Pending approval of the draft legislation, which had not occurred by 1993, an interim pesticide regulatory scheme was in operation (FAO 1993a). No pesticides are manufactured in Ghana, but several pesticides are formulated locally. Major agrichemical importers include Danafco Ltd., BASF, Dizengoff, and Shell (Ghana) Ltd. The government's lack of notification to the FAO (as of June 1993) regarding pesticides covered by the Prior Informed Consent Process (see section V of this report) suggests that there is no prohibition on the importation of any pesticides into Ghana.

IPM has been declared a part of national agricultural policy, but pest eradication programs are underway against a number of insect pests including maize stemborers, mango and cassava mealy bugs, green mites in cassava, and grasshoppers (Fleischer and Waibel 1994).

8. Guinea

Private companies and donor and government agencies import pesticides. No domestic manufacture or formulation facilities exist. The parastatal SEMAPE or government-appointed commercial operations sell most products directly to farmers. Extension agents distribute products that are imported expressly for an agricultural development program. Private firms, such as SOGUINEX and UNIGIC, sell only in Conakry at prices much higher than the parastatal due to the levy of significantly higher taxes on the private commercial trade. Pesticide legislation was drafted in 1992, but was not enacted until March 1994 (Faye and Knausenberger 1994). Once this legislation is enacted, there is a high likelihood that the import of certain pesticides (i.e., aldrin, dieldrin, HCH, and dinoseb) will be prohibited. The use of DDT is permitted but only for public health purposes.

9. Guinea-Bissau

Agriculture represents about 80 percent of export revenues with approximately 82 percent of the population involved in agricultural production (Environnement et Développement du Tiers Monde 1992). The government obtains all agrichemicals through the Direction de la Protection des Végétaux (DPV), principally from Japan, the European Union, and the United States. Considerable stocks have been donated as part of emergency aid packages and in the form of Japanese technical assistance. Some importation of formulated product from Sénégal occurs. There exist few data on the marketing and use of pesticides in the country due to the lack of an indigenous agrichemical industry.

Pesticide use is relatively low by West African standards but may increase with governmental concern for promoting growth in agricultural production and productivity. No agrichemical companies are represented in the country although new trade liberalization programs may generate corporate interest.

Pesticide legislation was developed in 1989 with the assistance of both Portugal and USAID and covers rules of importation and distribution, storage, and transport (Environnement et Développement du Tiers Monde 1992). Neither methods to ensure quality control nor measures to protect farmworkers' health exist. Similarly, financial resources do not exist to deal with these matters effectively.

10. Malawi

Malawian cash crops for export include tea, tobacco, sugar, coffee, tree nuts, and rubber. Maize and cassava are the principal staple crops. No reliable information on the volume of pesticides used in agricultural production exist, although the market is estimated to be roughly

$15 million (Nyirenda and Kapeya 1991).

Pesticide use is increasing at an average annual rate of 10 percent. The principal multinational companies that sell to the country are Shell, ICI, and Rhône-Poulenc. All product is imported from South Africa with some repackaging of bulk material at facilities that the government operates.

Estate land holdings represent 15 percent of arable land, supply 70 percent of agricultural exports, and their use accounts for about 75 percent of the total value of all pesticides used in the country ("Proceedings of the First National Plant Protection Workshop, Lilongwe, Malawi, June 1992, cited in van Oers 1994). Smallholders produce cotton, staples, fruits, vegetables, tobacco, coffee, and groundnuts. The production of tobacco, sugar, and cotton represent the largest market for pesticides. Commonly used pesticides include EDB (for tobacco), pyrethroids (for tea), carbaryl and pyrethroid compounds (for cotton), and pyrethroid compounds and copper fungicides (for coffee).

ADMARC, a parastatal, buys pesticides by tender and distributes pest control products as well as fertilizer and seeds to smallholders. ADMARC has the only retail network reaching extensively into rural areas. Until recently this parastatal had the exclusive pesticide distributorship to small farmers at subsidized prices. That is no longer the case. Prices for pesticides are now comparable to those in the private sector.

Shell (Malawi) Ltd. controls 40 percent of the pesticide market. Other companies include Malawi Pharmacies Ltd., Agricultural Trading Company Ltd., Rhône-Poulenc (Malawi) Ltd., Farmers Organization Ltd., Antipest Ltd., Hawk Industrial and Agricultural Trading Company Ltd., Piper Pest Control Ltd., and Agrikem. These companies concentrate on marketing to the large-holding estate sector. The major private companies belong to the Pesticide Suppliers Association of Malawi, which has been a member of GIFAP since 1990. Beginning in 1990, large holders can import directly from the major companies without passing through local agencies or dealers.

The government has received pesticides as part of donated aid packages, principally from Japan, and usually for use against migratory pest outbreaks. The law that governs pesticide distribution and use is the Fertilizers, Farm Feeds, and Remedies Regulations of 1989, which stipulates requirements for registration, labeling and packaging, and safety precautions for users and distributors to observe. The regulations reportedly lack effective sanctions, and enforcement is a problem. Furthermore, according to the FAO (1993a), the regulations are not in total conformity with the Code of Conduct. Products such as DDT and dieldrin, which are not approved for sale, continue to be sold and used because of problems with enforcement. Laboratory facilities are available to test for pesticide residues, but only for tobacco.

IPM has not yet been declared a national agricultural policy, although crop-specific IPM programs exist most notably for cotton and tobacco. An eradication program is underway against the larger grain borer. Approximately 30 percent of funds allocated to plant protection research are directed to development of biological control methods (Fleischer and Waibel 1994).

11. Mali

Mali is one of the largest consumers of pesticides in francophone West Africa. Pesticides are used heavily in the control of migratory pests (e.g., locusts, grasshoppers, Quelea birds, and armyworms), for pest control in cotton, and in large agricultural development projects. Approximately 80 percent of the population is involved in farming and agricultural production, which contributed about half of the nation's gross domestic product (Environnement et Développement du Tiers Monde 1992). The principal food crops are rice, maize, millet, sorghum, and groundnut. Cotton is the major cash crop accounting for 22 percent of gross domestic product. Cotton and groundnut make up about 60 percent of the value of Malian exports. The production of cotton consumes the bulk of pesticides used annually (Diarra and Kamissoko 1993). Cotton pesticides are applied on a regular 15-day cycle from seeding to harvest, resulting in 2.5 million liters of pesticides applied annually (Pesticide Action Network 1993).

Smallholders are increasingly using pesticides with the aid of a subsidy/tax-reduction system that makes purchases affordable. A crop protection service was established in 1987 to develop pesticide legislation and to enact a registry scheme. Such legislation was drafted in 1990, but it was not enacted, at least through mid 1993 (FAO 1993a). Most pesticides are imported and arrive as a result of donations, but some formulation of technical product does take place (FAO 1990). Agrichemical companies operating in Mali include ICI, Dow, Shell Chimie, Rhône-Poulenc, and ALM International. A major portion of the pesticides used in cotton production are obtained through private market tenders (A. Genrich, personal communication, 1994).

IPM pilot projects began in Mourdiah in 1985 and Baramba in 1990 to combat grasshoppers and millet head mites. Since 1989, about 10,000 farmers have been trained in IPM techniques.

The sole formulator in Mali is Société Malienne des Produits Chimiques (SMPC). Table 9 gives data on production of formulated pesticides by SMPC for 1986 through 1991. The Service National de la Protection des Végétaux (SPV) uses a large portion of the pesticides applied annually, most of which is supplied through donor aid-in-kind from France, Japan, Switzerland, and the United Kingdom. USAID provided carbaryl for combatting an outbreak of grasshoppers, most recently in 1990 (W. Knausenberger, personal communication, 1994). The SPV treated approximately 460,000 ha with 560 MT of powdered formulations and 350,000 liters of liquid product in 1991. A breakdown of pesticides that the SPV used is provided in Table 10. The SPV's total use for 1985 through 1991 is shown in Table 11. The use of herbicides has almost doubled over the past five years as the land area under cultivation has increased. The Compagnie Malienne pour le Développement des Textiles' use of insecticidal liquids in cotton production increased to 2.75 million liters in 1990/91 from an average of 1.5 million liters per year previously. In the Operation Haute Vallée, insecticide use on cotton also doubled in the past five years. In the areas where cereals and groundnuts are produced, pesticides are applied to control pest outbreaks (Environnement et Développement du Tiers Monde 1992).

About one hundred types of pesticides are used in Mali. Though labeling is required in Bambara or French and English, few peasants are sufficiently literate to benefit from the directions or explicit precautions. No laboratory exists to determine pesticide quality, obsolete stocks of pesticides are a major problem, and no pesticides are banned (FAO 1993a).

Table 9. Insecticide and Fungicide Production by the Malian Formulator, SMPC, 1986-91

Product	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991
Cotton Fungicides (MT)	23.8	29.8	26.7	32.1	12.0
Cereal Fungicides (MT)	16.0	22.6	9.3	9.1	10.0
lindane 1%, 2% (MT)	3.4	-	-	-	-
propoxur 2% (MT)	334.9	-	222.6	173.0	185.6
profenofos 18% (liters)	523.6	133.3	341.9	326.1	198.7
profenofos 10% (liters)	511.4	505.1	683.3	526.8	425.0
cypermethrin 13 ULV (liters)	2,500.0	1,000.0	-	-	-
cypermethrin/ chlorpyrifos (liters)	-	374,238.0	657,328.0	647,856.0	-
cypermethrin/ triazophos (liters)	-	-	301,457.0	-	-
cyfluthrin/omethoate (liters)	-	-	-	462,450.0	550,000.0
chlorpyrifos IDP (MT)	-	-	-	9.0	-
bendiocarb (MT)	-	-	-	161.0	-

Source: Environnement et Développement du Tiers Monde 1992

Table 10. Insecticides Used by Service National de la Protection Des Végétaux, Mali, 1985-91

Product	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991
HCH 25% (MT)	4.0	410.0	-	-	-	-
fenitrothion+propoxur (MT)	151.0	148.0	78.0	340.00	327.0	564.0
fenitrothion EC liters (000)	21.1	189.8	-	130.10	142.4	167.3
dieldrin EC liters (000)	29.4	-	-	-	-	-
endosulfan EC 35% liters	160.0	-	549.0	-	-	-
diazinon EC liters (000)	-	15.9	7.3	-	11.7	5.4
malathion 96% liters (000)	1.2	-	58.4	104.50	32.7	56.3
fenthion liters (000)	1.4	-	-	3.90	-	-
lindane liters	1,250.0	-	-	245.00	-	-
fenvalerate+fenitrothion liters (000)	-	2.2	-	-	-	-
chlorpyrifos ethyl liters (000)	-	-	-	1.00	103.6	80.0
alphamethrin liters	-	-	-	240.00	-	-
cypermethrin liters (000)	-	-	-	.41	6.2	-
actellic liters	-	-	-	120.00	-	-
lambda-cyhalothrin liters (000)	-	-	-	.13	20.3	21.6
dichlorvos 30% liters (000)	-	-	-	-	-	18.5
pyridaphenthion liters (000)	-	-	-	-	-	4.6
carbaryl liters (000)	-	-	-	-	-	4.8
deltamethrin liters (000)	-	-	-	-	-	1.4
bendiocarb liters (000)	-	-	-	5.00	1.3	-

Source: Environnement et Développement du Tiers Monde 1992

Table 11. Pesticides Applied and Area Treated in Mali by the SPV, 1985-91

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Area (ha)	124,174	595,337	330,597	502,098	722,492	460,334
Powders (MT)	151	550	78	340	327	564
Liquids (l)	54,497	207,874	115,442	245,737	318,205	359,948

Source: Environnement et Développement du Tiers Monde 1992

12. Mozambique

Although the state has owned the land in Mozambique, land tenure laws are being changed and access to property privatized. The agricultural sector is comprised of smallholder family farms and large commercial producers, which are, in turn, composed of cooperatives, large state farms, and private commercial operators. The cash crops produced on the large operations are tea, cotton, sugarcane, coconut, and sisal. The staple and cash crops of the smallholder include maize, sorghum, millet, cashew nuts, vegetables, cassava, and cotton.

The major use of pesticides is in the production of cotton (endosulfan), sugarcane (atrazine), and maize (pendimethalin). The fumigants actellic and aluminum phosphide are used for protecting stored grain. One estimate (do Rosario 1991) indicates that 1,536 MT of pesticides were used in Mozambique in 1987, but usage declined precipitously in the next two years to 262 MT and 22 MT, respectively.

Agricultural production and pesticide use have been declining since the early 1980s. This is due to the security situation until recently, persistent drought, and the lack of foreign exchange to purchase inputs. Insecticides comprised about three-quarters of pesticide material imported, mostly synthetic pyrethroids (56 percent), organophosphates (31 percent), and fungicides (21 percent) (do Rosario 1991).

The country has the capacity to formulate sufficient stocks of pesticide material to supply the agricultural sector. Empresa Mocambicana de Pesticidas (EMOP), a parastatal, imported technical material until recently from which was formulated liquid, granular, and dust products. Several pesticides were produced in the past but are no longer in "official" production--propanil, cypermethrin, endosulfan, dimethoate, propoxur, mineral oil, and deltamethrin. EMOP has a reputation for low quality pesticides due partly to lack of functional laboratory equipment (Fisher, Matteson, and Knausenberger 1994).

Legislation governing the use, importation, and distribution of pesticides was enacted in 1987. The law enables the implementation of a registration scheme that provides guidelines and procedures for classification, labeling, usage, and handling precautions. The security situation and a lack of trained personnel hamper enforcement.

The Ministry of Agriculture is responsible for registration and licensing of pesticides. Companies wishing to import and sell pesticides must provide data on efficacy and toxicology. Registration generally takes one to three months. Approximately 300 registration applications have been received since 1987, with 180 granted registration. Almost 70 pesticides are banned (FAO 1993a). Despite this large number, there appears to be considerable traffic in unregistered and illegal pesticides due principally to the lack of an industry association and chemical companies' subsequent ignorance regarding registration procedures and regulations (Fisher, Matteson, and Knausenberger 1994). Like several other countries in sub-Saharan Africa, the government of Mozambique had not notified the FAO that the country intended to prohibit the import of any pesticides, at least through June 1993.

The signing of peace accords in October 1992, has led to social and economic stability and the development of an estimated $5-10 million market in pesticides. Major players include Ciba-Geigy, Shell-Mozambique, Bayer, and Zeneca. InterQuimica, the state-controlled importer of pesticides (formerly the sole importer), continues to receive donations of pesticides from the Japanese government (Fisher, Matteson, and Knausenberger 1994). The entire operation is likely to be privatized soon. The government no longer subsidizes farmers' purchases of pesticides. Acquisitions occur in the open market.

In addition to the state-owned pesticide operations, at least 27 private companies market pesticides. The principal operators include Agroquimicos, Zeneca, Ciba-Geigy, Quimigal, and Shell. Fisher, Matteson, and Knausenberger (1994) provide a more detailed list.

Cleanup of obsolete and unwanted pesticide stocks is being undertaken to some extent. Shell is financing the repackaging of leaking drums of DDT, aldrin, monocrotophos, and other pesticides, including site cleanup, and shipping the materials to Germany for disposal. Ciba-Geigy has also been involved with the disposal of such stocks.

13. Namibia[11]

Livestock farming dominates agriculture in Namibia, but there is also some limited dryland and irrigated crop production. The principal crops include maize, sorghum, millet, groundnut, sunflower, wheat, vegetables, and cotton. Forty-four percent of arable land is divided into approximately 5,000 farming units, which constitute the commercial sector, while subsistence smallholders farm 41 percent of the arable land. Approximately 15 percent of the land area is unsuitable for agriculture. Communal subsistence farmers use few pesticides due to their expense and, in some cases, to the lack of information about their use. Livestock and veterinary services consume the major portion of pesticides used in agriculture, but actual data on use are not available. Flumethrin is the most widely used pyrethroid for tick control. Alphamethrin is used against tsetse fly, and diazinon and triazophos against sheep scab. The use of dieldrin against tsetse fly is being phased out. Cyfluthrin is used in mosquito control programs, but DDT remains in use, primarily for residential treatment of walls in homes. Pesticides are used in commercial production of maize (atrazine), sorghum (alachlor), millet (cyfluthrin), groundnut (triadimenol), sunflower (cyfluthrin), cotton (endosulfan and alphamethrin), wheat (monocrotophos), and vegetables (oxyfluorofen). Maize is the most important crop, although production of all food crops is insufficient for the population's food needs.

There are no manufacturing or formulating facilities, and repackaging does not occur in Namibia. All pesticides are imported from South Africa in ready-to-use form. Companies, cooperatives, and a few individuals import directly. The major pesticide distributors include AGRA, Bayer Namibia Ltd., and Agricura. The imports are received and stored in company

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[11] Much of the material on Namibia is from Muller and Duvenhage (1991).

warehouses in the urban centers from which consumers purchase their requirements. Cooperatives such as AGRA own depots for the storage of pesticides and equipment in 25 urban centers throughout the country.

Namibia does not have a government agency with responsibility for registering pesticides (FAO 1993a). The foundation for legislation controlling the distribution and use of pesticides is the Fertilizer, Farm Feeds, Agricultural Remedies, and Stock Act of 1947, which was enacted in South Africa and applied to Namibia. Under this act regulations were enacted to enforce the FAO's Code of Conduct and related guidelines. A pesticide registrar oversees the implementation of the 1947 Act and institutes changes that may be appropriate for the agricultural industry in an independent Namibia.

14. Niger

Arable land in Niger represents about 3 percent of total land area, but 80 percent of its population depends on agriculture for its livelihood (Environnement et Développement du Tiers Monde 1992). The principal crops are sorghum, millet, cowpea, and groundnut, which are not large consumers of chemical inputs. Flood plain cultivation along the Niger River and production of market vegetables in the regions surrounding the urban centers are the principal targets of pest management and control activities by governmental agencies. Cotton is produced on about 9,000 hectares. The principal insect pests in these regions are grasshoppers and a variety of cereal crop insects. The Direction de la Protection des Végétaux (DPV) applied pesticides to about 1.2 million hectares in 1990, 800,000 hectares of which were in the Niger River basin, to control grasshoppers. The primary insecticides used were fenitrothion, chlorpyrifos, and malathion. Aerial spraying was used for the majority of material applied, although village brigades and DPV cadre using equipment mounted on vehicles were also involved.

Several international donors, including Canada, Germany, and the United States, furnish logistical and material support to aid Niger in its plant health protection services. The FAO and the European Union are also involved. The Canadians were particularly involved in organizing village brigades to conduct ground spraying programs during pest outbreaks. About 12,000 brigades were in existence in 1990 covering about 50,000 hectares. The Canadians, however, furnish no pesticide material.

The German government was involved in training of extension cadre and the development of alternative pest management techniques in vegetable production. In addition, the Germans have been involved in research assessing the effects of pesticide residues on desert flora and fauna. Germany discontinued supplying pesticides to Niger in 1990. USAID concentrated its support on training, communications, the strengthening of surveillance operations, and research on neem. USAID supplied pesticides only in 1987-89.

The International Crops Research Institute for the Semi-Arid Tropics, which is located in Niamey, is involved in developing integrated methods for overcoming millet and groundnut problems including disease and drought susceptibility.

The pesticides most commonly found for sale at regional and local markets include lindane 5% powder, propoxur 5% powder, deltamethrin powder and emulsifiable concentrate (EC); cypermethrin EC, and dimethoate EC. The DPV usually supplies these pesticides. Other products of unknown origin are also available, including lindane in other formulations, HCH, and dicrotophos (Environnement et Développement du Tiers Monde 1992).

The residues of many pesticides are found in samples of market vegetables. In many instances residues surpass tolerance limits. Residues of the following products are regularly found through random market sampling: aldrin, dieldrin, chlorpyriphos, dicrotophos, dimethoate, fenitrothion, heptachlor, DDT and its degradate DDE, HCB (seed fungicide), and HCB and lindane. Explanations for residues of banned organochloride compounds include soil contamination from treatment regimes in years past, illegal importation and distribution, and old stocks being accessed and distributed.

Comprehensive legislation to control pesticides and other plant health protection products has been developed, and promulgation is occurring following a USAID-sponsored workshop in 1993 on pesticide health and safety. The French and Canadians also provided assistance for this workshop.

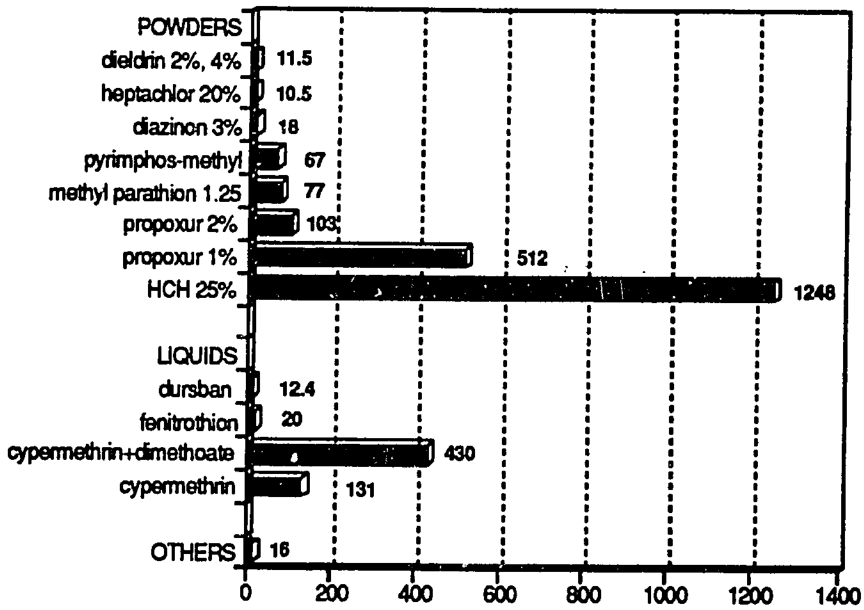
The importation of aldrin, dieldrin, and HCH is prohibited. In contrast, the government permits the import of DDT, dinoseb and its salts, and mercury compounds. At USAID's initiative, and with support from the Government of Germany and the Shell Chemical Company, the entire known stock of dieldrin remaining in Niger (about 55,000 liters) was removed to the Netherlands for high temperature incineration in 1991.

15. Sénégal

Agriculture in Sénégal has historically been based on the production of groundnut, sugarcane, and cotton for export. Currently, irrigated rice production as well as truck farming have developed into significant agricultural sectors. Approximately 90 percent of pesticide applications are directed at crops intended for export (Environnement et Développement du Tiers Monde 1992). The government, through its Direction de la Protection des Végétaux, provides pesticide application services to farmers who are outside the export sector. The particular private or parastatal commodity group purchases pesticides for application on commodities destined for export. Pesticides are also used to control locusts, grasshoppers, and migratory birds. About 552,000 hectares were infested and 230,000 hectares treated for pest control using about 370 MT of pesticides in 1993 (Adesina 1994). In addition, in the Northwest region, control of rats and grain-eating birds consumed about 88 MT of pesticides.

Approximately 667 pesticides were registered for use in Sénégal in 1990, including 309 insecticides, 123 herbicides, and 87 fungicides. A large proportion of pesticides consumed in Sénégal are prepared locally by the Société de Promotion Industrielle et Artisanale (SPIA) and the Société Sénégalaise des Engrais et Produits Chimiques (SSEPC) using imported technical product. SPIA, situated in Louga, produces about 3,000 MT of pesticides per year including 2,000 MT of powdered formulations and 1,000 MT of liquids. The pesticides that SPIA produced in 1983 are shown in Figure 12. About 32 percent of total SPIA production is exported to neighboring countries while the remainder is sold in Sénégal. SSEPC, which is located in Dakar, produced 711 MT of pesticides in 1983, 75 percent of which was sold domestically.

Figure 12. Pesticide Products Produced (MT) by SPIA, 1983



Source: Environnement et Développement du Tiers Monde 1992

Approximately $10 million of pesticides, mostly insecticides, are used annually in Sénégal (Environnement et Développement du Tiers Monde 1992).[12] The storage and distribution of pesticides in Sénégal are increasingly reverting to the private sector, but the government, through the DPV and various regional rural development agencies, still maintains extensive regional stocks to control migratory pest outbreaks as well as perennial problems. Illegal importation and sale of pesticides exists, which pose risks to farmers who in many instances, outside the purview of the DPV or regional Sociétés, handle and apply these materials incorrectly.

Many laws and presidential decrees govern the production, distribution, sale, and use of pesticides in Sénégal, the most recent being the Order of July 19, 1990, which requires that

[12] Rhône-Poulenc estimates the total pesticide market in Senegal to be about $6 to 7 million (G. Bruge, personal communication, 1994).

specific product information be included on labels affixed to pesticides. This decree brought regulations in line with the FAO's Code of Conduct. Effective implementation and enforcement have been difficult (FAO 1990), and it is uncertain whether the importation of any pesticides is prohibited. As of mid 1993, Sénégal had not notified the FAO that the country intended to prohibit the import of any pesticides covered by the rules of Prior Informed Consent.

16. Sierra Leone

Until recently the government and private companies imported most pesticides in Sierra Leone. Of the pesticides that are used, most are insecticides. The Japanese government once provided large amounts of ready-to-use material as grants. No pesticide formulation facilities exist in Sierra Leone and, as of 1993, no regulations existed controlling the use and distribution of pesticides. Draft legislation was being prepared (FAO 1993a).

17. Swaziland

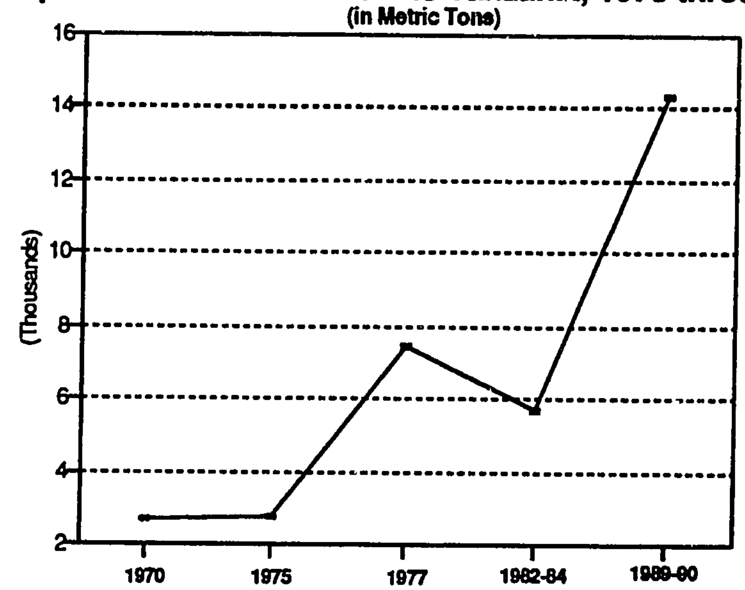
Modern commercial farming in Swaziland produces about 60 percent of agricultural output with smallholder production accounting for the remainder. The principal crops are rice, maize, cotton, citrus, pineapple, sugarcane, and vegetables. All pesticides are imported from South Africa, with approximately 80 percent distributed through two firms, Farm Chemicals and Swaziland Agricultural Supplies. The government's Agricultural Development and Advisory Services provide the bulk of the remainder. The most heavily used insecticides in 1989 were dithane, malathion, endosulfan, and petroleum oils. Popular herbicides include diuron, atrazine, alachlor, and ametryn. With the FAO's assistance, pesticide legislation and regulations were drafted in 1992 but were still awaiting final approval the following year (FAO 1993a; van Oers 1994).

18. Tanzania

Agricultural exports account for about 80 percent of Tanzania's foreign exchange earnings, the bulk of which derive from tea, coffee, cotton, sisal, cashew nuts, tobacco, and pyrethrum. The principal food crops include rice, maize, sorghum, millet, and cassava. Banana is also a dietary staple. Pesticide use is relatively high because of the dependence on agriculture for both staple foods and cash crop production. Figure 13 provides data on pesticide importation.

Due to the close correspondence between the Tanzanian and FAO figures for 1975, the data reported are taken as tons of active ingredients rather than formulated product. The pattern of pesticide importation and use is directly related to the demand for Tanzanian commodities because of Tanzania's heavy dependence on global markets for its cash crops.

Figure 13. Importation of Pesticides into Tanzania, 1970 through 1989-90



Source: Ak'Habuhayo 1983, FAO 1992

In 1983, after a period in which export earnings from agricultural, mineral, and industrial products had been falling by 10 percent per year, the government launched a program to increase the productivity of cash crops by 10 percent per year. The aim was to achieve self sufficiency in food production by 1993. Expectations were that the use of pesticides during implementation of the program would increase at least at the same rate as the projected growth in productivity. That projection has proven to be an underestimation: total pesticide use increased by 250 percent between 1984 and 1990. During the 1989-90 growing season, nearly 7,000 MT of fungicides were used, and this represented almost half of all pesticide consumption. Insecticides (at 4,744 MT) accounted for one-third of total consumption, and herbicides (at 2,592 MT) most of the remainder.

Crop production systems that used large amounts of pesticides in the 1989-90 season included coffee (copper-based fungicides), cotton (cypermethrin, endosulfan), maize (endosulfan, pirimiphos methyl, DDT dust), rice (endosulfan, fenitrothion, piperophos, dimethamethrin, propanil), wheat (endosulfan, dimethoate, fenthion, propanil, atrazine), cashew nuts (propanil, fenitrothion), and sugarcane (carbofuran, dimethoate, fenitrothion, atrazine, propanil).

Some pesticides, including endosulfan, malathion dust, carbaryl, mosquito coils, and pyrethrum-based mosquito spray solutions, are formulated locally. No manufacture of technical product occurs. Growers can purchase pesticides from marketing boards, cooperative unions, and state farms. The importation of dieldrin and fluoracetamide are prohibited. In contrast, there are no apparent restrictions on the import of dinoseb. DDT, HCH, and aldrin can be imported in limited amounts in emergency situations.

The Tropical Pesticides Research Institute Act of 1979 provides a legal framework for all aspects of the importation, manufacture, sale, and use of pesticides. Pesticide control regulations were enacted in 1984 to establish a registration scheme, and the first list of registered pesticides followed two years later. Revised lists were published in 1988, 1990, and 1992. Tanzania subscribes to the FAO's Code of Conduct. Nonetheless, the existing legislation is not in total conformity with the Code (FAO 1993a), which is understandable given the fact that the 1984 legislation predates the Code. The concept of integrated pest management has not as yet become a part of national agricultural policy, but general IPM guidelines have been established (Fleischer and Waibel 1994).

19. Togo

The principal cash crops in Togo are coffee, cocoa, cotton, and oil palm. Food crops include maize, sorghum, millet, and rice. The widespread use of pesticides in Togolese agriculture is a recent phenomenon but has developed rapidly over the past decade (Afanou n.d.). All pesticides used in Togo are imported. The four principal export crops, especially cotton, consume 85 percent of the pesticides applied. Approximately 1,700 MT were imported in 1987, of which 74 percent were used in the production of cotton. Société Togolaise de Coton (SOTOCO) and Société Nationale pour la Renovation et le Développement de la caféiere et de la cacaoyere Togolaise (SRCC), large parastatals responsible for the development of the cotton, cocoa, and coffee industries, directly import and distribute the pesticides used on their farms. SRCC imported 25,000 liters of assorted pesticide compounds. SOTOCO imported about 1.6 million liters of pesticides, mainly pyrethroids and organophosphates, in 1988. Draft pesticide legislation, which was finalized in 1990, is based on the FAO's Code of Conduct.

Prohibited pesticides include aldrin, dieldrin, DDT, HCH, aldicarb, 2,4,5-T, and compounds containing mercury and arsenic. The use of paraquat is severely restricted. With prior government approval, the importation of fluoracetamide is permitted.

20. Uganda[13]

Uganda's economy relies on foreign exchange earnings from the export of tea, coffee, tobacco, and cotton. Traditional food crops include plantain, cassava, sweet potato, maize sorghum, millet, and groundnut. Coffee and sugarcane are typically cultivated on large estates; much of the tea, cotton, and tobacco are grown on smallholder farms. Most pesticides in use are insecticides, but the use of herbicides is increasing. The pesticides with the greatest volume of use between 1989 and 1991 included cypermethrin (approximately 157,000 liters), chlorfenvinphos (63,000 liters), fenitrothion (54,000 liters), and copper oxychloride (97 MT) (Bazirake and Okoth 1992).

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[13] For a more detailed discussion of pesticide use in Uganda, readers may wish to read a companion study (Meltzer, Matteson, and Knausenberger 1994) of this project.

The distribution and marketing of pesticides has become an open-market situation. Parastatal provision of pesticide and other inputs to farmers, including to cotton producers, is being eliminated. British-American Tobacco (BAT) continues to provide pesticides to farmers (P. Matteson, personal communication, 1994).

Few data exist describing the environmental effects of pesticide use in Uganda. Organochlorides, including DDT, had been in wide use for cotton pests; along with DDT, BHC, and endrin against cotton bollworm; and dieldrin for control of banana weevils. Smallholder farmers continue to use these products for vegetables and other crops (P. Matteson, personal communication, 1994). Despite their apparent use, the importation of DDT and dieldrin is prohibited.

The organochloride compounds had also been used extensively for the control of human disease vectors. A program to eradicate the *Anopheles* mosquito using DDT was conducted in 1964. The species is now resistant to DDT. Other control efforts include bed nets, habitat control, and room sprays using dichlorvos and pyrethroids, but these efforts are limited. DDT was also used to control tsetse flies prior to 1960, and was replaced by dieldrin until 1988. Endosulfan is now used in Uganda for the control of tsetse flies, and deltamethrin is being evaluated.

The Control of Agricultural Chemicals Statute of 1989 governs the registration and use of agrichemicals in Uganda. Regulations to implement the statute were drafted in accordance with the FAO's Code of Conduct. The country is currently in the process of a pesticide re-registration program with no definitive list of registered products available, although pesticides registered under the Pharmacy and Drugs Act of 1970 have retained their status. As of December 1992, a registration board was in place, and a registrar had been appointed (Bazirake and Okoth 1992). Temporary registrations may be obtained while field studies are conducted. The National Agricultural Research Organization is chiefly responsible for crop protection research, but the Plant Protection Service conducts efficacy testing for registration purposes.

Control of pesticide imports has broken down. There is no system for screening license applications or shipments. Certain chemicals have their use restricted (i.e., aldicarb, carbofuran, dichlorvos, dimecron, methamidophos, methomyl, methyl bromide, monocrotophos, paraquat, parathion, and parathion-methyl), and seven pesticides are banned (i.e., aldrin, DDT, dieldrin, dinoseb salts, fluoracetamide, HCH, and lindane).

Table 12 provides estimates of average annual use of formulated pesticides between 1977 and 1981. Combined agriculture/forestry and medical/veterinary use averaged 817 tons per year during 1977-81. Over 300 pesticide formulations were in use in the country (Schaefers 1992). More recent data on pesticide use in Uganda are available from the Ciba/BMI data bank (Table 13).

Table 12. Average Annual Quantity (MT) of Formulated Pesticides Used in Uganda, 1977-1981

Pesticide Classification	Application	Metric Tons of Formulated Product
Organochloride	Agriculture and Forestry	617.6
	Medical and Veterinary	176.2
Organophosphates	Agriculture and Forestry	12.0
	Medical and Veterinary	11.1
	Total	816.9

Source: Edroma 1983

Table 13. Estimated Pesticide Use in Uganda, 1992

Pesticide Classification	Application	Metric Tons
Organophosphates	Agr/Forestry	250
	Veterinary	150
Pyrethroids	Agricultural	150
	Veterinary	20
Others	Agricultural	50
Total		620

Source: A. Genrich, personal communication, 1994

Based on these data, it appears that pesticide use in Uganda has shifted to incorporate the pyrethroid class of materials and de-emphasize organochloride use. Total documented use has declined approximately 25 percent from levels observed between 1977 and 1981.

The importation of agrichemicals and agricultural inputs in general has declined significantly since 1990 due principally to the uncertainty prevailing in the private sector (Table 14).

Table 14. Importation of Pesticides into Uganda, 1990-93

Class	1990		1991		1992		1993	
	Q	V	Q	V	Q	V	Q	V
Insecticides	363.0	2603	509	5117	na	2577	17.5	247.4
Herbicides	41.5	450	169	2391	na	472	na	289.7
Total	404.5	3053	678	7508	na	3049	na	537.1

na: not available
Q: Quantity in liters
V: Value in dollars

Source: Bank of Uganda 1993

The large increase in importation in 1991 resulted in part from heavy herbicide demand as tea and sugar estates expanded and a shortage of farm labor occurred. The gradual government withdrawal from intervention in agricultural input markets has left private traders with little information on existing and potential market demand. As a result, few have committed to full market participation. Private traders are establishing systems of distribution and information acquisition on pesticide needs.

21. Zaire

Bayer, Shell, Mobil, Hoechst, Sumitomo, Ciba-Geigy, Rhône-Poulenc, and other smaller formulators and distributors are represented in the pesticide market in Zaire. All technical active ingredients are imported with some local formulation. The government of Zaire received a donation of 200 MT of pesticides in 1989 from Japan, including fenitrothion, chlorpyrifos, and diazinon. Other products available include endosulfan, deltamethrin, PCNB, quintozene, acetate triphenyl, pyrazophos, pyracarbolide, and triazophos (Pesticides Trust 1989). According the FAO's Regional Office for Africa (van Oers 1994), estimates of legal imports of pesticides were 1,487 MT in 1989, 610 MT in 1990, and 1,075 MT in 1991.

Pesticides are used primarily in cotton production on large plantations. Much misuse is reported to occur, including the use of pesticides to kill fish for human consumption and the overdosing of organochloride compounds used in public health campaigns.

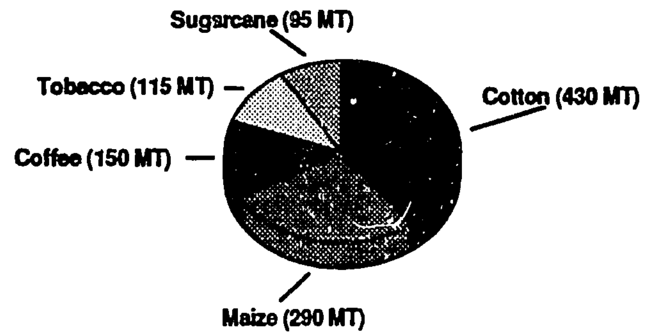
There has been no elaboration of regulations governing pesticide marketing and use since 1953, although in January 1993 new legislation was awaiting approval of an interministerial commission (FAO 1993b). The Ministry of Agriculture has requested assistance in developing a system to register pesticides for use in the country. No laboratories exist to test for pesticide efficacy nor for sampling pesticide residues on food items. Illegal commerce of pesticides exists.

22. Zambia

The principal crops in Zambian agriculture are maize, cotton, cowpea, cassava, sunflower, tobacco, soybean, and vegetables. Approximately 1,700 MT of pesticides were used in 1989, of which 80 percent were used in agriculture, 16 percent in public health programs, and 4 percent in animal health (Chalabesa and Kaposhi 1991). Large-scale commercial farmers used an estimated 60 percent of agricultural pesticides, smallholders 30 percent, and specific projects another 10 percent. Insecticides comprised 40 percent of the products used, herbicides 30 percent, and fungicides 10 percent. Methyl bromide and phostoxin are used in stored-product fumigation, primarily for maize. The distribution of pesticides by commodity is given in Figure 14.

Two local formulators, Marana and Freber, produce about 250 MT of the fungicide copper-oxychloride, of which about half is exported. Shell, Coopers, and Reckitt & Colman formulate a variety of products locally. Manufactured, formulated product totaled 250 MT in 1987, much less than what is thought to be capacity. The main importing companies include Shell, ICI, Rhino Trading, Growell Chemicals, Cooper, Hoechst, Lima Chemicals, and the parastatals ZCF and Lintco. The Zambian Agrichemicals Association was created in 1988, is affiliated with GIFAP, and represents 11 of the largest importers, distributors, and manufacturers of pesticides.

Figure 14. Pesticide Use by Major Crops in Zambia, 1989



Source: Chalabesa and Kaposhi 1991

The parastatals ZCF, Lintco (cotton), and Natco (tobacco) and commercial operators distribute pesticides to users. The government is not directly involved in the application or distribution of pesticides except for animal health operations that the Veterinary Service administers. Except for veterinary applications, no subsidies are offered for the purchase of pesticides.

The Zambian government enacted the Environmental Protection and Pollution Control Act in 1990, which the FAO (1993a) considers to be in conformance with the Code of Conduct. The act established a Pesticides and Toxic Substances Control Inspectorate, which has the authority to register pesticides and to control all aspects of the pesticide trade. Despite this action, the FAO (1993a) reported that the registration scheme was not operational in 1993.

D. Summary

A short synopsis of all of the information above and what it means for Africa is in order. A common current running through all nations is the need to expand agricultural production to accommodate population growth. Production growth can be most easily achieved through modernization of production technologies, which implies increased input intensity. The use of pesticides has, in general, increased in response. Use of purchased inputs has been targeted at cash crops for export to help bolster hard currency reserves, although some food crops are also treated with pesticides.

The agrichemical industry has not taken extraordinary measures to service demand in Africa. No facilities are in place to manufacture technical product. Most nations in the region have, however, some form of domestic formulating facilities to transform imported technical product to commercial compounds. It is difficult to foresee a major manufacturing presence as necessary as demand is currently accommodated through imports from Japan, Europe, the United States, and the Republic of South Africa.

A central feature of the cultivation of cash crops in the region is the preference for chemical pest management as it implies the adoption of modern crop production techniques. This establishes a difficult and almost untenable situation in which alternative pest control measures are seen as retrogressive and fraught with risk. The fragile state of African agriculture in most years due to weather and environmental or pest-related threats requires farmers to seek production techniques that are seen as risk reducing rather than risk augmenting. It is this aspect of chemical pesticides, the perception of risk reduction, that has fostered their growth in use, and will continue to spur growth in use until effective and efficient alternatives are developed and introduced.

IV. The Use of Pesticides in Cotton Production in Africa

Cotton is grown extensively in Africa and for many nations provides the bulk of foreign exchange earnings. In francophone Africa production of cotton fiber increased from 128,000 MT in 1961 to 1,212,000 MT in 1991 (O'Malley 1992). The area used for cotton in 12 African nations nearly doubled between 1982-83 and 1992-93 (Appendix C, Table 1). The production of cotton seed and fiber also doubled (Appendix C, Tables 2 and 3). Mali, Côte d'Ivoire, Chad, Burkina Faso, and Benin have the largest area devoted to cotton production in francophone Africa. Yield of cotton fiber varies considerably. Mali averages 546 kg/ha while the Central African Republic averages 196 kg/ha (Appendix C, Table 4). Differences in yield reflect differing environmental conditions, varying levels of managerial expertise, and input availability.

Pest control is particularly important because of the duration of the plant's fruiting period and its susceptibility to insect pest damage and yield reduction. Cotton production systems are, therefore, a prime consumer of pesticides in Africa. Expansion of area and attempts to increase productivity rely upon chemical pest control methods.

The trend in cotton production in Africa is upward, and land area devoted to cotton has increased about 10 percent per year. This warrants interest because of the intensity with which pesticides, mainly insecticides, are used. Some estimates indicate that large percentages of cotton-growing regions are treated regularly. For example, in the late 1980s and early 1990s, 95 percent of Mali's cotton area was treated at least three times per season with pesticides (O'Malley 1992). Large portions of individual nations' pesticide markets comprise chemicals used in cotton production. In Zimbabwe, 28 percent of the insecticides and 15 percent of the herbicides are used in cotton production. In Côte d'Ivoire, 78 percent of insecticides and 37 percent of the herbicides sold in 1992 were used on cotton.

Insecticide use by cotton parastatals varied considerably between 1987 and 1993 (Table 15), reflecting the variability in world market prices of the cotton complex including cottonseed, cottonseed oil, cottonseed cake, and cotton fiber.

Table 15. Insecticide Use by Cotton Parastatals in 12 African Nations 1987-93 (000 liters)

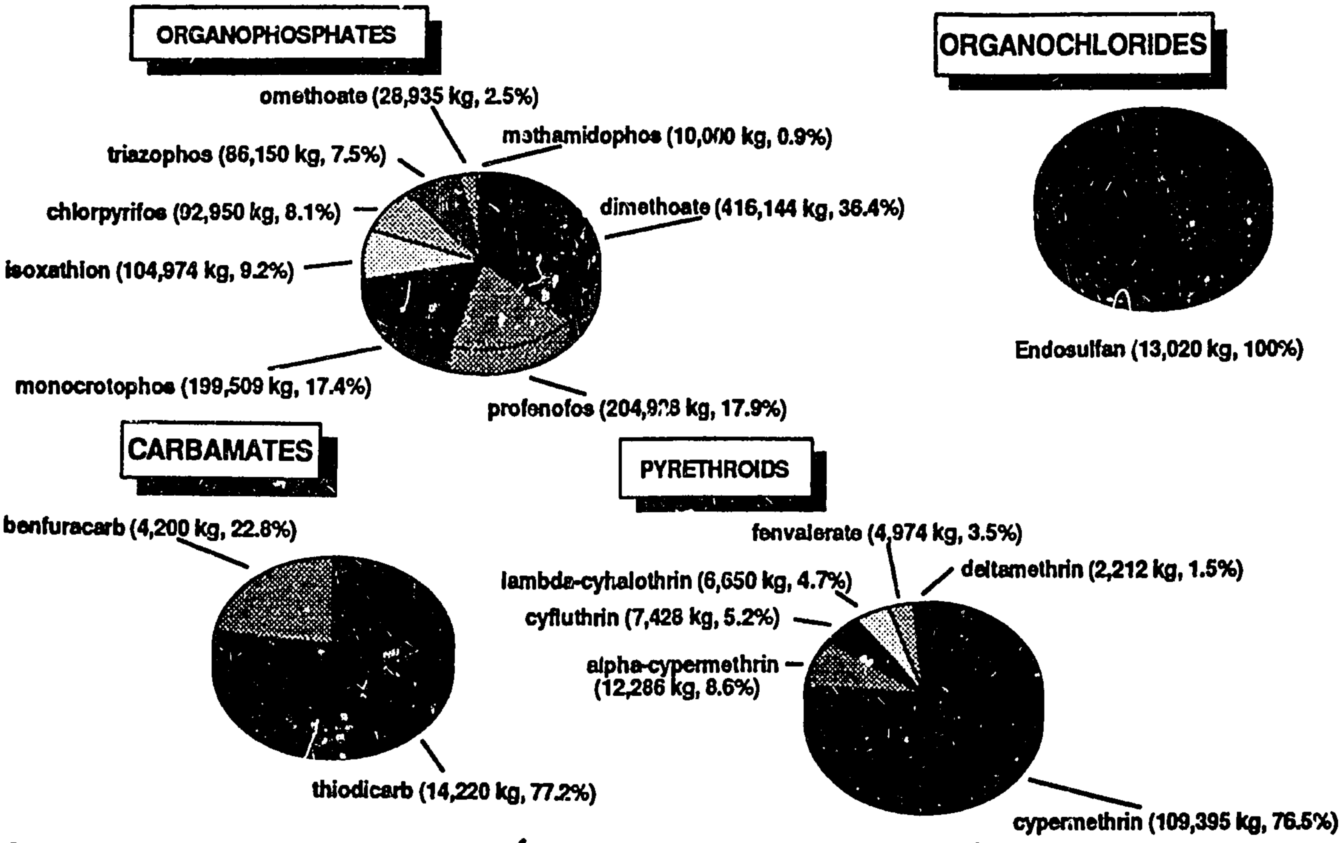
Country/Parastatal	1987	1988	1989	1990	1992	1993
Benin/SONAPRA	1980	1512	1200	1391	2113	1905
Burkina/SOFITEX	1200	1750	1050	600	1516	1100
Côte d'Ivoire/CIDT	2778	3427	3906	3390	3234	3234
Mali/CMDT	1431	751	2285	2351	1389	1700
Sénégal/SODEFITEX	120	600	738	100	440	171
Togo/SOTOCO	809	2267	200	na	680	770
Cameroon/SODECOTON	2107	1349	790	293	305	229
Central African Republic/SOCOCA	80	321	670	286	75	109
Chad/Cotontchad	348	1200	620	735	853	128
Burundi/COGERCO	na	na	41	110	79	108
Gambia/GAMCOT	na	na	na	na	45	23
Madagascar/HASYMA	na	na	315	276	176	262

Note: Data describing insecticide use in 1991 were not available.

Source: Compagnie Française pour le Développement des fibres Textiles, personal communication, 1994

During the 1992-93 cropping year, 1,318 MT of chemical insecticides were used in cotton production in the 12 nations listed in Figure 15. Organophosphates comprised 86 percent of the total. Dimethoate, profenofos, monocrotophos, and isoxathion were the leading products within the class.

Figure 15. Insecticides Used in Cotton by Class in 12 African Nations, 1992-93



Source: Compagnie Française pour le Développement des fibres Textiles 1994

The synthetic pyrethroids, principally cypermethrin, are used at significantly lower rates than the organophosphates or organochlorides (Table 16), and thus present less of an environmental persistence problem. Nonetheless, these materials are proportionately more costly and are also acutely toxic to bees, fish, and other aquatic life. These materials offer fast "knockdown" capability and are broad spectrum biocides offering no selectivity for managed pest control. Carbamate and organochloride use in 1992-93 was relatively inconsequential.

The mix of pesticides used in cotton has moved from extensive organochloride applications to the use of synthetic pyrethroids, organophosphates, and carbamates (Table 16). Endosulfan, technically an organochloride insecticide, does not have the characteristic environmental persistence properties that older organochlorides such as DDT, aldrin, and dieldrin have. The development of resistance and secondary insect resurgence and the recognition of their potentially harmful environmental effects are the main reasons for the elimination of these products.

Table 16. Principal Cotton Insecticides Used in Africa

Chemical	Class	Application rate (g/ha)
cypermethrin	pyrethroid	30-50
lambda cyhalothrin	pyrethroid	10-20
deltamethrin	pyrethroid	6-12
fenvalerate	pyrethroid	40-80
chlorpyrifos	organophosphate	250-500
profenofos	organophosphate	250-750
triazophos	organophosphate	150-250
dimethoate	organophosphate	280-400
monocrotophos	organophosphate	200-300
carbaryl	carbamate	500-1000
thiodicarb	carbamate	200-400
endosulfan	organochloride	300-750

Source: Compagnie Française pour le Développement des fibres Textiles, personal communication, 1994

There is some indication that intensive insecticide use directed at yield maximization has resulted in poor fiber quality and subsequent discounted sales price on the world market (O'Malley 1992). To de-emphasize yield maximization and focus on improved fiber quality, cotton growers and marketers in Chad initiated a "contract plan" in 1988 to limit production and promote higher quality, less intensified cotton. During that year about 71 percent of cotton fields in Chad were treated regularly with pesticides. Three years later, 95 percent of Chad's cotton harvest was sold at the highest world market grade, a distinct improvement from previous marketing results.

Many cotton-growing nations in the developing world have a large domestic textile industry. This is true in India, Egypt, Brazil, Pakistan, and Bangladesh. In contrast, several of the African nations that produce cotton do not possess a domestic industry to impart added value to their crop. These nations are obliged, therefore, to export the raw commodity and are vulnerable to the annual variability of the world market. Cotton prices have varied between $ 0.49/pound in 1985-86 and $ 0.94/pound in 1979-80. Current average world price is $ 0.68/ pound (U.S. Department of Agriculture 1994). Volatility in the terms of trade for raw agricultural products increases economic uncertainty and instability in Africa.

The importance of cotton in the foreign trade of many African nations has obliged governments to provide input subsidies, particularly for pesticides, which in many instances have been responsible for the widespread use of pesticides in cotton culture. Subsidy schemes and the subsequent reliance on chemical pest control has probably hindered the dissemination of alternative pest control methods.

V. Pesticide Trade and Regulatory Issues

Although pesticides have had a positive effect on the production of many foods and fibers worldwide, their nature as biocides entails risk in their manufacture, transport, storage, distribution, use, and disposal. Over the last decade the international community has reacted to the increased and unregulated shipment, distribution, and use of pesticides and other toxins in Africa and the developing world by establishing guidelines and regulatory controls to minimize risk in handling and use and to effect a level of order in what has been a disorderly and hazard-prone situation. One FAO (1989a) survey indicated that 25 percent of the developing nations lack any type of legislation to govern the distribution and use of pesticides, and 80 percent lack the resources to implement and enforce such legislation. About 60 percent lack facilities to analyze pesticide product quality, and few have the means to handle adequately the importation of banned or restricted compounds. In many developing countries there is inadequate capacity to establish, implement, and enforce a regulatory system for pesticide use (Schaefers 1993). This undesirable situation is particularly acute in sub-Saharan Africa. As the FAO (1993a) recently noted:

> most countries [in Africa] lack or are short of technical, physical and administrative facilities to be able to effectively monitor and enforce the provisions of the Code of Conduct, including a legal pesticide regulation, an operational registration and control scheme, educational materials to support the extension of safe and efficient use of pesticides, and laboratory facilities for pesticides analysis.

Indeed, the FAO's survey found that 76 percent of the nations lacked pesticide control statutes. Among the 10 countries in the Southern African Development Community, only Zimbabwe, Tanzania, and Mozambique had pesticide regulation schemes in the early 1990s (Schaefers 1992). In West Africa, neither comprehensive pesticide legislation nor registration and control schemes exist in most nations. Exceptions include Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Niger, and Sénégal.

The following section deals with these trade and regulatory issues, beginning with an overview of the pesticide export trade in the United States, the European Union, and Japan, the sources of more than three-quarters of pesticide technical material and formulated products (Wood MacKenzie & Co. Ltd. 1993b) and then turns to the controls that have been established pertinent to international movements of pesticides.

A. Pesticide Exports

1. U.S. Exports

Most of the major agrichemical corporations have sited facilities to manufacture, formulate, and distribute pesticides throughout the world. The majority of technical-grade pesticide material and formulated products, however, is manufactured and shipped from Europe, Japan, and the United States.

According to U.S. Customs data, pesticide exports in 1991 for U.S. manufacturers totaled 230,000 MT, an increase of 5,000 MT over 1990 (Smith 1993). The cryptic nature of product descriptions, however, makes identification of specific products difficult. Smith (1993) found that 74 percent of pesticides exported from the United States in 1991 could not be specifically identified from the records of the U.S. Customs Service.

At least 1,900 MT of banned, canceled, or voluntarily suspended pesticides manufactured in the United States were exported from the United States in 1991, including mirex, captafol, dinoseb, and DDT (U.S. Senate 1991). In addition, about 2,700 MT of never registered pesticides were shipped, an increase of 19 percent over 1990 levels. According to the National Agricultural Chemicals Association, a U.S. association of agricultural chemical producers, actual shipment totals may be higher. Up to 35 percent of total pesticide exports by members of the association consist of products not registered for use in the United States (U.S. Senate 1991). It is highly unlikely that U.S. international assistance agencies were involved in exports of any of these products.

"Severely Restricted" pesticides are those for which the USEPA has prohibited most registered uses but for which specific uses remain authorized. At least 3,000 MT of such pesticides, including chlordane, heptachlor, and carbofuran, were shipped from U.S. ports in 1991. Chlordane has no allowed uses on crops grown in the United States, but residues of the product are detected on imported fish, rice, beef, squash, and mushrooms (Smith 1993). Chlordane's use in food production in the developing world is therefore likely.

"Restricted Use" pesticides include materials that only trained applicators, or persons under their direct supervision, can purchase and use. Use by the general public is forbidden "because of the very high toxicities and/or environmental hazards associated with these materials" (Meister Publishing Co. 1993). About 21,400 MT of restricted use pesticides were exported from the United States in 1991. This amount represented about 38 percent of all identifiable pesticides exported from U.S. ports and a 20-percent increase over identifiable products in 1990 (Smith and Beckman 1991).

One study (World Health Organization 1989) identified a group of 15 pesticides with priority for epidemiological study due to potential for "severe effects on human health or the environment." U.S. Customs Service records indicate that nine of these compounds were exported from the United States in 1991, totaling 5,900 MT (Table 17).

Table 17. Level of U.S. Exports of Pesticides in 1991 Designated by WHO as Priorities for Public Health Studies

Compound	Exports (MT)
Aldicarb	41.1
Chlordane	520.0
DDT	87.1
EDB	388.0
Heptachlor	17.8
Lindane	59.2
Mirex	480.0
Paraquat	4,237.0
Parathion	17.4
Total	5,847.6

Source: Smith 1993

In 1991, about one-third of the pesticide compounds exported from the United States classified as banned, unregistered, or restricted use were shipped to Central and South America, 4.5 percent to Africa, 5 percent to Southeast Asia, and 1.2 percent to South Asia. Two of the largest initial destinations, Belgium and the Netherlands, were likely ports of transfer (Smith 1993).

2. European Exports

Most European trade in formulated pesticides takes place within Europe or with other industrial nations. Nonetheless, large quantities of formulated and technical products are exported, with a significant amount going to developing nations. Nations that lead in pesticide exports to the developing world include Italy, Germany, France, the United Kingdom, the Netherlands, and Switzerland. The destination of pesticide exports from the major exporting countries for 1989 and 1990 is shown in Table 18.

Exports to Africa represented 6 percent of the monetary value of the total exports of formulated pesticides from the European Union in 1991. While the proportion is small, the quantities and value are significant in relation to imports for most African importing nations. Table 19 shows exports to Africa by major European exporters. In addition, 7 percent of Swiss pesticide exports (valued at $41 million) were shipped to Africa in 1991 (Dinham 1993a).

Table 18. Destination of Formulated Pesticides from the Main European Exporting Nations, 1989-1990

Importing Country Group	1989 $ Mil	1990 $ Mil	% Change
Eastern Europe	244	270	11
Northwest Africa	43	46	8
Africa	269	185	-31
North America	194	173	-11
Central America	93	83	-11
South America	68	77	12
Middle East	189	250	32
Asia	102	108	6
Far East	163	150	-8
Pacific	37	28	-27
Total All Exports	3,734	3,940	6

Source: Cited in Dinham 1993a

Table 19. Value of Pesticide Exports to Africa by European Union Nations, 1989-1990

	$ Million		
Country of Origin	1989	1990	Percent Change
Belgium/Luxembourg	8.0	4.6	-43
France	74.8	58.0	-23
Germany	46.0	44.0	-5
Italy	4.6	6.9	+50
Netherlands	18.4	13.8	-25
United Kingdom	92.0	52.0	-44
Total	243.8	178.3	-27

Source: Cited in Dinham 1993a. The table excludes exports to northwest Africa.

3. Japanese Exports

Japan has an active agrichemical industry as well as an agricultural sector that tends to be heavily dependent on pesticides, particularly in regard to rice. According to the FAO's Inter-Country Programme for Integrated Pest Control in Rice in South and Southeast Asia (K. Gallagher, personal communication, 1994), for example, rice yields per hectare in Japan and in many parts of China are comparable, but the typical Japanese rice farmer spends almost $500 per hectare on pesticides compared to the typical Chinese farmer, who spends about $20 per hectare.

To some observers, the high levels of pesticide use in Japan suggests that the market for pesticides is already saturated. In response, so the argument goes, Japanese agrichemical companies have looked to overseas markets in order to maintain or increase both sales and profits. As the data in Table 20 suggest, however, this approach has not met with great success. Although the total value of exports rose by more than 30 percent between 1980 and 1991, the value of exports plunged in the next two years. The value of exports in 1993 was only slightly higher than in 1980.

Much the same can be said about the volume of exports (see Table 21). The volume of exports at the end of the 1980s was higher than in 1980. By 1993, however, exports were significantly lower than in any of the previous seven years. The same situation obtains for sub-Saharan Africa; the volume of Japanese exports to the region in 1993 was less than half of what it had been in 1980.

Both tables also provide data of particular importance to this report, namely that exports to sub-Saharan Africa comprise only a small portion of the total value and volume of Japan's overall exports. Although there are several plausible explanations for this situation, at least stands out. In order to justify a marketing presence in several African countries, agrichemical concerns require reasonably stable demand and markets from one year to the next. These do not appear to exist, at least for Japanese exporters to Africa. In 1980, as an illustration, Madagascar imported 655 MT of insecticides of organic phosphorus from Japan; by 1987, it imported none. Burkina Faso imported 190 MT of pesticides from Japan in 1986, but none the following year. Ethiopia imported almost 231 MT in 1989, but none the following year. In contrast, Gambia did not import any Japanese pesticides in 1986, but received more than 108 MT the following year. Only Sudan appears to be a consistent importer.

Of the exports to sub-Saharan Africa, 80 percent or more were insecticides, at least through 1989. More recently, insecticides have declined as a proportion of the overall total whereas the proportion of fungicides has increased.

Table 20. Value of Japanese Pesticide Exports, 1980 and 1986-1993

	Total Value (Million Yen)	Total Value to sub-Saharan Africa (Million Yen)	Percent to sub-Saharan Africa
1980	30,386	705	2.32
1986	27,079	1,467	5.42
1987	28,690	1,101	3.84
1988	32,330	1,496	4.63
1989	35,646	1,927	5.41
1990	37,071	1,193	3.21
1991	39,647	1,481	3.73
1992	34,606	841	2.43
1993	30,578	1,131	3.70

Source: Japan Tariff Association, 1981, 1987-1994

Table 21. Volume of Japanese Pesticide Exports, 1980 and 1986-1993

	Total Volume (MT)	Total Volume to sub-Saharan (MT)	Percent to sub-Saharan Africa
1980	24,176	1,085	4.49
1986	22,122	1,243	5.62
1987	21,735	827	3.81
1988	25,568	1,052	4.11
1989	26,725	1,269	4.75
1990	22,972	656	2.82
1991	26,319	850	3.23
1992	22,396	519	2.28
1993	19,853	501	2.50

Source: Japan Tariff Association, 1981, 1987-1994

4. Shift in Production Sites

Due to the regulatory limitations being imposed on the production and use of many of the older but still profitable pesticides in the developed world, production facilities for these products are shifting to the developing world, particularly to countries with large pesticide markets. A general expansion of production capacity has taken place in these nations by the large multinational agrichemical firms. Nonetheless, significant capacity for production of restricted or banned technical products remains in place in exporting nations. Domestic capacity for pesticide production is growing significantly in India and Latin America. Growth in production capacity in Africa is generally concentrated in a few nations (Wright 1991). At least 33 tropical and subtropical countries have facilities for formulating pesticides, and at least 11 produce technical-grade active ingredients (Dinham 1993a).

The major producing sites among the developing nations are in Asia, with China accounting for 7.3 percent and South Korea 5.7 percent of global production. India, Taiwan, and Indonesia are also major producers. Eastern Europe and the former Soviet Union produced 21 percent of the world's pesticides in 1985.

No manufacturing of technical-grade product occurs in sub-Saharan Africa except in the Republic of South Africa. Formulation capacity exists in African nations having the largest pesticide markets, including Kenya, Zimbabwe, Tanzania, Nigeria, and Côte d'Ivoire (Wright 1991). As noted above, at least 14 African nations have formulation facilities. Nonetheless, such facilities are, in general, underutilized due to the depressed economic situation in the region, financial constraints in the private sector, and the subsequent contraction of the market for pesticides. Indeed, Cameroon's facilities have been closed.

The value of Europe's pesticide exports to Africa declined by 27 percent between 1989 and 1990 (Table 19), and the actual market continues to diminish because of recurring instability in the economic and political situations of many nations in the region. Formulation capacity, therefore, will likely remain at present levels with little investment in expansion since existing facilities and imports can satisfy current demand. This underutilized capacity can meet the expected increase in pesticide demand when economic and political conditions warrant expansion of agricultural production. Amounts of donated pesticides, or products subsidized by various price and nonprice factors (Farah 1993), are difficult to assess because of limited reporting and sparse archived data. Despite the paucity of information, available information suggests that the amounts overshadow domestic formulation. The extent of pesticide donations to African nations is also likely to affect any further growth in Africa's formulating capacity. The reader is reminded, however, that a detailed analysis of pesticide formulation capacity of African nations is beyond the scope of this study.

B. The Circle of Poison

The expression "Circle of Poison," which originated with consumer advocacy groups, refers to the practice of producing banned and unregistered pesticides for export, in many instances to countries with few controls, which then return as residues on imported products (Weir and Schapiro 1981). In the United States, pesticide manufacturers may export two types of unregistered pesticides--those never registered for use and those that were registered for use at one time but because of changed business factors or regulatory prohibitions are no longer registered for use. In some cases the USEPA prohibits all uses of a product because of health or environmental concerns. Examples of such pesticides include chlordane and heptachlor, two organochloride compounds, which were once widely used to control insect pests in maize and for termites.

U.S. manufacturers of these products can still export them legally. To do so, "prior notice" must be given to the foreign purchaser regarding the products' status. Notice must also be given to the nation to which the material is being shipped in accordance with section 17(a)(2) of Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which states that:

> Prior to export, the foreign purchaser has signed a statement acknowledging that the purchaser understands that such pesticide is not registered for use in the United States and cannot be sold in the United States under this Act. A copy of that statement shall be transmitted to an appropriate official of the government of the importing country.

The act's section 17(b) requires the U.S. Department of State to notify foreign governments of significant regulatory actions taken concerning a pesticide product, such as the imposition of restrictions, handling requirements, or outright suspension or cancellation. Product labels are required to carry restrictions and use warnings in the language of the importing country.

Critics argue that the present U.S. notification system inadequately protects the safety of pesticide users in importing countries and U.S. consumers of imported food that contain residues of banned or unregistered pesticides. Other arguments center around the moral dilemma of offering materials for export that are thought to be hazardous to health or in other ways harmful to inhabitants of the United States (S. Marquardt, personal communication, 1994).

Proposed legislation to control the export of unregistered pesticides as well as those products considered highly hazardous but registered in the United States has been considered since 1989 (Pesticide Export Reform Act) and was close to becoming law in 1990. The proposal was reintroduced in 1991 (Circle of Poison Prevention Act), but there was no legislative action. The 1991 version would have established a regulatory framework that would require more than what is now included in FIFRA and in the FAO's Code of Conduct. Both the Code and FIFRA rely strictly on the exchange of information as the basis of export controls, and compliance with the Code is voluntary. The proposed act would prohibit the export of certain pesticides in addition to the promotion of information exchange. If approved, the act would:

* Prohibit the export of banned or unregistered pesticides or products that do not have a food residue tolerance, have had the majority of registrations canceled, or are not registered for use on food in the United States but would be used for that purpose in

the importing country.

* Add the "right to refuse" to "prior informed consent" by allowing governments of importing countries to refuse the importation of "particularly hazardous substances" including restricted use pesticides and those undergoing special review by the USEPA.

* Permit U.S. citizens to file law suits against violators of the act.

* Automatically revoke tolerances for pesticide residues on food for pesticides no longer registered in the United States.

* Require the USEPA to disseminate information on pest control alternatives not involving chemicals and to improve strategies for the adoption of sustainable agricultural practices.

Through mid 1994, there had been no legislative action, but this may change. The Clinton administration expressed support for some of the principles offered in the 1991 bill. In testimony during a hearing before a committee of the U.S. House of Representatives in January 1994, the USEPA's administrator expressed the administration's support for changes to the FIFRA that would include prohibit the export of pesticides: a) that have had their registrations revoked for health reasons; or, b) that have been banned for environmental reasons unless an importing country has specifically requested them (Browner, Lyons, and Taylor 1994). Such provisions would affect approximately 50 pesticides. Further, the administration believes that the export of any pesticide to a country that refuses shipment would be prohibited according to the guidelines covering prior informed consent, which is discussed below. Pesticides that have not been registered for use on foods could be exported only if there is a U.S. tolerance for the active ingredient and/or a method capable of detecting residues of the affected pesticides in food. The proposed law would still permit the export of a never-registered pesticide if three countries with "credible regulatory" schemes had registered the pesticide and a test methodology for its detection exists.

If implemented, these requirements would stop exports from the United States of most materials that the USEPA has restricted, suspended, or banned. Nonetheless, the multinational nature of the pesticide industry would allow production of offensive materials to be shifted to overseas operations with no such prohibitions as has already occurred for some pesticides. Trade in these materials would not be affected significantly and the problem of prohibited material in food residues would not be addressed effectively. Global coordination of pesticide export regulations is necessary to affect the volume of trade in pesticides that pose an inordinate amount of risk. Promoting alternatives to chemical pest control is another need requiring global coordination.

In related recently proposed U.S. legislation (Pesticide Food Safety Act of 1994) the USEPA administrator would be authorized to spend up to $4 million per year to provide technical assistance in developing countries in safe handling and use of pesticides, alternative methods of pest control, strengthening of pesticide regulatory institutions, provision of technical information, support for pesticide management and safety training programs, and coordination with assistance efforts conducted by other donor or international organizations. Priority would be given to developing countries that are major sources of food imported to the United States. The USEPA would work with USAID in USAID-assisted countries. There had been no legislative action to implement the proposed regulation as of mid 1994.

Even in the absence of statutory change, the USEPA had acted in early 1993 to revise and strengthen its policies governing the export of pesticides from the United States (*Federal Register* 1993). The agency decided to increase the amount of information provided to foreign governments about the status of proposed and final suspensions and cancellations of pesticide registrations. In addition, the new regulations require a foreign purchaser of unregistered pesticides to sign a statement, prior to export, acknowledging that the pesticide is unregistered and cannot be sold or used in the United States. The U.S. exporter must provide the signed statement to the USEPA, which then sends copies to the countries receiving the exports.

C. International Guidelines and Regulatory Frameworks

The growth in developing countries' capacity to manufacture and formulate pesticides can undermine the leverage of developed nations' domestic regulations to control the trade in banned or severely restricted products. The international community has attempted to address this issue by promulgating global agreements that offer guidelines for implementing structural and regulatory controls and allowable residue limits on the trade and use of toxic products including pesticides. The following section summarizes briefly these agreements.

1. Prior Informed Consent

Inadequate control of the distribution and use of pesticides in the developing world has created situations of toxic residues, availability of pesticides in unlabeled containers, supply of inferior quality products, and the failure to provide users with adequate information and instructions for safe and effective use. In response, the FAO adopted an International Code of Conduct on the Distribution and Use of Pesticides in 1985. The Code was amended in 1989 (FAO 1989b) to incorporate the principal of Prior Informed Consent (PIC) to give governments the right to prohibit the importation of certain hazardous products. Nations can assess the risks associated with certain pesticides and register a prohibition on their import. The Code states that:

> Pesticides that are banned or severely restricted for reasons of health or the environment are subject to the Prior Informed Consent Procedure. No pesticide in these categories should be exported to an importing country participating in the PIC procedure contrary to that country's decision made in accordance with the FAO operational procedures for PIC (FAO 1989b).

Governments are asked to inform the FAO of their decision to prohibit or consent to import of the pesticide within three months. Countries are provided with information on the status of all pesticides in the PIC process to inform domestic export and import industries of decisions to allow or prohibit importation. To qualify for inclusion in the PIC process, a pesticide must have been banned, its use severely restricted, or have been withdrawn from the market by its manufacturer because of health or environmental reasons. By February 1993, 55 governments had responded to the first six Decision Guidance Documents, which summarize the reasons for use restrictions or bans in specific nations from which importing nations can make trade decisions (Dinham 1993a). In addition, there are currently 39 pesticides and chemicals that are in the process of being confirmed for PIC or awaiting completion of Decision Guidance Documents targeting those substances that pose the greatest human health risk. The original list of 12 did not necessarily include those pesticides most responsible for health hazards (Pesticide Action Network 1994). The pesticides that are currently subject to the PIC guidelines include: aldrin, chlordane, chlordimeform, cyhexatin, DDT, dieldrin, dinoseb, EDB, fluoracetamide, HCH, heptachlor, and mercury compounds. Twelve additional products will be included in this list if they are found to be produced or traded; these include chlordecone, DBCP, endrin, kelevan, leptophos, nitrofen, schraden, strobane, TEPP, thallium sulphate, and 2,4,5-T with dioxin contamination.

As governments receive updated information on the PIC pesticides, they will become aware of positions of other governments and will be able to make informed decisions about the importation of potentially hazardous materials. PIC provides a structure to prevent unwanted imports as the major agrichemical companies have agreed not to export contrary to a government decision. Nonetheless, PIC places the onus on the importing country to attempt to prevent unwanted imports. PIC does not prevent the exportation of materials banned in the exporting country.

Other articles in the Code deal with recommendations on pesticide management, testing of pesticides, reducing health hazards, regulatory and technical requirements, availability and use, distribution and trade, labeling, packaging, storage, disposal, and advertising. Many FAO guidelines covering various aspects of the Code of Conduct exist or are under development. Appendix D provides a list of these guidelines and their status as of early 1994.

Most members of the OECD have joined the scheme, and the European Union has required that the PIC process be legally enforceable within its member countries. The European Union approved a regulation in December 1991, to incorporate the PIC procedures. The regulation took effect in June 1992. In the United States, the Clinton administration is currently considering similar legislation.

At a meeting of experts in Rome in March 1994, it was reported that 120 governments including all major industrial countries, are now PIC participants. There are, however, some significant pesticide exporters, most notably Taiwan and South Korea, that have not appointed Designated National Authorities (DNA) and are, therefore, not participating in the PIC scheme (Pesticide Action Network 1994).

It is difficult to determine what the current situation is with regard to PIC in Africa. Some formulation capability exists, and most African governments formally subscribe to the Code of Conduct and PIC.[14] Despite these governments' approval of the Code, PIC-listed products are known to enter countries in the absence of appropriate notification. Indeed, many of the formally listed materials remain in extensive use in Africa. Furthermore, insufficient knowledge of specific guidelines limits the capacity of some African nations to implement the Code of Conduct (Youdeowei and Alomenu 1989). In one assessment of the implementation of the Code of Conduct in Africa, the FAO (1993a) identified more than a dozen problems with the Code's implementation. Inadequate legislation, poor enforcement, and the absence of effective registration schemes were common. In the words of the FAO's report, the PIC procedures are poorly enforced due to a lack of training on the part of national staffs responsible for their use.

Enforcement is a chronic problem. A survey that the FAO conducted between 1986 and 1988 indicated that as many as 84 developing countries do not have the resources to control potentially hazardous pesticides effectively within their borders; 76 percent of African nations fall within this category (FAO 1989a). DNA training workshops were held in Chile and Thailand in 1993 and another is scheduled for Andean Pact countries in July, 1994. The FAO has not scheduled any workshops for Africa, although funding from the European Union may be available to offer informational and training sessions in Africa in the future (Pesticide Action Network 1994). Most African nations require strengthening of their technical, physical, and administrative facilities, including laboratories for quality control and residue analysis to allow them to monitor and enforce the Code effectively.

In addition, a stipulation of PIC principles includes the condition that shipment of PIC-listed chemicals can proceed if no decision by the DNA is received by the exporter and the pesticide is registered in the country or has previously been used in the country, or has a history of previous importation. Given the institutional weaknesses for regulation and control of pesticides mentioned above, it is not surprising that many of the PIC-listed pesticides remain in widespread use in Africa.

The FAO initiated a five-year regional project in 1989 to assist African countries with implementation of the Code of Conduct (Adam 1989). Objectives included the promotion of effective pesticide policies, the encouragement of regional harmonization of pesticide registration requirements, establishment of a national and regional laboratory infrastructure, and training of staff. Based on the information gathered for this report, the chief beneficial results of the initiative have been the acceptance of the FAO's Code of Conduct and PIC-list procedures by most nations in the region. The development of a laboratory infrastructure and staff training await implementation. Attempts should be made to integrate PIC activities with other related

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[14] There are, however, several notable exceptions. As of late 1993, for example, Botswana, Guinea-Bissau, Malawi, Mali, Namibia, and Swaziland had not established Designated National Authorities.

programs such as IPM and the FAO/OECD initiative for developing programs to reduce pesticide use.

2. Codex Alimentarius

The FAO and the World Health Organization (WHO) sponsor the Codex Committee on Pesticide Residues as part of the Codex Alimentarius Commission, which was created in 1963. The Codex establishes Maximum Residue Limits (MRL) that can be accepted by other member countries for pesticides in foods and feeds in order to facilitate international trade and to protect the health of consumers. As of June 1993, the Codex has set standards for 230 food commodities and made recommendations for several hundred pesticides and additives. Despite this effort, Codex standards have not been accepted widely. Member nations prefer to develop unique standards for domestic requirements. Many developed nations fear that harmonization will bring standards down to the lowest common level. Harmonization within the European Union, for example, will increase the permitted list of pesticide residues in every member country (Avery 1993). The number of chemicals allowed in Germany and Greece will more than double and the range of foods that may contain additives will increase substantially. Many Codex standards are lower than many national ones.

The Codex allows food residues of parathion, paraquat, and lindane, but these substances are banned or restricted in most developed and some developing nations. The Codex allows the residues of five pesticides that the USEPA classifies as probable human carcinogens: captan, chlorothalonil, folpet, lindane, and propargite (U.S. Department of Agriculture 1993). The Codex Alimentarius Commission has enabled many developing nations to forego risk assessment procedures needed to develop food and agricultural standards and to apply Codex standards where otherwise none existed (Avery, Drake, and Lang, 1993). The developing nations have historically had difficulties meeting the food safety standards of the developed world because of financial and technical constraints. Lowered phytosanitary and pesticide residue standards in the North may benefit the food export economies of the South in a manner that is deleterious to the health and well-being of both the developed and the developing world. Technical and financial resources that are now directed to assist developing nation food exporters would probably be redirected to the detriment of all citizens.

3. The Codex and the General Agreement on Trade and Tariffs

Governments are not obligated to adopt Codex standards, but the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) may give Codex significant influence over methods by which governments will be able to set MRLs. Harmonization is an important component of the GATT because its primary objectives include the facilitation of international trade and the removal of unnecessary and other technical barriers that preclude such trade. Under GATT, national residue standards set more strictly than those set by the Codex could be considered barriers to trade if they impede trade flow. As currently proposed in the GATT, nations would not be allowed to cite animal welfare or environmental protection as justifications for health and safety standards set more strictly than the Codex. Nations that fail to justify standards to the satisfaction of a GATT panel could be subject to retaliatory trade measures or asked to pay compensation to nations whose high standards affect exporters (Avery 1993). It will be difficult for nations to maintain standards higher than the Codex if such standards affect imports. In contrast to these concerns, harmonized standards will be a great advantage to food and agrichemical companies that trade products globally. Export procedures will be streamlined and domestic regulatory control over allowable MRLs will be transferred to the international commission.

The GATT has potentially significant implications for Africa and the global agrichemical industry. Multinational firms are lobbying for harmonization. If international regulations gain precedence over national rules guiding allowable food residues, and pesticides formerly banned are allowed to be imported as detectable residues, then markets for African agricultural products on which banned products are used could expand. It is not likely, however, that nations will surrender their regulatory sovereignty in favor of economic considerations. It is equally unlikely that either human health concerns established during years of laboratory tests or regulatory decisions established after years of litigation will be abandoned. In contrast, a more likely prospect is the extension of the economic lives of many older pesticides that are manufactured or formulated in or imported to Africa. The continued use on food crops of these products for domestic consumption or for use on commodities traded regionally slows the introduction of less toxic chemical compounds already available in the developed world, and more important, impedes adoption of alternative pest control methods including the precepts of IPM.

Another obstacle to the introduction of modern, less toxic pesticide compounds is cost. Most modern pesticides remain under patent protection allowing the proprietary manufacturer to recoup the costs of research and development over a period of 17 years through maintenance of, in many instances, extraordinarily high prices when compared with older, off-patent, generically manufactured products. Much of the new chemistry is unaffordable to nations with few hard currency reserves.

Codex harmonization not only jeopardizes the health and welfare of the developed world by the threat of chronic long-term exposure to hazardous chemicals that have had their "day in court" and continue to be imported as residues on foreign agricultural commodities, but in a more immediate sense, also places the populations of many African nations at risk. These risks include both acute and chronic exposure to these older and more toxic substances because of their continued manufacture and use.

Many of the PIC-list compounds have been replaced in use by what is considered advanced pesticide chemistry, but considerable use of older products continues on both cash and food crops. Many of the newer products, particularly the organophosphates, present significant acute toxic risks themselves. And, practically speaking, the use of chemical pesticides in agriculture can never approach a risk-free situation. Nonetheless, new pesticide chemistry coordinated with nonchemical pest management practices in a comprehensive IPM scheme tailored to specific crops and regions is an effective option. As Kiss and Meerman (1991) point out, effective IPM programs include a chemical control option as a method of "last resort" when other measures fail to prevent pest populations from exceeding a predetermined economic threshold level. The rate of adoption of IPM practices by African farmers can be enhanced by including the chemical pesticide "insurance" option, since the risk involved in adopting a technology with significant output effects is lowered. In few agricultural production situations are these types of insurance against technology failure available. Availability of new chemistry as part of a comprehensive IPM approach can also be offered as a necessary intermediate stage in which appropriate alternative pest control methods, once adopted, are allowed to be established in fields, in agricultural communities, and in the farmer's perception of a sustainable agricultural system.

Donor aid may be required to promote use and adoption of new materials and to fund research in alternative production systems for staple and cash crops. Agrichemical multinationals could be encouraged to expand their involvement in addressing many of the problems that beset the use of the products they manufacture. One such effort is GIFAP's "Safe Use Initiative."[15] Other examples are also relevant. Ciba-Geigy is attempting to transfer IPM technology to smallholders in Africa. The firm's pilot "Small Farmer Program" in Africa targets farmers in Mali, Nigeria, and Mozambique for introduction to applied IPM methods including, as needed, use of chemical pesticides. This appears to be a rational approach in introducing the greatest number of smallholder farmers to the methods of IPM. Reliance on an extension cadre that is generally understaffed, ill-equipped, and lacking in methodological expertise as well as resources, is not a promising avenue. The program, however, should include large cash-crop production systems in which most of the pesticides are used and in which most of the environmental and health risk involved in pesticide use is focused.

VI. Trade and the Environment

The imposition of trade restrictions in an attempt to enforce uniform environmental standards, specifically those that comply with the criteria of developed nations, could affect the nations of Africa significantly. Easy access to cheap resources historically has been a prime engine of economic development. That requirement has not diminished. International conventions to restrict resource access, either by placing limits on natural resource exploitation, limiting access to cheap production inputs, or the stipulation of environmentally conscious production methods, impede the natural operation of markets and with it economic progress. Despite this situation, global environmental agreements make it clear that the world community, including the developing world, considers environmentally sound economic development to be a singular priority. Having noted this preference, the concept of economic progress is necessarily different for the nations of the North and those of the South. The developed world

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[15] However meritorious such programs may be, they remain subject to criticism. For example, one pesticide policy expert (Waibel, personal communication, 1994) remains hesitant to support more safe-use training "unless the incentive structure for pesticides has been changed." He adds that if "pesticides are underpriced relative to their social prices, safe use training acts as an incentive to maintain current levels of use."

has been "mined"; the developing nations, in general, have not. Imposing trade sanctions to prevent the exploitation of natural resources requires developing nations to find other protocols to advance the economic and social condition of their peoples.

In the realm of pesticide use, an emphasis on research to develop alternative pest control methods for various cropping systems as well as educating farmers in alternative methods and techniques and introducing new materials would begin to address the current problems. A strong emphasis on the dissemination of IPM practices for all levels and types of cropping systems would demonstrate an awareness for integrating environmental considerations into a nation's economic and social development. Coordination with governmental ministries, special interest groups, and donor agencies would be required. Resources would be needed to upgrade agricultural research facilities and direct research missions toward reduced-input, sustainable agricultural practices. Modernization of agricultural production and enhancement of productivity could be reached with minimal environmental disruption and in some instances with enhancement of previously degraded agri-ecosystems.

VII. Mitigation of Risks

The response of the agrichemical industry and the international assistance community to the concern of nongovernmental organizations as well as many governments about the use of pesticides in agriculture has been the promotion of safe procurement, transport, handling, and use of pesticides. Through national agrichemical industry organizations and through membership in GIFAP, pesticides are seen as manageable poisons necessary for the successful production of agricultural commodities. Dangers arise when materials are mishandled, are used incorrectly, or applied inappropriately. The influence of international organizations, such as the FAO and the United Nations Development Program, and such extranational organizations as GIFAP has begun to establish an elementary order in a disorderly environment. Some of the actions taken to mitigate risks are discussed below.

A. Procurement

As noted earlier, many developing nations do not have effective regulatory control over the type, nature, and use of the pesticides that are imported or formulated domestically. Pesticides are usually purchased as ready-to-use products or in bulk for local formulation and packaging. Some donor agencies provide pesticides to plant protection services or directly to projects themselves in support of agricultural projects or for migratory pest control.

In many instances pesticides arrive at their place of use in inappropriate package sizes, are poorly packaged and may leak or degrade, or have labels in the language of the country of origin rather than the country of use, or provide insufficient information about safe handling and use. Many people in the international agrichemical community argue that many of the problems associated with pesticide use in the developing world could be dealt with effectively by strengthening the methods by which tenders are offered for pesticides. In many cases tender choices are made according to a least-cost criterion when safety issues should also be considered.

Many tender offers do not mention the need to conform to the International Code of Conduct especially in nations that have no regulatory structure for pesticides (Thomas 1990).

The Code of Conduct has guidelines for procurement of pesticides that attempt to alleviate these problems. The guidelines include specification of packaging size appropriate for intended use, packaging security appropriate for level of potential hazard, transport conditions, and probable handling conditions during shipment and storage, methods for proper tender offering to assure uniform quality of the product received, supplier requirements for provision of technical support in handling and possible disposal when necessary, and details on how to determine reputable bidders.

B. International Measures

Several international agreements and conventions attempt to control international traffic in hazardous materials. The Organization of African Unity adopted the Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa in January 1991 (Organization for African Unity 1991). This convention bans the import of hazardous substances that have been banned, canceled, or refused registration or voluntarily withdrawn from the country of manufacture for human health or environmental reasons. The U.N. Conference on Environment and Development called for strict adherence to the Code of Conduct and stipulated conditions to make the Code internationally binding. The London Guidelines for the Exchange of Information on Chemicals in International Trade (United Nations Environmental Program 1987) were originally adopted in 1987. These guidelines request signatories to notify the International Register of Potentially Toxic Chemicals of control actions to ban or severely restrict use so that information can be transmitted to designated national authorities of other countries. The guidelines were expanded in 1989 to include the PIC procedures. The Basel Convention (1992) dictates that responsibility for the disposal of hazardous waste is the manufacturer's. The convention also provides for the control of transboundary movement of hazardous and certain other material through prior notice and consent procedure between exporting and importing countries. Other provisions include stipulations on the return of illegally shipped material and interdiction should the exporting nation feel that the receiving nation could not manage the material in an environmentally sound manner.

There is a significant cost to the developing nations in attempting to abide by these agreements. The conventions address neither the underlying situation of poverty that give rise to the trade of hazardous substances nor the environmental conditions that exist in specific nations. In spite of the Lomé Convention, which contains an agreement on banning from Africa the trade of hazardous wastes from a list of materials established by the Basel Convention, trade will continue until socioeconomic conditions improve to the point where the costs of continuing the practice exceed the financial incentives.

VIII. Conclusions and Recommendations

Sub-Saharan Africa encompasses a vast and complex geographic region. Agricultural production practices differ by region and crop and impart differing levels of degradation on the surrounding environment. Conversion from traditional production of staple crop to cash cropping of monocultures is harmful to biodiversity and ecological stability. Attempts to eradicate indigenous plants and animals to promote the successful establishment of a cash crop system through chemical pesticides adds further embarrassment to a system already ecologically compromised. Nevertheless, effective pest control mechanisms are needed.

There is some indication that cheap chemical control is being inappropriately used on food crops raising the question of food safety as well as environmental effects. Misapplication, overdosing, or the lack of safety precautions and equipment during application procedures compromise the health and safety of farmers and farm workers. These problems are common in Africa and in the developing world in general. Regardless of their location, the problems deserve remedies. Unfortunately, effective action will require considerable information that is not now readily available. In Africa, for example, what is lacking are data describing the:

* degree of environmental degradation from pesticide use - soils, water, and natural ecosystem productivity;

* the human cost of pesticide use including acute and chronic illness to farmers and farm workers from field exposure as well as food-related illnesses in the general population from pesticide residues;

* a detailed accounting of the costs versus benefits of pesticide use in the region by crop using conventional accounting procedures; and,

* an accounting including the environmental and health costs versus the economic benefits, which has only recently seen a methodology established (Rola and Pingali 1993).

This report has established that the use of chemical pesticides has increased in nations with an expanding agricultural sector, stable political situations, and economies not intimately linked to world markets for raw agricultural commodities. In nations that rely on the export of cotton, tobacco, coffee, cocoa, or other raw cash crops to generate a major portion of their national income, however, the annual use of pesticides is linked directly to the crop's world market price. At work are two opposing trends of a single factor: world prices. On the one hand, as world prices increase, more land area is used for the production of cash crops, thus requiring increased input use and subsequently increasing input demand. On the other hand, increased revenues from the sale of the cash crop permits the purchase of the requisite inputs, transforming the initial demand to what is termed "effective" demand. As world prices decrease, the opposite occurs, thus imparting one measure of variability to pesticide use in Africa.

The majority of pesticides used in the region are insecticides, an element that also imparts annual variability to use trends, because degree of infestation plays an important role. Although there is much prophylactic application of insecticides, especially on land used for cash crops, both migratory and perennial pest outbreaks influence the quantities of insecticides purchased, donated, and applied. The same can be said of insecticide use in the developed world. The increase in the use of chemical pesticides over the last 30 years in the North has been spurred by both the technical and marketing success of herbicides for weed control. Virtually all cash and food crop land in developed nations is treated with one or more pre- or post-emergent chemical herbicide application (Osteen and Szmedra 1989). Insecticide use, however, varies with annual infestations.

The use of herbicides in Africa is not extensive. As a general rule, the supply of agricultural labor is sufficient and available at prices lower than chemical weed control per hectare. In addition, hand-weeding provides livestock fodder to supplement other feed sources. The use of herbicides in the region is, therefore, not expected to influence trends in pesticide use significantly in the next decade.

There has been a de-emphasis in the use of organochloride products through the combined efforts of the international community and individual nations in Africa. Most nations in the region subscribe to the FAO's Code of Conduct and the PIC process in which pesticides restricted or banned in exporting nations because of health or environmental reasons can be refused entry by the importing nation. Enforcement is a common problem in the region. Illegal shipment and use of banned products takes place. Residue sampling of market food products indicates that misuse and overdosing occur. The extent of the problem, however, is difficult to discern without extensive residue sampling programs. More data are needed.

Likewise, the brief country reports provided herein attest to the desirability of substantially more information about the procurement, management, use, and disposal of pesticides in virtually all African countries. Although manufacturing capacity is limited to the Republic of South Africa, further attention to this capacity is highly desirable. South Africa is a major exporter to neighboring countries, and there is considerable reason to believe that the country's exports will increase. For this reason alone, further investigation of South Africa's pesticide industry would be useful.

Regardless of the source of pesticides, unwanted, inappropriate, and obsolete pesticide stocks are a problem in some nations, although the agrichemical industry, specifically the multinationals, have instituted disposal and cleanup programs in some locations. This issue continues to be important for many nations in Africa and warrants further attention.

Pest management and control problems in the region vary considerably. Production systems of like size are markedly similar. Many nation grow rice, cotton, coffee, and tobacco, but production environments are diverse and require differing management regimes. Unfortunately, many national agricultural extension services are understaffed and lack the resources and the technical expertise to advise on alternative pest management practices. The universal alternative to good information is to attempt to eradicate pests with chemical pesticides.

Good information is the basic tenet of IPM and requires extensive data collection and analysis. Many nations in Africa have accepted IPM as an important aspect of national agricultural policy. Without region-specific data collection and research focused on describing the biological interaction of multipest, multicrop production environments, however, little advancement in alternative pest management techniques will occur. Further, data are needed describing current patterns of pesticide use against specific pests within a cropping system to help forecast resistance buildup and to target alternative pest management programs. A regional data depository is needed to aggregate and disseminate what is known and what further data are required to answer specific questions and to help solve specific problems.

Cheap, effective, easily managed alternatives have yet to be introduced on a scale large enough to offer what chemical pesticides currently deliver: presumed insurance against pest damage and loss that is directly tangible, either through sufficient food production to provide for subsistence and a possible marketable surplus, or yields of cash crops that offer income to provide for all needs. The problem of agricultural prosperity through pesticides is the acute and chronic health and environmental effects that accompany extensive pesticide use.

Mature markets in the developed nations for particular classes of pesticides have caused many agrichemical companies to focus on the developing world for growth. Few regulatory structures are in place to channel that growth towards products that minimize human and environmental risk. The current situation in sub-Saharan Africa is often one of intended compliance with global agreements and conventions but insufficient institutional structures and capabilities for enforcement. With a few exceptions, donor agencies have devoted scant attention to this issue. A companion study (Tobin 1994) examines donor policies and practices, which are of particular relevance to Africa because of the volume and value of the donated pesticides it receives.

Development aid targeted at increasing agricultural productivity could include technical assistance to governments to help provide farmers with alternative pest control and management practices including chemical pesticides for use as a "last resort" method when other nonchemical controls have failed to keep pest populations below action threshold levels. That assistance would also include increased measures to ensure safe handling and use of chemical pesticides and the inculcation of the risks involved in the use of chemical pesticides into the farming community. Other related measures to put substance "on the ground" in support of the language of agreements could include programs to assist in the teaching of safe handling and application procedures for those unable to read product labels; assistance in the purchase, distribution, and proper use of protective clothing and equipment; and responsibility for disposal of unused or unwanted product and empty containers. Other suggestions (H. Waibel, personal communication, 1994) include agreement among international donors to stop the support of plant protection activities in developing countries that use the most dangerous pesticides (e.g., those that the World Health Organization places in categories 1a and 1b)

Forging effective policy in dealing with the seemingly conflicting issues of promoting agricultural productivity and avoiding environmental degradation in Africa is, in theory, not a difficult task. A substantial commitment of resources within the donor community aimed at strengthening the individual nations' information dissemination and collection services is essential. If productivity growth, while limiting chemical inputs, is deemed important to national policy, then increased attention to research on alternative pest control methods is needed. Similarly, training of a nucleus of extension cadre expert in the application of pest management methods is highly desirable. The first steps in this process have been taken with the establishment of the International Centre for Insect Physiology and Ecology in Nairobi. Other centers would focus research on problems indigenous to the Sahel or to West Africa for instance. Upgrading data collection methods with files being maintained both locally and at regional data repositories is needed to establish uniformity in collection methods and to develop expertise in analysis and determine further data requirements. Furthermore, if environmental concerns by the donor community and the African nations are paramount, then policies and programs could be established to enhance the economic incentives that would promote alternatives to chemical pesticides including favorable credit terms for adopters, a crop insurance structure offering levels of insurance at rates less expensive than comparable perceived protection levels offered by chemical pesticides, or direct subsidy for purchase of alternative methods. Further investigation could determine other, perhaps more compelling economic incentives.

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Appendix A: Summary of Pesticide-Related Characteristics in 25 African Nations

Country	Market or Controlled Pesticide Prices	State or Private Pest Outlets	Local Formulation	Trend in Use	FAO/PIC Signatory	Aid-in-Kind Donations	Regulations Exist	Pesticide Registration	IPM Policy Goal
Angola	both	both	yes	-	yes	-	yes	yes	-
Botswana	both	both	no	-	no	yes	no	no	-
Burkina Faso	both	both	yes	-	yes	yes	yes	yes	-
Burundi	controlled	state	yes	up	yes	yes	no	no	-
Cameroon	market	both	no	down	yes	yes	yes	yes	no
Côte d'Ivoire	controlled	both	yes	flat	yes	yes	yes	yes	-
Gambia	controlled	state	no	-	yes	yes	no	no	-
Ghana	-	-	yes	up	yes	yes	no	no	yes
Guinea	controlled	state	no	-	yes	yes	yes	no	-
Guinea-Bissau	controlled	-	no	-	no	yes	no	no	yes
Kenya	market	private	yes	down	yes	yes	yes	yes	no
Malawi	both	both	no	up	no	yes	yes	yes	no
Mali	controlled	state	yes	up	yes	yes	no	no	yes
Mozambique	market	both	yes	down	yes	yes	yes	yes	-
Namibia	market	private	no	-	no	-	yes	no	-
Niger	-	-	no	-	yes	yes	yes	no	-
Sénégal	market	both	yes	-	yes	yes	yes	yes	-
Sierra Leone	-	-	no	-	no	yes	no	no	-
Swaziland	both	both	no	-	no	-	no	no	-
Tanzania	market	both	yes	up	yes	yes	yes	yes	no
Togo	controlled	state	no	-	yes	-	yes	no	-
Uganda	market	private	no	down	yes	yes	yes	yes	-
Zaire	-	-	yes	-	yes	yes	yes	no	-
Zambia	both	both	yes	-	yes	-	yes	no	-
Zimbabwe	market	private	yes	up	yes	yes	yes	yes	no

The data in this table attempt to summarize information that is difficult to verify or that is subject to frequent change. Readers who note errors or mistakes are encouraged to inform the staff of USAID's Environmental and Natural Resources Policy and Training Project.

Appendix B: Detailed Pesticide Use in Zimbabwe, Kenya, and Côte d'Ivoire

Appendix B, Table 1. Insecticide Active Ingredient Use by Commodity: Zimbabwe 1992 Harvest Year

Barley (2,000 ha)	**Area Treated (000 ha)**	**Volume (000 kg)**
Dimethoate	1.0	0.20
Oxydemeton-M	1.0	0.08
Total Barley	**2.0**	**0.28**
Coffee (10,000 ha)		
Disulfoton	0.3	1.50
Monocrotophos	5.0	2.00
Parathion-M	20.0	20.00
Total Coffee	**25.3**	**23.50**
Corn (900,000 ha)		
Alphacypermethrin	5.00	0.05
Carbaryl	5.00	4.25
Carbofuran	12.00	24.00
Cyhalothrin-L	20.00	0.25
Cypermethrin	6.00	0.18
Dimethoate	10.00	2.00
Endosulfan	55.00	3.75
Fenvalerate	10.00	0.40
Fluvalinate-TAU	5.00	0.25
Monocrotophos	10.00	2.00
Trichlorfon	23.75	4.75
Total Corn	**161.75**	**41.88**
Cotton (160,000 ha)		
Alphacypermethrin	5.0	0.05
Amitraz	12.0	2.88
Carbaryl	12.0	10.20
Carbosulfan	30.0	4.50
Chlorfenvinfos	2.0	0.60
Cyhalothrin-L	53.0	1.59
Cypermethrin	36.0	1.08
Dimethoate	175.0	26.00
Endosulfan	105.0	37.50
Fenvalerate	190.0	7.60
Fluvalinate-TAU	30.0	1.50
Monocrotophos	28.0	11.20
Oxydemeton-M	86.0	6.10
Tetradifon	10.0	1.00
Thiodicarb	24.0	9.00
Triazophos	30.0	3.60
Total Cotton	**828.0**	**124.40**

Appendix B, Table 1. Insecticide Active Ingredient Use by Commodity: Zimbabwe 1992 Harvest Year

Groundnuts (124,000 ha)	**Area Treated (000 ha)**	**Volume (000 kg)**
Cyhalothrin-L	1.00	0.01
Endosulfan	0.20	0.07
Fenvalerate	1.00	0.04
Monocrotophos	0.25	0.10
Total Groundnuts	**2.45**	**0.22**
Pome/Stone Fruit (4,000 ha)		
Lime Sulphur	1.5	18.75
Methidathion	1.5	0.45
Total Pome/Stone Fruit	**3.0**	**19.20**
Soybeans (61,000 ha)		
Cyhalothrin-L	1.50	0.02
Cypermethrin	2.00	0.06
Endosulfan	0.25	0.04
Fenvalerate	3.00	0.12
Total Soybeans	**6.75**	**0.24**
Sugarcane (6,000 ha)		
Monocrotophos	2.0	0.8
Total Sugarcane	**2.0**	**0.8**
Tobacco (88,000 ha)		
Acephate	0.50	3.75
Alphacypermethrin	12.50	0.10
Chlorpyrifos-E	80.00	19.20
Cypermethrin	4.00	0.20
Dimethoate	2.05	2.02
Disulfoton	11.00	11.00
Ethylene Dibromide	40.00	990.00
Fenamiphos	25.00	40.00
Fenvalerate	5.00	0.40
Fluvalinate-TAU	50.00	0.50
Methomyl	10.00	2.25
Methyl Bromide	0.35	240.10
Monocrotophos	30.51	15.67
Trichlorfon	2.50	0.25
Total Tobacco	**273.41**	**1325.44**
Vegetables (10,000 ha)		
Alphacypermethrin	3.00	0.04
Carbaryl	1.00	1.28
Carbofuran	0.50	1.00
Cyhalothrin-L	2.50	0.03
Cypermethrin	6.00	0.18
Diazinon	3.00	0.45
Dimethoate	0.80	0.40
Endosulfan	1.00	0.75

Appendix B, Table 1. Insecticide Active Ingredient Use by Commodity: Zimbabwe 1992 Harvest Year

	Area Treated (000 ha)	Volume (000 kg)
Malathion	5.00	2.50
Methamidophos	8.00	2.40
Mevinphos	4.00	0.48
Monocrotophos	1.00	0.40
Pirimicarb	1.25	0.10
Tetradifon	2.00	0.19
Total Vegetables	**39.05**	**10.20**
Wheat (10,000 ha)		
Dimethoate	2.0	0.40
Oxydemeton-M	7.0	0.53
Total Wheat	**9.0**	**0.93**

Appendix B, Table 2. Insecticide Active Ingredient Use For All Surveyed Crops: Zimbabwe 1992

Active Ingredients	Area Treated (000 ha)	Volume (000 kg)
Acephate	0.50	3.75
Alphacypermethrin	25.50	0.24
Amitraz	12.00	2.88
Carbaryl	18.00	15.73
Carbofuran	12.50	25.00
Carbosulfan	30.00	4.50
Chlorfenvinfos	2.00	0.60
Chlorpyrifos-E	80.00	19.20
Cyhalothrin-L	78.00	1.90
Cypermethrin	54.00	1.70
Diazinon	3.00	0.45
Dimethoate	190.85	31.02
Disulfoton	11.30	12.50
Endosulfan	161.45	42.11
Ethylene Dibromide	40.00	990.00
Fenamiphos	25.00	40.00
Fenthion	0.33	3.96
Fenvalerate	2.09	8.56
Fluvalinate-TAU	85.00	2.25
Lime Sulphur	1.50	18.75
Malathion	5.00	2.50
Methamidophos	8.00	2.40
Methidathion	1.50	0.45
Methomyl	10.00	2.25
Methyl Bromide	0.35	240.10
Mevinphos	4.00	0.48
Monocrotophos	76.76	32.17
Oxydemeton-M	94.00	6.71
Parathion-M	20.00	20.00
Pirimicarb	1.25	0.10
Tetradifon	12.00	1.19
Thiodicarb	24.00	9.00
Triazophos	30.00	3.60
Trichlorfon	26.25	5.00
Total	**1353.04**	**1551.05**

Appendix B, Table 3. Herbicide Active Ingredient Use by Commodity: Zimbabwe 1992 Harvest Year

Barley (2,000 ha)	Area Treated (000 ha)	Volume (000 kg)
Bromoxynil	0.35	0.16
Dicamba	0.17	0.02
MCPA	0.17	0.14
Total Barley	**0.69**	**0.32**
Coffee (10,000 ha)		
Dalapon	0.10	0.21
Diuron	0.25	0.80
Glyphosate	1.00	1.23
Metolachlor	1.85	2.60
Paraquat	1.50	1.13
Simazine	1.00	2.40
Terbuthylazine	0.10	0.23
Total Coffee	**5.80**	**8.60**
Corn (900,000 ha)		
Pendimethalin	0.14	0.25
Alachlor	14.00	23.52
Ametryn	2.00	3.20
Atrazine	70.00	151.25
Cyanazine	7.00	7.50
EPTC	0.29	0.73
Glyphosate	6.00	2.46
MCPA	0.33	0.40
Metolachlor	14.00	17.64
Paraquat	12.50	6.25
Total Corn	**126.26**	**213.20**
Cotton (160,000 ha)		
Cyanazine	16.67	12.50
Diuron	0.67	0.80
Fluazifop-B	0.80	0.25
Fluometuron	17.00	12.30
Glyphosate	2.50	2.05
Metolachlor	14.00	15.12
MSMA	0.20	0.29
Paraquat	10.00	5.00
Prometryne	15.00	7.50
Trifluralin	3.00	2.34
Total Cotton	**79.84**	**58.15**
Groundnuts (124,000 ha)		
Metolachlor	2.5	3.6
Trifluralin	1.5	1.0
Total Groundnuts	**4.0**	**4.6**

Appendix B, Table 3. **Herbicide Active Ingredient Use by Commodity: Zimbabwe 1992 Harvest Year**

Sugarcane (6,000 ha)	**Area Treated (000 ha)**	**Volume (000 kg)**
Ametryn	1.0	1.20
Atrazine	2.5	2.50
MCPA	0.5	0.40
Metolachlor	1.0	1.44
Total Sugarcane	**5.0**	**5.54**
Soybeans (61,000 ha)		
Bentazone	1.00	1.68
Fluazifop-B	1.00	0.31
Fomesafen	2.40	0.75
Metazachlor	0.32	0.16
Metolachlor	17.00	21.42
Metribuzin	35.00	10.08
Oxadiazon	2.00	1.56
Paraquat	5.00	1.25
Sethoxydim	1.00	0.40
Terbutryn	0.25	0.25
Trifluralin	7.00	4.67
Total Soybeans	**121.97**	**114.53**
Tobacco (88,000 ha)		
Alachlor	33.00	47.52
Fluazifop-B	0.50	0.13
Metazachlor	0.30	0.12
Metolachlor	30.00	54.00
Pebulate	0.50	2.69
Total Tobacco	**64.30**	**104.46**
Vegetables (10,000 ha)		
Bentazone	0.33	0.48
Metazachlor	0.30	0.12
Oxadiazon	0.50	0.52
Terbuthylazine	0.50	0.30
Terbutryn	0.83	1.20
Total Vegetables	**2.46**	**2.62**
Wheat (10,000 ha)		
Bromoxynil	0.50	0.22
Cyanazine	2.00	0.30
Dicamba	3.33	0.48
MCPA	3.33	2.80
Total Wheat	**9.16**	**3.80**

Appendix B, Table 4. Herbicide Use by Active Ingredient for All Surveyed Crops: Zimbabwe 1992

Active Ingredient	Area Treated (000 ha)	Volume (000 kg)
Alachlor	97.00	143.00
Ametryn	3.00	4.40
Atrazine	72.50	153.75
Bentazone	1.33	2.16
Bromoxynil	0.85	0.38
Cyanazine	25.67	20.30
Dalapon	0.10	0.21
Dicamba	3.50	0.50
Diuron	0.92	1.60
EPTC	0.29	0.73
Fluazifop-B	2.30	0.69
Fluometuron	17.00	12.30
Fomesafen	2.40	0.75
Glyphosate	9.50	5.74
MCPA	4.33	3.74
Metazachlor	0.92	0.40
Metolachlor	80.35	115.82
Metribuzin	35.00	10.08
MSMA	0.20	0.29
Oxadiazon	2.50	2.08
Paraquat	29.00	13.63
Pebulate	0.50	2.69
Pendimethalin	0.14	0.25
Prometryne	15.00	7.50
Sethoxydim	1.00	0.40
Simazine	1.00	2.40
Terbuthylazine	0.60	0.53
Terbutryn	1.08	1.45
Trifluralin	11.50	8.01
Total	**419.48**	**515.82**

Appendix B, Table 5. Fungicide Active Ingredient Use By Commodity: Zimbabwe 1992 Harvest Year

Coffee (10,000 ha)	**Area Treated (000 ha)**	**Volume (000 kg)**
Benomyl	0.5	0.25
Captafol	2.5	8.00
Chlorothalonil	1.0	1.00
Copper-Hydroxide	3.0	7.50
Copper-Oxychloride	30.0	105.00
Disulfoton	2.0	4.50
Triadimenol	5.4	1.69
Total Coffee	**44.4**	**127.94**
Cotton (160,000 ha)		
Quintozene (PCNB)	3.25	4.88
Total Cotton	**3.25**	**4.88**
Groundnuts (124,000 ha)		
Benomyl	8.00	1.00
Chlorothalonil	1.75	1.75
Mancozeb	5.00	8.00
Total Groundnuts	**14.75**	**10.75**
Pome/Stone Fruit (4,000 ha)		
Iprodione	0.50	0.50
Mancozeb	3.30	7.92
Thiophanate-M	2.31	1.95
Total Pome/Stone Fruit	**6.11**	**10.37**
Sugarcane (6,000 ha)		
Triadimefon	1.0	0.13
Triadimenol	2.0	0.50
Total Sugarcane	**3.0**	**0.63**
Tea (6,000 ha)		
Copper-Oxychloride	20.0	50.00
Total Tea	**20.0**	**50.00**
Tobacco (88,000 ha)		
Anilazine	44.0	41.25
Benomyl	1.0	0.75
Copper-Oxychloride	0.4	2.80
Iprodione	3.5	1.75
Mancozeb	2.0	3.20
Triadimenol	0.5	4.50
Total Tobacco	**51.4**	**54.25**

Appendix B, Table 5. Fungicide Active Ingredient Use By Commodity: Zimbabwe 1992 Harvest Year

Vegetables (10,000 ha)	Area Treated (000 ha)	Volume (000 kg)
Anilazine	2.50	3.75
Benomyl	5.00	1.25
Captan	1.00	2.50
Chlorothalonil	4.00	5.00
Copper-Hydroxide	0.40	1.00
Copper-Oxychloride	8.00	14.00
Cymoxanil	2.50	0.45
Dodemorph	2.00	2.10
Fosetyl-AL	1.00	2.40
Lime Sulphur	1.00	3.75
Mancozeb	33.00	51.84
Metalaxyl	3.00	0.48
Propamocarb	5.00	1.44
Propineb	3.00	5.95
Quintozene (PCNB)	0.05	0.75
Triadimenol	1.00	0.63
Triforine	2.40	0.67
Total Vegetables	**74.85**	**97.96**

Appendix B, Table 6. Fungicide Use By Active Ingredient for All Surveyed Crops: Zimbabwe 1992

Active Ingredients	Area Treated (000 ha)	Volume (000 kg)
Anilazine	46.50	45.00
Benomyl	14.50	3.25
Captafol	2.50	8.00
Captan	1.00	2.50
Chlorothalonil	6.75	7.75
Copper-Hydroxide	3.40	8.50
Copper-Oxychloride	58.40	171.80
Cymoxanil	2.50	0.45
Disulfoton	2.00	4.50
Dodemorph	2.00	2.10
Fosetyl-AL	1.00	2.40
Iprodione	4.00	2.25
Lime Sulphur	1.00	3.75
Mancozeb	43.30	70.96
Matalaxyl	3.00	0.48
Propamocarb	5.00	1.44
Propineb	3.00	5.95
Quintozene (PCNB)	3.30	5.63
Thiophanate-M	2.31	1.95
Triadimefon	1.00	0.13
Triadimenol	8.90	7.32
Triforine	2.40	0.67
Total	**217.76**	**356.78**

Appendix B, Table 7. Fungicide Use By Commodity: Kenya 1992 Harvest Year

Barley (36,000 ha)	HA Treated (000 ha)	Volume (000 kg)
Carbendazim	9.5	1.65
Chorothalonil	7.0	6.30
Flusilazole	2.5	0.50
Flutriafol	5.0	0.63
Propiconazole	16.0	2.00
Tebuconazole	4.0	0.75
Triadimenol	6.0	0.75
Total Barley	**50.0**	**12.58**
Beans: Green (11,000 ha)		
Benomyl	1.00	0.50
Biterfanol	0.25	0.15
Chorothalonil	2.00	3.75
Copper-Hydroxide	1.00	1.00
Hexaconazole	3.00	0.15
Mancozeb	2.00	4.00
Propineb	2.00	3.50
Tebuconazole	1.00	0.10
Triforine	1.00	0.28
Total Beans: Green	**13.25**	**13.43**
Citrus (18,000 ha)		
Benomyl	1.00	0.75
Copper-Oxychloride	3.50	10.50
Triadimefon	0.50	0.25
Total Citrus	**5.00**	**11.50**
Coffee (150,000 ha)		
Chlorothalonil	30.00	101.25
Copper-Hydroxide	10.00	20.00
Copper-Oxide	3.83	14.37
Copper-Oxychloride	85.00	340.00
Prochloroz	20.00	22.00
Triadimefon	3.00	1.50
Total Coffee	**151.83**	**499.12**
Flowers/Orn (1,500)		
Benomyl	4.66	3.50
Bitertanol	4.00	1.20
Bupirimate	10.00	1.25
Captan	5.50	4.57
Chlorothalonil	2.85	3.74
Dodemorph	2.60	2.60
Fenpropimorph	1.00	0.75
Fosetyl-AL	1.00	2.40
Iprodione	7.50	3.75
Mancozeb	3.00	5.40
Metalaxyl	1.00	0.19

Appendix B, Table 7. Fungicide Use By Commodity: Kenya 1992 Harvest Year

Flowers/Orn (1,500)	HA Treated (000 ha)	Volume (000 kg)
Metiram	1.00	1.20
Propineb	8.20	14.35
Pyrazophos	2.00	0.60
Thiabendazole	4.00	1.80
Triadimefon	0.50	0.25
Triadimenol	2.00	0.25
Triforine	4.00	0.94
Vinclozolin	1.11	1.00
Total Flowers/Orn	**65.92**	**49.74**
Fruit (Other)		
Benomyl	0.40	1.00
Captan	10.00	10.38
Copper-Hydroxide	1.00	1.00
Copper-Oxychloride	7.00	10.50
Iprodione	0.30	0.23
Mancozeb	6.00	11.76
Metalaxyl	0.40	0.08
Pyrazophos	1.00	0.30
Sulphur	7.00	8.40
Triadimefon	2.00	0.25
Total Fruit (Other)	**35.10**	**43.90**
Pineapple (8,000 ha)		
Benomyl	6.50	6.50
Fosetyl-AL	4.80	9.60
Total Pineapple	**11.30**	**16.10**
Potatoes (95,000 ha)		
Chlorothalonil	2.00	2.25
Copper-Oxychloride	15.00	15.00
Mancozeb	27.00	52.20
Metalaxyl	3.00	0.56
Propineb	16.00	28.00
Total Potatoes	**63.00**	**98.01**
Tobacco (10,000 ha)		
Benomyl	1.00	0.50
Copper-Oxychloride	2.00	2.50
Mancozeb	10.00	20.48
Metalaxyl	2.00	0.60
Propineb	1.60	2.80
Total Tobacco	**16.60**	**26.80**
Tomatoes (18,000 ha)		
Copper-Hydroxide	2.50	2.50
Copper-Oxychloride	5.00	7.50
Mancozeb	15.00	28.20

Appendix B, Table 7. Fungicide Use By Commodity: Kenya 1992 Harvest Year

Tomatoes (18,000 ha)	HA Treated (000 ha)	Volume (000 kg)
Metalaxyl	3.00	0.56
Metiram	2.00	4.00
Propineb	6.00	10.50
Total Tomatoes	**33.50**	**53.26**
Vegetables (70,000 ha)		
Benomyl	2.0	1.00
Bitertanol	1.0	0.18
Chlorothalonil	5.0	5.63
Copper-Hydroxide	3.0	3.00
Copper-Oxychloride	5.0	5.00
Iprodione	0.4	0.25
Mancozeb	4.8	9.60
Propineb	4.0	7.00
Thiabendazole	2.0	0.90
Tridimefon	2.0	0.25
Total Vegetables	**29.2**	**32.81**
Wheat (100,000 ha)		
Carbendazim	3.0	0.60
Chlorothalonil	3.0	2.70
Fenpropimorph	5.0	3.75
Flutriafol	5.0	0.63
Propiconazole	34.0	4.25
Tebuconazole	2.0	0.38
Thiophanate-M	5.0	2.50
Triadimenol	12.0	1.50
Total Wheat	**69.0**	**16.31**

Appendix B, Table 8. Fungicide Use by Active Ingredient for All Surveyed Crops: Kenya 1992

Active Ingredient	Area Treated (000 ha)	Volume (000 kg)
Benomyl	16.56	13.75
Bitertanol	5.25	1.53
Bupirimate	10.00	1.25
Captan	15.50	14.95
Carbendazim	12.50	2.25
Chlorothalonil	51.85	125.62
Copper-Hydroxide	17.50	27.50
Copper-Oxide	3.83	14.37
Copper-Oxychloride	122.50	391.00
Dodemorph	2.60	2.60
Fenpropimorph	6.00	4.50
Flusilazole	2.50	0.50
Flutriafol	10.00	1.26
Fosetyl-AL	5.80	12.00
Hexaconazole	3.00	0.15
Iprodione	8.20	4.23
Mancozeb	67.80	131.64
Metalaxyl	9.40	1.99
Metiram	3.00	5.20
Prochloraz	20.00	27.00
Propiconazole	50.00	6.25
Propineb	37.80	66.15
Pyrazophos	3.00	0.90
Sulphur	7.00	8.40
Tebuconazole	7.00	1.23
Thiabendazole	6.00	2.70
Thiophanate-M	5.00	2.50
Tridimefon	8.00	2.50
Triadimenol	20.00	2.50
Triforine	5.00	1.22
Vinclozolin	1.11	1.00
Total	**543.70**	**873.64**

Source: Landell Mills Market Research 1993

Appendix B, Table 9. Herbicide Active Ingredient Use by Commodity: Kenya 1992 Harvest Year

Barley (36,000 ha)	Area Treated (000 ha)	Volume (000 kg)
Bromoxynil	9.50	2.48
Chlorsulfuron	1.00	0.01
Dicamba	7.00	0.63
Diclofop-M	1.00	0.90
Ioxynil	1.50	0.23
MCPA	8.00	2.[illegible]5
MCPP	8.50	9.53
Pendimethalin	1.50	2.25
Triallate	0.30	0.72
Total Barley	**38.30**	**19.00**
Coffee (150,000 ha)		
Glufosinate	3.00	0.60
Glyphosate	10.00	7.20
Paraquat	17.00	10.20
Total Coffee	**30.00**	**18.00**
Corn (1,400,000 ha)		
2,4-D	30.00	21.60
Alachlor	4.50	6.96
Atrazine	11.00	10.10
Bentazone	3.00	2.10
Glyphosate	2.50	1.80
Metolachlor	4.00	5.00
Paraquat	3.00	1.80
Total Corn	**58.00**	**49.36**
Fruit (24,000 ha)		
Glyphosate	1.0	0.72
Paraquat	3.0	1.80
Total Fruit	**4.0**	**2.52**
Pineapple (8,000 ha)		
Bromacil	2.0	6.40
Diuron	5.0	12.00
Glyphosate	1.0	1.08
Total Pineapple	**8.0**	**19.48**
Sisal (35,000 ha)		
2,4-D	1.25	2.00
Ametryn	1.50	1.13
Atrazine	1.50	1.13
Bromacil	2.00	6.40
Diuron	3.00	7.20
Picloram	1.25	0.56
Total Sisal	**10.50**	**18.42**

Appendix B, Table 9. Herbicide Active Ingredient Use by Commodity: Kenya 1992 Harvest Year

Sugarcane (90,000 ha)	**Area Treated (000 ha)**	**Volume (000 kg)**
2,4-D	13.0	11.70
Ametryn	2.5	3.75
Atrazine	2.5	3.75
Diuron	7.0	16.80
Glyphosate	1.5	1.62
Ioxynil	13.0	1.95
Paraquat	3.0	1.80
TCA	7.0	79.80
Total Sugarcane	**49.5**	**121.17**
Tea (98,000 ha)		
Glufosinate	2.0	0.40
Glyphosate	6.0	4.32
Paraquat	10.0	4.00
Total Tea	**18.0**	**8.72**
Vegetables (70,000 ha)		
Alachlor	2.0	2.4
Linuron	4.0	4.0
Total Vegetables	**6.0**	**6.4**
Wheat (100,000 ha)		
2,4-D	50.0	54.00
Bromoxynil	25.0	6.94
Chlorsulfuron	35.0	0.52
Dicamba	3.0	0.31
Diclofop-M	1.0	0.90
Glyphosate	5.0	3.60
Ioxynil	1.0	0.19
MCPA	24.0	6.75
MCPP	4.0	5.14
Paraquat	1.0	0.40
Pendimethalin	3.0	4.50
Triallate	0.6	1.44
Tribenuron-M	10.0	0.11
Total Wheat	**162.6**	**84.80**

Appendix B, Table 10. Herbicide Use by Active Ingredient for All Surveyed Crops: Kenya 1992

Active Ingredient	Area Treated (000 ha)	Volume (000 kg)
2,4-D	94.25	89.30
Alachlor	6.50	9.36
Ametryn	4.00	4.88
Atrazine	15.00	14.98
Bentazone	3.00	2.10
Bromacil	4.00	12.80
Bromoxynil	34.50	9.42
Chlorsulfuron	36.00	0.53
Dicamba	10.00	0.94
Diclofop-M	2.00	1.80
Diuron	15.00	36.00
Glufosinate	5.00	1.00
Glyphosate	27.00	20.34
Ioxynil	15.50	2.37
Linuron	4.00	4.00
MCPA	32.00	9.00
MCPP	12.50	14.67
Metolachlor	4.00	5.00
Paraquat	37.00	20.00
Pendimethalin	4.50	6.75
Picloram	1.25	0.56
TCA	7.00	79.80
Triallate	0.90	2.16
Tribenuron-M	10.00	0.11
Total	**384.90**	**347.87**

Appendix B, Table 11. Insecticide Active Ingredient Use by Commodity: Kenya 1992 Harvest Year

Barley (36,000 ha)	Area Treated (000 ha)	Volume (000 kg)
Bifenthrin	4.0	0.50
Cypermethrin	17.0	0.70
Demeton-S-M	2.0	0.25
Monocrotophos	15.0	3.75
Phosphamidon	6.0	3.00
Total Barley	**44.0**	**8.20**
Beans: Green		
Biffenthrin	2.00	0.25
Carbofuran	2.00	0.50
Carbosulfan	1.00	0.25
Cyhalothrin-L	4.00	0.05
Cypermethrin	10.00	0.50
Deltamethrin	2.50	0.03
Diazinon	1.00	0.60
Dichlorvos	2.00	1.44
Dicofol	1.00	0.37
Dimethoate	2.00	0.80
endosulfan	1.33	0.70
Ethion	1.00	0.72
Total Beans: Green	**29.83**	**6.21**
Citrus (18,000 ha)		
Cypermethrin	5.00	0.25
Diazinon	2.00	1.20
Dimethoate	3.00	1.80
Endosulfan	0.67	0.35
Ethion	1.00	0.48
Fenitrothion	2.00	1.00
Fenthion	1.00	0.50
Oil	0.70	14.00
Omethoate	1.00	1.00
Triazophos	2.00	0.40
Total Citrus	**18.37**	**20.98**
Coffee (150,000 ha)		
Aldicarb	0.33	0.74
Bacillus-Thur.	2.00	0.26
Carbofuran	0.67	1.00
Carbosulfan	0.50	0.25
Chlorpyrifos-E	8.00	2.88
Cypermethrin	5.00	0.25
Deltamethrin	5.00	0.10
Dimethoate	2.00	0.80
Disulfoton	0.20	0.90
Ethion	3.00	2.16
Fenitrothion	7.50	7.50
Fenthion	1.50	1.50

Appendix B, Table 11. Insecticide Active Ingredient Use by Commodity: Kenya 1992 Harvest Year

Coffee (150,000 ha)	Area Treated (000 ha)	Volume (000 kg)
Methomyl	1.67	0.90
Oil	0.75	12.00
Omethoate	1.00	0.88
Triazophos	2.00	0.40
Total Coffee	**41.12**	**32.52**
Corn (1,400,000 ha)		
Carbofuran	1.0	1.5
Cypermethrin	10.0	0.5
Endosulfan	20.0	7.0
Trichlorfon	6.0	1.5
Total Corn	**37.0**	**10.5**
Cotton (90,000 ha)		
Cyhalothrin-L	2.66	0.05
Cypermethrin	50.00	2.20
Deltamethrin	5.00	0.05
Diazinon	4.00	6.00
Dicofol	2.50	0.93
Dimethoate	2.50	1.00
Fenvalerate	5.00	0.35
Monocrotophos	15.00	3.75
Profenofos	15.00	6.00
Total Cotton	**101.66**	**20.33**
Flowers/Orn (1,500 ha)		
Abamectin	0.20	0.09
Acephate	2.50	3.75
Aldicarb	0.60	2.40
Amitraz	0.80	0.64
Bifenthrin	4.00	0.50
Carbofuran	0.25	0.50
Carbosulfan	0.50	0.25
Cypermethrin	3.60	0.18
Dazomet	0.15	73.50
Deltamethrin	6.00	0.06
Diazinon	4.00	2.40
Dichlorvos	2.50	2.40
Dicofol	1.00	0.56
Dienochlor	5.00	1.88
Dimethoate	1.00	0.40
Disulfoton	0.10	0.20
Endosulfan	1.50	1.05
Fenamiphos	0.50	1.00
Fenbutatin Oxide	6.00	1.50
Formothion	1.80	0.90
Methomyl	11.00	2.47
Methyl Bromide	0.30	147.00

Appendix B, Table 11. Insecticide Active Ingredient Use by Commodity: Kenya 1992 Harvest Year

Flowers/Orn (1,500 ha)	Area Treated (000 ha)	Volume (000 kg)
Oxamyl	2.00	1.44
Propargite	1.60	2.28
Total Flowers/Orn	**56.90**	**247.35**
Fruit (24,000 ha)		
Bacillus-Thur.	3.00	0.19
Chlorpyrifos-E	2.00	0.96
Cypermethrin	5.00	0.25
Diazinon	4.00	2.40
Dicofol	1.50	0.56
Dimethoate	3.00	1.20
Endosulfan	2.00	0.70
Ethion	1.00	0.72
Fenitrothion	3.00	1.50
Fenthion	0.50	0.50
Oil	0.40	6.40
Omethoate	1.00	1.00
Triazophos	2.00	0.40
Total Fruit	**28.40**	**16.78**
Pineapple (8,000 ha)		
Chlorpyrifos-E	2.00	2.40
Diazinon	7.00	4.20
Dichloropropene	1.00	368.00
Fenamiphos	0.25	0.56
Oxamyl	0.50	1.32
Total Pineapple	**10.75**	**376.48**
Potatoes (95,000 ha)		
Bifenthrin	2.00	0.25
Cyhalothrin-L	2.00	0.03
Cypermethrin	5.00	0.25
Diazinon	1.00	0.60
Dimethoate	2.00	0.80
Propargite	0.40	0.57
Total Potatoes	**12.40**	**2.50**
Rice (17,000 ha)		
Carbofuran	2.5	1.50
Chlorpyrifos-E	2.0	1.68
Fenvalerate	5.0	0.35
Total Rice	**9.5**	**3.53**
Sugarcane (90,000 ha)		
Endosulfan	1.5	1.05
Total Sugarcane	**1.5**	**1.05**

Appendix B, Table 11. Insecticide Active Ingredient Use by Commodity: Kenya 1992 Harvest Year

Tobacco (10,000 ha)	Area Treated (000 ha)	Volume (000 kg)
Acephate	10.00	3.75
Carbofuran	0.30	0.53
Cypermethrin	5.00	0.20
Dazomet	0.03	11.76
Dimethoate	4.00	3.20
Endosulfan	1.00	0.70
Fenamiphos	0.02	0.14
Methyl Bromide	0.01	4.90
Monocrotophos	5.00	1.25
Total Tobacco	**25.36**	**26.43**
Tomatoes (18,000 ha)		
Bacillus-Thur.	2.00	0.13
Carbofuran	2.00	0.50
Carbosulfan	1.00	0.25
Cyhalothrin-L	4.00	0.05
Cypermethrin	5.00	0.25
Deltamethrin	4.00	0.03
Dimethoate	2.00	0.80
Ethion	1.00	0.72
Ethoprophos	0.10	0.20
Fenamiphos	0.05	0.05
Total Tomatoes	**21.15**	**2.98**
Vegetables (70,000 ha)		
Bacillus-Thur.	3.00	0.19
Bifenthrin	9.00	1.13
Carbaryl	6.00	1.50
Carbofuran	4.00	1.00
Chlorpyrifos-E	2.00	0.96
Cyhalothrin-L	10.00	0.13
Cypermethrin	33.00	1.65
Deltamethrin	7.50	0.08
Diazinon	12.00	7.20
Dichlorvos	2.50	2.40
Dicofol	2.50	0.93
Dimethoate	12.00	4.80
Endosulfan	5.00	1.75
Ethoprophos	0.35	0.70
Fenamiphos	0.10	0.10
Formothion	3.00	0.99
Propargite	1.00	0.57
Total Vegetables	**112.95**	**26.08**

Appendix B, Table 11. Insecticide Active Ingredient Use by Commodity: Kenya 1992 Harvest Year

Wheat (100,000 ha)	Area Treated (000 ha)	Volume (000 kg)
Bifenthrin	4.0	0.50
Cypermethrin	8.0	0.35
Demeton-S-M	4.0	0.50
Dimethoate	2.0	1.20
Monocrotophos	5.0	1.25
Phosphamidon	9.0	4.50
Total Wheat	**32.0**	**8.30**

Appendix B, Table 12. Insecticide Use by Active Ingredient for All Surveyed Crops: Kenya 1992

Active Ingredient	Area Treated (000 ha)	Volume (000 kg)
Abamectin	0.20	0.09
Acephate	12.50	7.50
Aldicarb	0.93	3.14
Amitraz	0.80	0.64
Bacillus-Thur.	10.00	0.77
Bifenthrin	25.00	3.13
Carbaryl	5.00	1.50
Carbofuran	12.72	7.03
Carbosulfan	3.00	1.00
Chlorpyrifos-E	16.00	8.88
Cyhalothrin-L	22.66	0.31
Cypermethrin	161.60	7.53
Dazomet	0.18	85.26
Deltamethrin	30.00	0.35
Demeton-S-M	6.00	0.75
Diazinon	35.00	24.60
Dichloropropene	1.00	368.00
Dichlorvos	7.00	6.24
Dicofol	8.50	3.35
Dienochlor	5.00	1.88
Dimethoate	35.50	16.80
Disulfoton	0.30	1.10
Endosulfan	33.00	13.30
Ethion	7.00	4.80
Ethoprophos	0.45	0.90
Fenamiphos	0.92	1.85
Fenbutatin Oxide	6.00	1.50
Fenitrothion	12.50	10.00
Fenthion	3.00	2.50
Fenvalerate	10.00	0.70
Formothion	4.80	1.89
Methomyl	12.67	3.37
Methyl Bromide	0.31	151.90
Monocrotophos	40.00	10.00
Oil	1.85	32.40
Omethoate	3.00	2.88
Oxamyl	2.50	2.76
Phosphamidon	15.00	7.50
Profenofos	15.00	6.00
Propargite	3.00	3.42
Triazophos	6.00	1.20
Trichlorfon	6.00	1.50
Total	**582.89**	**810.22**

Appendix B, Table 13. Insecticide Use (Formulated Product) By Commodity: Côte d'Ivoire 1992

Crop/Formulated Product	Area Treated (000 ha)	Product dose kg or liter/ha	Volume of Formulated Product (MT) Applied
Bananas			
Curlone 050 DP	2.17	60.0	130.2
Temik 100 GR	2.10	40.0	84.0
Rugby 010GR	2.30	40.0	92.0
Miral 100GR	1.30	50.0	65.0
Nemacur 400EC	1.20	15.0	18.0
Vydate-L 240SL	1.00	15.0	15.0
Total Bananas	**10.07**		**404.2**
Cocoa			
Callifan 500EC	26.0	0.50	39.00
Thiodan 500EC	53.0	0.50	79.50
Calludine 600EC	2.5	0.66	4.95
Basudine 600EC	41.0	0.66	81.18
Gawa 200EC	4.5	2.00	27.00
Gama 200EC	16.0	2.00	96.00
Lindane 200EC	3.0	2.00	18.00
Total Cocoa	**146.0**		**345.63**
Coffee			
Decis 050DP	1.13	2.0	2.26
Volaton 030DP	0.22	25.0	5.50
Durexa 250EC	3.00	4.0	60.00
Total Coffee	**4.35**		**67.76**
Cotton			
Efetrine-D 112UL	38.2	3.0	676.8
Efetrine-C 062UL	28.0	3.0	495.6
Nurelle-D-10/50 027UL	24.9	3.0	440.7
Polytrine-C 180EC	10.2	1.0	60.0
Polytrine-C 110UL	21.1	3.0	373.2
Cymbush+Hostathion 280EC	20.3	1.0	120.0
Fastac-C 056UL	27.5	3.0	487.8
Alphacal 090UL	16.0	3.0	282.6
Baythroid-P 106UL	11.7	3.0	207.3
Deltaphos 053UL	23.6	3.0	417.7
Total Cotton	**221.5**		**3561.6**
Oil Palm			
Decis 012EC	12.76	1.0	12.76
Temik	0.29	40.0	11.60
Unspecified Fungicide	6.30	1.0	6.30
Total Oil Palm	**19.35**		**30.66**

Appendix B, Table 13. Insecticide Use (Formulated Product) By Commodity: Côte d'Ivoire 1992

Crop/Formulated Product	Area Treated (000 ha)	Product dose kg or liter/ha	Volume of Formulated Product (MT) Applied
Pineapple			
Dyfonate 050GR	0.45	50.0	45.0
Marshal 480EC	0.80	8.0	6.4
Rugby 010 GR	0.20	50.0	10.0
Mocap 020GR	0.70	60.0	42.0
Nemacur 400EC	0.20	15.0	3.0
Telone 900LI	0.05	150.0	7.5
Total Pineapple	**2.40**		**113.9**
Rice			
Diafuran 050GR	0.20	20.0	4.0
Decis 012EC	0.40	1.0	0.4
Total Rice	**0.60**		**4.4**
Sugarcane			
Furadan 050 GR	0.79	20.0	15.8
Total Sugarcane	**0.79**		**15.8**

Appendix B, Table 14. Herbicide Use (Formulated Product) By Commodity: Côte d'Ivoire 1992

Crop/Formulated Product	Area Treated (000 ha)	Product Dose kg or liters/ha	Volume of Formulated Product (MT) Applied
Bananas			
Folar 520EC	0.5	4.0	2.0
Calloxone 200EC	0.5	3.0	9.0
Gramoxone 200SL	2.5	3.0	33.0
Basta 150SL	1.0	3.0	15.0
Diuron 800WP	1.0	3.0	3.0
Total Bananas	**5.5**		**62.0**
Cocoa			
Gramoxone 200SL	0.9	3.0	2.7
Calloxone 200EC	6.9	3.0	20.7
Total Cocoa	**7.8**		**23.4**
Coffee			
Gramoxone 200SL	9.30	3.0	27.90
Roundup 360SL	0.62	4.0	2.48
Unspecified Herbicide	0.50	3.0	1.50
Total Coffee	**10.42**		**31.88**
Corn			
Bellater-Extra 500SC	3.0	4.0	12.0
Primigram 500SC	13.0	4.0	52.0
Challenge-M 500SL	2.5	4.0	10.0
Total Corn	**18.5**		**74.0**
Cotton			
Stomp 330EC	10.0	3.0	30.0
Cotodon 400EC	40.0	4.0	160.0
Cotogard 500EC	10.0	4.0	40.0
Gramoxone 200SL	10.0	3.0	30.0
Fusilade 250EC	3.0	2.0	6.0
Total Cotton	**73.0**		**266.0**
Pineapple			
Hyvar-X 800WP	1.2	4.0	4.8
Spica-30 800WP	1.4	4.0	11.2
Callitryne 500FW	1.4	3.0	4.2
Diuron 800WP	2.4	4.0	9.6
Total Pineapple	**6.4**		**29.8**

Appendix B, Table 14. Herbicide Use (Formulated Product) By Commodity: Côte d'Ivoire 1992

Crop/Formulated Product	Area Treated (000 ha)	Product dose kg or liter/ha	Volume of Formulated Product (MT) Applied
Rice			
Ronstar 250EC	15.0	4.0	60.0
Propanil + Thibencarb 336SC	3.5	6.0	21.0
Basagran-PL2 500SC	2.0	6.0	12.0
Garil 430EC	4.0	5.0	20.0
Tamariz 336SC	2.0	6.0	12.0
Rifit-Extra 500EC	11.0	4.0	44.0
Total Rice	**37.5**		**169.0**
Rubber			
2,4-D 720SL	3.33	2.0	6.66
Gramoxone 200SL	0.50	2.0	1.00
Fusilade 250EC	0.10	2.0	0.20
Gramuron 400SC	0.10	3.0	0.30
Garlon-4E 480EC	0.10	1.0	0.10
Total Rubber	**4.13**		**8.26**
Sugarcane			
2,4-D 720SL	3.30	2.0	6.6
Diuron 800WP	0.80	4.0	3.2
Ametral-Mixte 500SL	3.20	9.0	28.8
Roundup 360SL	3.85	4.0	15.4
Total Sugarcane	**11.15**		**54.0**

Appendix B, Table 15. Fungicide Use (Formulated Product) By Commodity: Côte d'Ivoire 1992

Crop/Formulated Product	Area Treated (000 ha)	Product dose kg or liter/ha	Volume of Formulated Product (MT) Applied
Bananas			
Punch 400EC	4.6	0.25	1.15
Tilt 250EC	4.5	0.40	9.50
Calixin 750EC	1.0	0.60	3.06
Bayfidan 100FL	2.0	0.40	3.20
Sumi-8 500SL	1.0	2.00	2.00
Peltis 400SC	4.5	0.75	20.78
Total Bananas	**17.6**		**39.68**
Pineapple			
Aliette 800WP	0.2	8.0	1.6
Maneb 800WP	0.8	10.0	8.0
Total Pineapple	**1.0**		**9.6**
Rubber			
Bayfidan 010GR	0.5	20.0	20.0
Total Rubber	**0.5**		**20.0**

Source: Landell Mills Market Research, personal communication, 1993

Appendix C: Supplementary Tables on Pesticide Use on Cotton

Table 1. Cotton Area in 12 African Nations 1982/83 to 1992/93 (000 ha)

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Benin	24	40	56	100	103	72	97	111	123	144	148
Burkina	72	77	82	94	127	170	171	150	166	186	182
Côte d'Ivoire	128	136	146	153	159	180	213	201	199	191	224
Mali	105	111	119	146	152	149	190	189	205	214	247
Sénégal	42	33	46	39	26	29	39	24	43	44	45
Togo	27	30	44	69	61	68	81	76	80	80	80
Cameroon	55	71	73	89	95	95	112	89	94	90	97
C.A.R*	69	72	80	83	66	40	53	40	47	43	26
Chad	138	176	142	148	124	149	199	185	207	182	199
Burundi	5	7	7	7	7	8	7	7	7	6	9
Gambia	3	1	3	5	2	1	3	4	4	3	3
Madagascar	17	20	24	33	43	22	26	29	27	22	20

* Central African Republic

Source: Compagnie Française pour le Développement des fibres Textiles 1992

Table 2. Cotton Seed Production in 12 African Nations 1982/83-1992/93 (000 MT)

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Benin	31	46	88	89	135	70	109	105	146	177	162
Burkina	76	79	88	116	169	148	146	152	190	167	163
Côte d'Ivoire	160	142	212	189	213	256	291	242	261	194	245
Mali	128	141	144	175	202	199	247	231	273	273	319
Sénégal	47	31	47	28	27	39	39	29	45	51	48
Togo	28	25	55	64	79	67	79	79	98	101	90
Cameroon	72	95	98	116	123	114	165	104	113	114	121
C.A.R.*	29	33	46	36	25	19	28	27	37	22	12
Chad	102	159	96	100	90	128	138	151	158	175	125
Burundi	5	7	7	8	8	7	7	6	7	5	10
Gambia	2	1	3	2	1	1	2	3	2	2	2
Madagascar	26	26	34	43	41	27	32	41	32	27	24

* Central African Republic

Source: Compagnie Française pour le Développement des fibres Textiles 1992

Appendix C: Supplementary Tables on Pesticide Use on Cotton

Table 3. Cotton Fiber Production in 12 African Nations 1982/83-1992/93 (000 MT)

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Benin	12	17	33	34	48	27	44	43	59	75	69
Burkina	29	30	34	46	66	59	59	62	77	69	69
Côte d'Ivoire	66	58	88	82	93	114	128	108	116	87	108
Mali	50	54	55	67	79	75	97	99	115	114	135
Sénégal	18	12	19	11	11	15	16	12	18	20	19
Togo	11	10	23	26	33	28	33	34	41	42	21
Cameroon	29	37	38	46	49	45	69	43	47	47	51
C.A.R.*	10	12	17	13	10	8	11	11	14	9	5
Chad	38	60	36	35	34	48	53	58	60	68	49
Burundi	2	2	3	3	3	3	3	2	3	2	4
Gambia	0.8	0.3	1	0.6	0.4	0.3	0.7	1	0.7	0.6	0.9
Madagascar	10	10	13	17	16	10	12	16	12	10	9

* Central African Republic

Source: Compagnie Française pour le Développement des fibres Textiles 1992

Table 4. Cotton Fiber Yield in 12 African Nations 1982/83-1992/93 (kg/ha)

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Benin	490	430	601	338	464	380	456	383	482	518	465
Burkina	400	392	418	489	520	344	344	416	465	373	382
Côte d'Ivoire	512	428	606	538	586	631	601	534	583	456	483
Mali	474	487	464	460	518	504	511	521	558	535	546
Sénégal	438	352	409	280	421	531	402	503	420	459	431
Togo	414	340	534	384	542	412	405	440	513	522	262
Cameroon	523	519	522	514	513	476	614	482	496	524	513
C.A.R.*	150	168	214	160	145	193	215	272	326	211	196
Chad	277	341	250	260	275	322	264	314	292	373	244
Burundi	351	358	392	468	454	393	401	332	404	365	453
Gambia	305	223	288	133	190	287	260	303	196	238	283
Madagascar	571	509	568	501	371	468	462	534	452	451	454

* Central African Republic

Source: Compagnie Française pour le Développement des fibres Textiles 1992

Appendix D: The FAO's Pesticide-Related Guidelines and Their Status as of April 1994

1. "Guidelines for the Registration and Control of Pesticides" (including a model scheme for the establishment of national organizations). This publication is currently being printed in a new version. The previous version is available upon request.

Addenda to the "Guidelines for the Registration and Control of Pesticides" include "List of Data Requirements to be Submitted to the Regulatory Authority When Seeking Registration of a Pesticide" and "Proprietary Rights to Pesticide Data." These are being printed in a new version. The previous versions are available upon request.

2. "Guidelines of Efficacy Data for the Registration of Pesticides for Plant Protection." Available upon request.

3. "Guidelines for the Packaging and Storage of Pesticides for Plant Protection." Available upon request. Publication of new storage and packaging guidelines is anticipated in late 1994. (See No. 18.)

4. "Guidelines on Good Labelling Practice for Pesticides, Pictograms for Pesticide Labels." Publication of new guidelines is anticipated in late 1994.

5. "Guidelines on Pesticide Residue Trials to Provide Data for the Registration of Pesticides and the Establishment of Maximum Residue Limits." Revised version available upon request.

6. Specifications (quality control standards). Available upon request.

7. "Guidelines for the Disposal of Waste Pesticide and Pesticide Containers on the Farm." Out of print; revision in progress.

8. "Guidelines on Environmental Criteria for the Registration of Pesticides." Available in a revised version upon request.

9. "Guidelines on Post-Registration Surveillance and Other Activities in the Field of Pesticides." Available upon request.

10. "Guidelines for Legislation on the Control of Pesticides." Available upon request; revision in progress.

11. "Guidelines on the Registration of Biological Pest Control Agents." Available upon request.

12. "Guidelines for Good Practice for the Ground and Aerial Application of Pesticides." Revision in progress in combination with item 16.

13. "Guidelines for Retail Distribution of Pesticides with Particular Reference to Storage and Handling at the Point of Supply to Users in Developing Countries." Available upon request.

14. "Guidelines on the Disposal of Bulk Quantities of Pesticides." Now being developed.

15. "Guidelines on the Registration of Household Pesticides." Now being developed.

16. "Guidelines on Prevention of Groundwater Contamination by Pesticides" and "Guidelines for Monitoring Surface and Groundwater Quality: Site Selection and Sampling Procedures." Revision in progress in combination with item 12.

17. "Guidelines on Personal Protection When Working with Pesticides in Tropical Climates." Available upon request.

18. "Guidelines on Safe Handling of Pesticides During Their Formulation, Packaging, and Transport." Publication of guidelines is anticipated in late 1994.

19. "Guidelines on Construction of Pesticide Stores Using Locally Available Materials." Available upon request.

20. "Guidelines for Inspection Staff in Pesticide Stores." Now being developed.

21. "Guidelines on Government Responsibilities in Implementing the Pesticide Code of Conduct." To be available late 1994.

22. "Guidelines on the Initial Introduction and Subsequent Development of a Simple National Pesticides Registration and Control Scheme." Available upon request.

23. "Guidelines on Tender Procedures for the Procurement of Pesticides." Now being developed; provisional version anticipated in August 1994.

Source: "FAO-GIFAP Workshop on Guidelines on Tender Procedures for the Procurement of Pesticides." Agropolis, Montpellier, France. April 26-28, 1994.

These documents are available from: Food and Agriculture Organisation, Via della Terme di Caracalla, 00100 Rome, Italy. Facsimile number is (39) 6.52.25.31.52.

Source: FAO-GIFAP Workshop on Guidelines on Tender Procedures for the Procurement of Pesticides. Agropolis, Montpellier, France. April 26-28, 1994

Appendix E: Individuals and Agencies Contacted

Amuti, Kofi	DuPont Agricultural Products	Wilmington, DE
Barnes, Cathleen	USEPA	Washington, DC
Bearse, Gina	Pesticide Action Network	San Francisco, CA
Beaumont, Peter	The Pesticides Trust	London, England
Bruge, Georges	Rhône-Poulenc	Paris, France
Burgon, Paul	Landell Mills Market Research	Bath, England
Casey, Hannah	National Westminster Bank	London, England
Chavatte, Didier	Compagnie Française pour le Développement des fibres Textiles	Paris, France
Cooke, Sanjiva	The World Bank	Washington, DC
Cottrell, Thomas	Wood MacKenzie & Co. Ltd.	Edinburgh, Scotland
Daberkow, Stan	USDA	Washington, DC
Dinham, Barbara	The Pesticides Trust	London, England
Earthscan		London, England
Fleischer, Gerd	Göttingen University	Göttingen, Germany
FAO Library		Washington, DC
Genrich, Alberto	Ciba-Geigy	Basel, Switzerland
Glass, Edward	Cornell University	Geneva, NY
Hoppin, Polly	World Wildlife Fund	Washington, DC
Jensen, Janice	USEPA	Washington, DC
Knausenberger, Walter	USAID	Washington, DC
Marquardt, Sondra	Greenpeace	Washington, DC
Matteson, Patricia	Iowa State University	Ames, Iowa
McCarthy, John	National Agricultural Chemicals Association	Washington, DC
Meltzer, Martin	University of Florida	Gainesville, Florida
Nelson, David	Washington Analysis	Washington, DC
Plunkett, Don	CGIAR	Washington, DC
Pretot, Claude	GIFAP	Brussels, Belgium
Ralston, Katherine	USDA	Washington, DC
Schaefers, George	Cornell University	Geneva, NY
Schonfield, Ann	Pesticide Action Network	San Francisco, CA
Srivastava, Jitendra	The World Bank	Washington, DC
UNDP Library		Washington, DC
UNEP Reference Center		Washington, DC
USAID Library		Rosslyn, VA
Waibel, Hermann	Göttingen University	Göttingen, Germany
Weinstein, Jennifer	Washington Analysis	Washington, DC
Wimshurst, Adam	Landell Mills Market Research	Bath, England
Woodburn, Allen	Allen Woodburn Associates	Edinburgh, Scotland
Yohe, John	University of Nebraska	Lincoln, NE