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Environmental and Economic Implications of Agricultural Trade and Promotion Policies in Uganda: Pest and Pesticide Management

by

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List of Acronyms

ADB	African Development Bank
ADP	Agricultural Development Project
AMREF	African Medical and Research Foundation (NGO)
ANEPP	Agricultural Nontraditional Export Promotion Program (USAID/Uganda)
APE	Action Program for the Environment (USAID/Uganda)
APEMAF	African Pest and Environment Management Foundation
ASAC	Agricultural Sector Adjustment Credit (World Bank/IDA)
CAAS	Cooperative Agriculture and Agribusiness Support Project (USAID/Uganda)
CRSP	Collaborative Research Support Project (USAID)
DANIDA	Danish International Development Agency
EEC	European Economic Community
EDF	European Development Fund
EPADU	Export Policy Analysis and Development Unit
ETL	Economic Threshold Level (for pesticide application)
EU	European Union
FAO	United Nations Food and Agriculture Organization
GOU	Government of Uganda
GTZ	Gesellschaft für Technische Zusammenarbeit (Agency for Technical Cooperation, Germany)
HPR	Host plant resistance (to pest infestation)
IDA	International Development Association
IDEA	Investment in Developing Export Agriculture project (USAID)
IFAD	International Fund for Agricultural Development
IPM	Integrated pest management
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau (Bank for Reconstruction, Germany)
MAAIF	Ministry of Agriculture, Animal Industries, and Fisheries
MFAD	Manpower for Agricultural Development project (USAID/Uganda)
MPED	Ministry of Planning and Economic Development
MRL	Maximum residue level (allowable for pesticides)
MUIENR	Makerere University Institute of Environment and Natural Resources
NARO	National Agricultural Research Organization
NEAP	National Environmental Action Plan
NEMP	National Environmental Management Policy
NGO	Nongovernmental Organization
NICU	National Inputs Coordination Unit (Agricultural Secretariat)
ODA	Overseas Development Administration (United Kingdom)
PIC	Prior informed consent (to export of hazardous pesticides)
PPS	Plant Protection Service (MAAIF)
SWRARP	South West Region Agricultural Rehabilitation Project
UCB	Uganda Commercial Bank
UNDP	United Nations Development Programme

UNFA	Uganda National Farmers' Association
USAID	United States Agency for International Development

Preface

This report is one of a series of reports on the environmental implications of agricultural trade and promotion policies in sub-Saharan Africa completed for the U.S. Agency for International Development's Bureau for Africa. The related reports examine pesticides and the agrichemical industry in the region; the policies on pest and pesticide management of major bilateral donor agencies; and the implications and consequences of policy reforms vis-à-vis pest management in Kenya and Cameroon.

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

The authors would like to mention specifically Dr. Jack Nyeko's assistance. He served as the team's in-country liaison and provided invaluable assistance. The staff of USAID/Uganda provided outstanding technical and other support services. The team was especially impressed by the courtesy and genuine interest in the study that many officials in the Government of Uganda demonstrated. They provided access to considerable data and patiently explained the history and situation of pesticide use and management in Uganda. Business people, farmers, and many other interested Ugandans readily responded to enquiries so that the team could more fully understand Ugandan agriculture. The team hopes that the report will help Ugandans to appreciate some of the problems associated with pest management, and thus contribute to the continued and sustainable growth of agricultural production in Uganda.

Finally, this report reflects the detailed and thorough comments of several reviewers, including Walter Knausenberger of the Bureau for Africa, Richard J. Tobin of the Winrock International Environmental Alliance, Agi Kiss of the World Bank's Regional Office in Nairobi, Kenya, Akinwumi Adesina of the West African Rice Development Association, and William J. King of the Natural Resources Institute. The considerable editorial assistance of Tropical Research and Development, Inc., is appreciated.

Executive Summary

The Government of Uganda signed a Structural Adjustment Facility with the International Monetary Fund in 1986. Actions taken under the economic reform program included devaluing the currency, lowering taxes and tariffs, abolishing parastatal marketing monopolies, and the removal of subsidies for imported agricultural inputs such as pesticides. The overall objective of these actions is to foster economic development and to improve the country's balance of payments.

This study focuses on the impact of these actions on the procurement, use, and management of pesticides. The central question of this study is this: Have the economic reforms sufficiently altered the incentives to use pesticides so as to cause to a change in the pattern of pesticide use? Of particular interest is the impact of the removal of subsidies versus the impact of free market prices for agricultural products. For many years, the price of pesticides was heavily subsidized using a variety of direct and indirect methods. The government imported most pesticides, and outside agencies often financed or donated these pesticides. This meant that many pesticides were purchased in bulk, probably at preferential rates. It is likely that such imports often received preferential treatment at the border in the form of lower taxes. Once inside the country, pesticides were distributed using government-funded systems. Farmers where also given preferential rates on loans used to purchase inputs. Data on pesticide use and factors affecting that use (e.g., prices) are scarce. There were, however, sufficient data to make the following conclusions and recommendations.

1. **Relative prices of pesticides in Uganda remain essentially unchanged.** Due to a growth rate that approximately doubles the population every twenty years, Uganda needs to increase food production and expand economic development. Government policies and plans to increase production and economic activity include promoting crop production packages, some of which contain agrichemicals. An examination of the economics of using pesticides showed, however, that economic reforms have not altered significantly the incentives to use pesticides. For example, although gross margins and returns to labor have risen over time, so have pesticide prices. Relative to labor costs, herbicides have become more expensive, and this should further discourage their use. Thus, economic reforms have not yet changed the economic incentives to use pesticides, nor are there any clear indications that this will change in the near future.

2. **Promotion of nontraditional export crops has had little impact to date on the use of pesticides.** The government sees promotion of nontraditional export crops as a means of contributing to the economic reform program's goals of diversification and expansion of the economy. Despite this goal, traditional crops, such as coffee, tea, cotton and tobacco constitute 80 percent of all agricultural exports. Maize and sesame make up the bulk of the nontraditional agricultural exports. Nontraditional export crops that customarily receive intensive pesticide application, such as cut flowers and vegetables, are less than 1 percent of total exports. Attempts to increase exports of these crops significantly face many problems such as the lack of cold-storage and handling facilities, and the high cost of airfreight. Lack of credit and expertise are also significant problems preventing rapid increases in the exports of many

nontraditional crops. There are some well-publicized examples of farmers increasing their incomes by growing a nontraditional export crop Nonetheless, marketing difficulties will likely mean that most farmers will produce only small amounts of nontraditional export crops. This will not noticeably change their demand for agrichemical inputs.

3. **Economic reforms have reduced the supply of pesticides.** In recent years, economic reforms have altered the supply of pesticides radically, specifically the importation and distribution of pesticides. Government subsidies for pesticides have essentially halted, and such quasi-government organizations as the Uganda Commercial Bank (UCB) have ceased active distribution of pesticides. The private sector has faced, and is still facing, many problems in taking over the role of main importer of pesticides. The net result has been a dramatic decline in the amount of pesticides imported over the past three years. The situation is unlikely to change in the near future. The two main reasons are that (a) the private sector has problems financing imports of pesticides and (b) private companies have yet to develop distribution systems capable of reaching large numbers of farmers rapidly.

4. **Overall impact on patterns of pesticide use.** No quantitative data were found that showed that farmers have increased their use of pesticides in response to altered price incentives. Further, no data were found to suggest that the economic reforms have caused a noticeable change in cropping patterns that has resulted in an increase in pesticide use. No data were found to suggest that encouraging export crops leads to a de facto increase in pesticide use. There may be small, localized increases in pesticide use, but these were not detectable using aggregated, national data. In the short term, the private sector's lack of capacity to import and deliver pesticides will limit regular pesticide use to those farmers near large urban centers (ease of delivery) and to those few areas where there are sufficient farmers producing high-value crops (able to pay high transport costs).

5. **Problems of pesticide use that existed before the advent of the structural adjustment programs still exist.** Just because the economic policy reforms have not significantly changed the incentives and disincentives to use pesticides does not mean that no problems exist with the use and management of pesticides in Uganda. Any problems associated with pesticide use predate the advent of the policy reforms (see points 6 and 7 below). These problems include the lack of an adequate regulatory system, weak or absent enforcement of existing requirements, deficiencies in marketing infrastructure, and limited access to protective equipment and information on the safe use of pesticides. Furthermore, the economics associated with the use of pesticides point to an urgent need for alternatives to the intensive use of pesticides to manage pests and to maintain production of export quality. Farmers are caught between the need to intensify production (foodcrops), or maintain quality (export horticulture), and the economic necessity of keeping input costs as low as possible. At the moment, the intensive use of pesticides is, for farmers, something of an insurance payment. They apply pesticides intensively because no other technology has been presented to them.

6. **Health and environmental impacts.** One of the most serious problems concerning the use of pesticides is the health impact. Ugandan farmers typically do not use any

protective clothing when applying pesticides. Such clothing must be imported, making it both expensive and scarce. The scanty data available on the impact of pesticides on human health and the environment in Uganda suggests that there are several problems. Several organochlorine pesticides, such as dieldrin and lindane, are on sale for general use. Due to their potentially harmful effects such pesticides are either banned or registered for use in only restricted circumstances in the United States. These older pesticides are often noticeably cheaper to purchase than are newer, more environmentally safe pesticides (e.g., synthetic pyrethroids).

7. **Lack of ability to regulate and monitor pesticide use.** Uganda has had laws and regulations governing the importation, registration, distribution, and use of pesticides since 1989. These laws are in full accordance with the United Nations Food and Agriculture Organization's *International Code of Conduct on the Distribution and Use of Pesticides*. In spite of these laws, one of the factors contributing to the hazardous distribution and use of pesticides in Uganda is an absence of effective enforcement. The management structure to enforce these laws is only now being assembled, and the efforts are hampered because only one laboratory in Uganda is capable of analyzing pesticide residues.

8. **Donor policies and funded projects.** Many donors have policies and projects aimed at rehabilitating or improving agricultural productivity. Many of these projects encompass some aspect of pest management. For example, the World Bank/International Development Association (IDA) is funding a five-year cotton subsector development project, which includes the development and application of integrated pest management. Most of the major donors are reluctant to become involved in funding purchases of pesticides, with the noticeable exception of the Japan International Cooperation Agency, which allows governments of countries receiving Japanese assistance to request shipments of pesticides as part of their aid packages.

9. **Impact of donor policies and projects on the short-term future use of pesticides.** Although the government's policies and donor-supported projects to improve agricultural productivity are impressive, we believe there will be little change in the use of pesticides in the next three to five years. This conclusion is considered particularly true for nontraditional export crops, which face a wide range of difficulties (see point 2, above).

10. **Short-term recommendations.** In the short term, the most urgent needs for alleviating the negative health and environmental impacts of using pesticides are (a) to establish an information network to foster collaboration among government agencies and donor organizations and (b) to ensure continued and even increased support of the Agricultural Secretariat's ability to gather and analyze data. Without the collection and distribution of data, many other recommendations cannot be implemented effectively.

11. **Long-term recommendations.** The highest priority for long-term (ten to twenty years) goals should be given to the research, development, and extension of alternative technologies to manage pests. Given the economics of using pesticides (points 1-3, above), there is an economic imperative for the investment in the research on and extension of pest-management technologies that will lower significantly the amount of pesticides farmers need to

manage a given problem. Without new tools, there may not be sufficient incentives for farmers to change existing patterns of pesticide use. Enforcement of pesticide regulations should also be easier if extension agents are able to offer farmers alternative methods of managing pests.

12. **Funding the recommendations.** The Government of Uganda should develop a long-term (ten to twenty years) plan that will ensure the funding of (a) research on, and development and extension of, new pest-management technologies (b) enforcement of pesticide regulations, and (c) implementation of the National Environmental Action Plan, including environmental monitoring and enforcement of environmental legislation. Both the donors and the Government of Uganda must make firm commitments to give these programs long-term support. Without such commitment, the development of viable alternatives to current pest-management practices and adequate pesticide management will be limited severely in Uganda.

1. INTRODUCTION

1.1 A growing population: The need to increase agricultural output

Uganda's population growth rate is well over 3 percent yearly (Table 1), resulting in the population almost trebling in 30 years. This high rate of growth is expected to continue, and it has been predicted that Uganda's population will reach 55 million by 2025 (World Resources Institute 1990). This situation, combined with the reduction in the per capita index of food production and the less-than-required daily calorie supply (Table 1), means that there will be continued pressure on resources to produce ever larger amounts of food.

Table 1. Changes in population and foodcrop production in Uganda

Population (millions)

1960	1990
6.6	18.4

Average annual population growth rates

1965-1970	1985-1990
3.96%	3.49%

Index of food production: total (1979-1981 = 100)

1967-78	1978-80	1986-88	1988-90
111	103	104	127

Index of food production: per capita (1979-1981 = 100)

1976-78	1978-90	1986-88	1988-90
122	106	82	92

Average daily calorie supply (as percentage of requirements)

1965	1985	1983-85
96%	95%	98%

Sources: World Resources Institute 1990, 1992; UNDP 1991.

Agriculture is also crucial to Uganda's economic development. Over 90 percent of Uganda's exports are agricultural in origin, with the large majority of the value being produced

by coffee, tea, tobacco, and cotton (Stepanek 1993). Thus, attempts to revitalize Uganda's economy after the political instability of the 1970s and 1980s will have to depend initially on agricultural production and the export of agricultural goods.

1.2 Factors crucial to increasing agricultural production

The Government of Uganda is aware of the importance of agriculture and the pressing need to increase foodcrop production to feed a rapidly growing population. One example of the government's concern is a study that considered the conditions needed to increase the production of grains, beans, and groundnuts (Ministry of Trade and Industry 1993). The study identified the 10 conditions and variables that are crucial to increasing food production:

(a) research into improved strains and varieties
(b) dissemination of field-tested new strains and varieties
(c) spread of improved methods of cultivation
(d) availability of additional arable land
(e) extension services
(f) land tenure
(g) trade statistics
(h) chemical inputs
(i) tools and implements, and
(j) credit.

An expanded explanation of these 10 items is provided in Appendix A. The study did not prioritize or categorize these factors in terms of their relative importance to increasing food productivity.

1.3 Structural adjustment

The Government of Uganda signed a Structural Adjustment Facility with the International Monetary Fund in 1986. Some of the actions taken under the program included devaluing the currency, making foreign exchange more accessible to the private sector, lowering taxes and tariffs, abolishing parastatal marketing monopolies, and reducing the size of the civil service workforce (Lateef 1991; Economist Intelligence Unit 1993). The overall objective of these actions was to foster economic development and to improve the country's balance of payments.

Two consequences of the structural adjustments have been the removal of government control of the markets for most agricultural products and the active promotion of both traditional and nontraditional crops for export. In theory, the deregulation of the markets and the growth of export crops should increase farmers' incomes. It is possible that an increase in farmers' incomes will increase the use of pesticides. Balancing this possible increase in pesticide use is the rise in the cost of pesticides due to the removal of subsidies. This removal of subsidies was also part of the economic reform program.

1.4 Subsidies

For many years, the price of pesticides was subsidized heavily, using a variety of direct and indirect methods. Pesticides were mostly imported by the government or on government tender, and outside donors often financed or donated such pesticides. This meant that many pesticides were purchased in bulk, probably at preferential rates, and such imports avoided many of the problems that the private sector still faces in obtaining adequate foreign currency. It is likely that such imports often received preferential treatment at the border in the form of lower taxes. Once inside the country, pesticides were distributed using a government-funded system, whose costs were apparently absorbed in the general operating budget of institutions such as the Uganda Commercial Bank and not charged to the farmers. Farmers were also given preferential rates on loans used to purchase inputs. There are no data that quantify the magnitude of these subsidies, and it is thus impossible to quantify the impact of these subsidies on the prices farmers paid. The small amount of specific information regarding subsidies that was found during the course of this study is presented latter in the paper.

1.5 The study's focus

This study focuses on the impact of agricultural trade and policy reform programs on the procurement, use, and management of pesticides. Before the economic reforms, government directly and indirectly controlled the prices of many inputs and outputs. The economic reforms removed many of these controls, leaving input and output prices to free market forces. The central question of this study is: Have the economic reforms sufficiently altered the incentives to use pesticides so as to cause a change in the patterns of pesticide use? For example, despite the removal of many of the subsidies, have economic reforms lowered the relative price of pesticides, causing an increase in their use? Have cropping patterns changed to such an extent that pesticide use has noticeably increased? Has the encouragement of the production of export crops meant a de facto intensification of pesticide use? Is there any evidence to indicate that research into, and use of, alternatives to the intensive use of pesticides, such as integrated pest management (IPM), have been encouraged or discouraged since the inception of the economic reforms?

The use of pesticides can increase the production of food and export crops, but the intensive use of pesticides can also cause negative environmental and health impacts. These impacts can be cumulative to the extent that, over time, the true cost of the negative impacts can be greater than the value of any increased productivity associated with the use of pesticides. Thus, this study seeks to define the incentive(s) and need to use pesticides, the conditions under which they are used, the costs and returns to their use, and prospects of using alternative methods of managing pests. This study is based on interviews and data collected during a two-week stay in Uganda in February 1994.

1.6 Choice of crops

All indications are that Uganda's future is irrevocably linked to the success of

expanding exports and of a well-balanced program of import substitution (Ministry of Trade and Industry 1993).

The patterns of pesticide use considered in this study were chosen on the basis of:

(a) the relative importance of commodities, both for domestic consumption and export;
(b) the amount of pesticide used (a deliberate effort to include crops on which pesticides are heavily used);
(c) the focus of government and donor health and agricultural development policies and programs;
(d) the economic and pest management data available; and
(e) opportunities for comparison among Uganda, Cameroon, and Kenya, each of which is the subject of a country report.

The use of pesticides in both crop-production systems and human and animal health programs were considered using the criteria listed above. Based on those criteria, trends in pesticide use and their attendant health and environmental implications were analyzed using data on:

(a) crop protection regimes for the traditional export crops coffee, tea, and cotton;
(b) crop protection regimes for nontraditional export crops, such as maize, sesame, and horticultural crops;
(c) animal health programs aimed at controlling problems associated with tick and tsetse infestations; and
(d) human health programs designed to control diseases such as sleeping sickness and malaria that insect vectors spread.

2. FACTORS AFFECTING THE DEMAND FOR PESTICIDES

2.1 Trends in crop production

2.1.1 Production of foodcrops

Comprehensive production databases (total amount, area planted, and yields over time) are readily available for eight foodcrops and nontraditional export crops (maize, millet, sorghum, beans, groundnuts, cassava, bananas, and sweet potatoes). Further, the 1990-1991 National Census on Agriculture and Livestock provided one-year production estimates for cowpeas and field peas, Irish potatoes, and pigeon peas. Although an analysis of trends in foodcrop production might be expected to include vegetables, no data are available.

Foodcrop production in Uganda in the late 1980s and early 1990s has just recovered to levels achieved during the 1970s (Table 2). The decline in average food production during the early 1980s can probably be attributed to political instability and civil unrest.

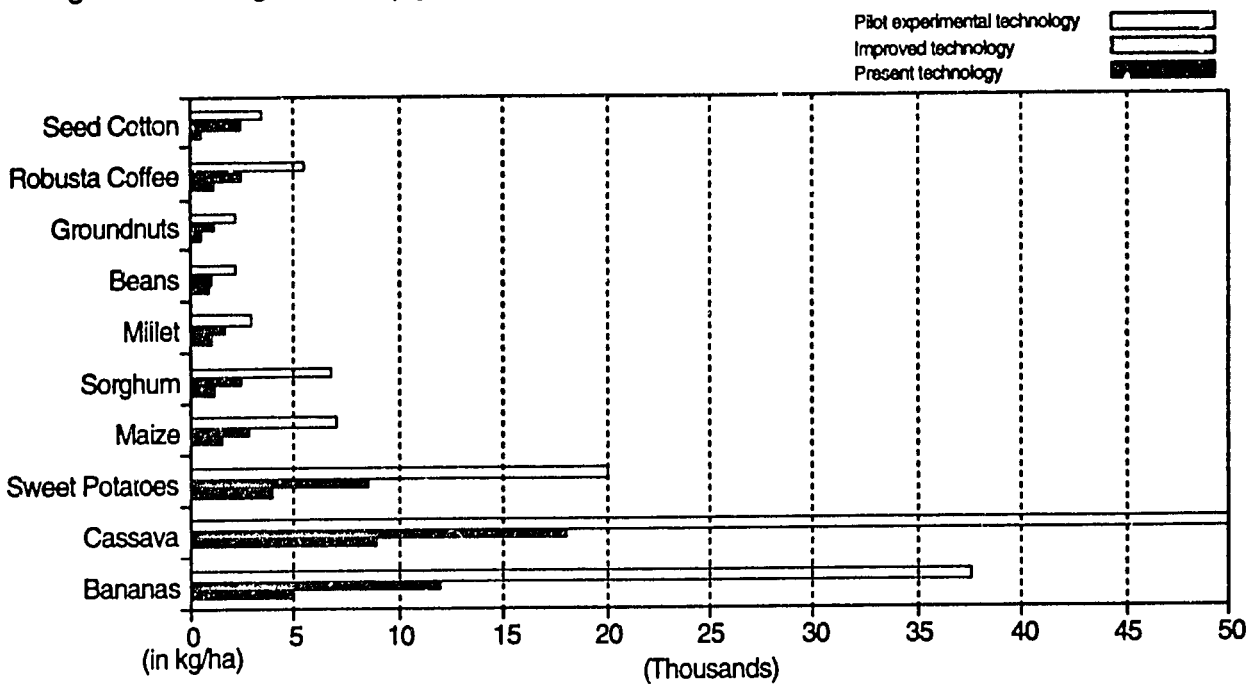
Table 2. Trends in foodcrop production in Uganda: 1970-1991 (in thousands of metric tons)

	1970-79			1980-85			1986-90/91		
	High	Low	*Mean*	High	Low	*Mean*	High	Low	*Mean*
Maize	674	253	*482*	413	280	*343*	624	286	*490*
Millet	783	481	*563*	545	264	*459*	626	350	*476*
Sorghum	467	316	*382*	407	148	*276*	378	280	*338*
Beans	388	170	*260*	314	133	*254*	513	267	*361*
Groundnuts	251	80	*189*	118	70	*94*	176	85	*144*
Cassava	2,993	2,100	*2,508*	3,239	1,673	*2,495*	3,339	1,871	*2,896*

Source: Appendix B.

A study for Uganda's Ministry of Agriculture in 1990 clearly revealed that there are technologies available that can increase production of foodcrops. The study emphasized the need for intensification of production (i.e., increasing yields), as opposed to increasing area under cultivation. Some of the study's predictions concerning the potential to increase foodcrop yields can be found in Figure 1.

Figure 1. Average foodcrop yields under present, improved, and experimental technologies.



Source: Ministry of Agriculture, *Crop Production Handbook* (January 1990); cited in Ministry of Agriculture 1990.

The source did not elaborate on how the high yields in the column labeled Pilot Experimental Technology were achieved, but Appendix C contains data that can account for the differences in yields when comparing Present Technology with Improved Technology. Using data from Appendix C, maize yields are predicted to improve from 1,500 kg/ha (present technology) to 2,800 kg/ha (improved technology) by using fertilizer at a rate of 300 kg/ha, and herbicide at 2 liters/ha. The source records neither input used with "present technology. The use of such agrichemicals was estimated to increase the costs of production, gross income, and net income by 86 percent each. Whether these projections are realistic is discussed in section 2.4, below.

Such bold optimism for the potential to increase yields and production is also contained in a more recent grain marketing study (Ministry of Trade and Industry 1993). Having considered the status of, and potential to alter, the 10 factors crucial to increasing production (Appendix A and section 1.2), the authors of the study made projections for eight crops (Figure 2).

Unlike the projections in Figure 1, which extrapolated research results, an analysis of trends in production apparently influenced the projections in Figure 2. The authors of the report that included the projections given in Figure 2 did not address how the identified constraints to increasing productivity could, or should, be overcome. For example, there is no detailed discussion in the report about how the Government of Uganda should ensure widespread dissemination of improved strains or varieties.

Further, a note of caution needs to be made regarding the validity of the data used to make the projections presented in Figure 2 and Appendix B, as indicated by the data presented in Box 1 and the following comment: "Given the insecurity of the database, particularly estimates of land under cultivation and potential arable land, these estimates [of increased foodcrop production] will need to be re-examined in the light of the results of the Agriculture and Livestock Census of 1991 (Ministry of Trade and Industry 1993, 25).

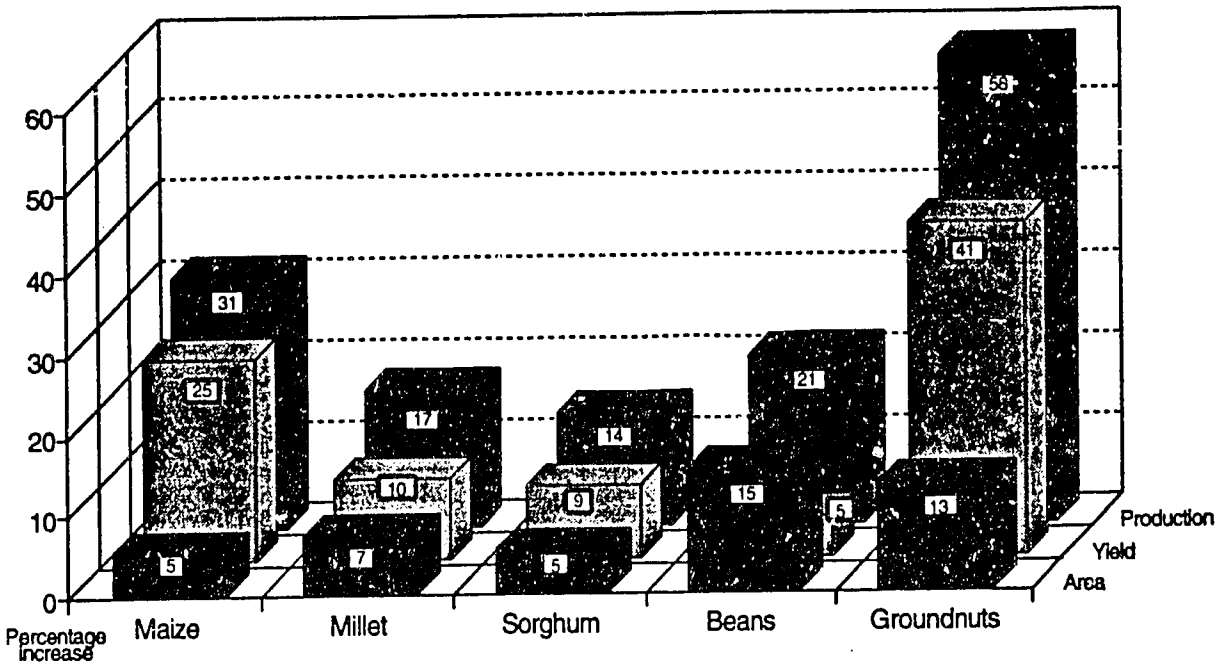
Box 1. A note of caution: Data discrepancies

Different sources of data concerning the production of foodcrops in Uganda often have large differences. For example, there is a 10-percent difference between the two estimates for the production of maize in 1989. The Ministry of Agriculture, Animal Industry, and Fisheries estimated production at 624,000 metric tons (MT) while the former Ministry of Planning and Economic Development produced an estimate of 560,000 MT. The latter estimate was obtained using data from a Household Budget Survey (Ministry of Trade and Industry 1993).

Other differences in the estimates from the two ministries also exist. An analysis of the survey data indicated that production of beans was 49 percent higher than the amount the Ministry of Agriculture estimated. Even the National Census of Agriculture and Livestock contains noticeable errors. It indicates an estimated average yield of cassava to be 27.2 MT/ha (Ministry of Agriculture, Animal Industry, and Fisheries 1992). In contrast, analysis of other data sets from the Ministry of Agriculture indicate a yield of 8 to 9 MT/ha (Appendix B). The lower figure coincides with average yields elsewhere in Africa (El-Sharkawy 1993).

Despite the differences in actual amounts between the various data bases, the data all reflect the same trends and themes. A consistent trend found in all data sets is that Uganda has experienced a low-to-negligible growth in the production of foodcrops. Thus, the conclusion from Tables 1 and 2, namely that Uganda has experienced a reduction in per capita food production, remains valid. Only the exact magnitude of that reduction should be questioned.

Figure 2. Projected increases in production, area, and yields, 1989-1995



Source: Ministry of Trade and Industry 1993.

Note: Calculations using data presented in Appendix B indicate that the authors of the Ministry of Trade and Industry's report chose to compare predicted values for 1995 with estimates of crop production for 1989, which the Ministry of Planning and Economic Development (MPED) produced, rather than with estimates from the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF). The MPED's estimates (in italics, Appendix B) are markedly different from those of the MAAIF (see Box 1). The report's authors did not clarify why they chose the MPED's estimates.

2.1.2 Trends in export crops

Over the three and one-half year period considered, nontraditional export crops have been an important proportion of total exports (Table 3). Despite this finding, it is important to examine the commodities that constitute nontraditional exports. First, over 80 percent of nontraditional exports consist of the aggregated categories labeled cereals, beans, and oilseeds (Table 3). In contrast, horticultural exports, defined as fruits and related products plus vegetables, are relatively insignificant, accounting for less than 1 percent of total export revenues (Table 3). Second, the bulk of the cereal exports have been maize, and the majority of oilseed exports have been sesame (Stepanek 1993). Third, the demand for maize exports has been driven by drought and political instability in neighboring countries, as suggested in the following statement:

> The drought in Kenya and political crisis in other neighboring countries also recently generated external demand for food. In 1992, food crops exports constituted 20 percent of the total nontraditional exports. During 1993 the relative share of food exports is

expected to increase to 40 percent mainly due to export of maize and beans through the World Food Program (Agricultural Secretariat 1993a).

The countries that have been the largest recipients of Uganda's maize exports illustrate the nature of the trade. By volume, in 1990 and 1991, Sudan received 30 percent and 34 percent, respectively, of all maize exported, while in 1992 and the first six months of 1993 Kenya received 40 percent and 30 percent. Sixty-five percent of all maize exported in the first six months of 1993 went to Rwanda (Stepanek 1993). The World Food Program is apparently willing to pay a premium for maize that can be delivered promptly (Stepanek 1993). Thus, when the World Food Program requires food in central and eastern Africa, Uganda has a distinct locational advantage over exporters who have to ship grain across the ocean to reach Africa.

Like maize, sesame exports have grown due to failures of the crop in the Sudan (Sergeant and Macartney 1993). When Sudanese production resumed, however, Uganda's market share fell dramatically because its sesame "is a lower quality [than Sudanese] and Uganda is a higher cost producer" (Stepanek 1993).

Another reason for the relative growth in nontraditional export crops is the fall in the average price of coffee (Table 4). This fall has been particularly dramatic following the collapse of the International Coffee Organization's coffee quota market in July 1989. The fall in coffee prices resulted in a drop in the volume of coffee exports.

Table 3. Value of exports from Uganda: 1990 to mid-1993 (in thousands of U.S. dollars)

	1990	1991	1992	1993 (Jan-June)
Traditional agricultural exports				
Coffee	139,574	100,672	93,021	16,174
Tea	2,920	5,331	5,672	4,668
Cotton	12,460	10,062	8,941	1,923
Tobacco	2,908	4,519	4,203	4,614
Subtotal	145,414	120,584	111,837	27,379
Nontraditional agricultural exports				
Cereals	3,420	4,463	4,459	10,084
Beans	4,150	4,211	2,781	5,836
Oil crops	5,437	11,119	7,595	2,758
Fruits and related products	791	362	286	173
Vegetables	169	245	127	268
Spices	118	496	486	362
Subtotal	14,085	20,897	15,734	19,481
Other nontraditional agricultural exports	8,990	10,914	11,389	7,305
Total nontraditional agricultural exports	23,074	31,811	27,123	26,786
Other agricultural	247	306	869	1,398
Total agriculture	168,735	152,700	139,829	55,564
Nonagricultural	1,657	11,581	3,532	3,605
Total exports	170,393	164,281	143,361	59,168
Total Agriculture as % of total	99%	93%	98%	94%
Total Trad. Agriculture as % of total	85%	73%	79%	49%
Total Horticulture[a] as % of total	0.5%	0.4%	0.3%	0.7%
Total nontraditional agricultural exports as % of total	14%	19%	19%	45%

Source: Adapted from Stepanek 1993.

Crops and products in each category:

Cereals: Maize, oats, millet, sorghum, cereals, maize flour, cereal grains

Beans: Dried leguminous beans, beans

Oil crops: Groundnuts, sesame, other oil seeds, other vegetable oil, soya beans

Fruit and related products: Oranges, bananas, pineapples, avocados, guavas and mangosteens, mangoes, other fresh fruit, dried fruit, papain (crude)

Vegetables: Potatoes, shelled vegetables, tomatoes, other vegetables, onions

Spices: Pepper, vanilla, ginger

Other nontraditional agricultural exports: Honey, cocoa beans, nuts, animal skins, fish, fish products, timber, coffee husks and skins, sugar, sugar preparations and honey, crude animal and vegetable material (except papain)

a. Horticultural exports, defined as the sum of fruits and related products plus vegetables.

Table 4. Trends affecting exports of coffee and maize

	1990	1991	1992	World prices[a] ($/kg) 1980-92 High	Low
Coffee					
Volume (metric tons)	142,397	127,438	118,549		
Value (in thousands of U.S. dollars)	141,587	117,641	95,140		
Unit price ($/kg)	0.99	0.92	0.80	2.95[b] (1980)	1.01[b] (1992)
Maize					
Volume (metric tons)	26,733	33,070	29,623		
Value (in thousands of U.S. dollars)	3,318	4,188	3,894		
Unit price ($/kg)	0.12	0.13	0.13	0.13 (1980)	0.10 (1990)

Sources: Stepanek 1993; Agricultural Secretariat 1993a.

a. Reflects average world market prices, not necessarily the realized prices for Ugandan products.

b. Simple average price of robusta and arabica world market prices.

2.1.3 Potential to increase exports of nontraditional export crops

A set of papers prepared for the USAID-funded Export Policy Analysis and Development Unit (EPADU) considered the opportunities for nontraditional agricultural exports from Uganda. Some of these reports explicitly project medium-term export targets. For example, Sergeant and Caiger (1993) project that in the medium term Uganda could produce up to 2,000 tonnes of spices and essential oils (e.g., citronella, dried ginger, chilies, vanilla, paprika, pyrethrum), utilizing approximately 7,750 ha of land. The study also notes, however, that:

> the markets for many of them [essential oils and spices] are already oversupplied and it will be difficult for new entrants, unless they have significant competitive advantages. Most of the major competitors are low cost producers with a tradition of producing good quality products. Uganda is disadvantaged by being landlocked and therefore has more expensive freight than many other countries. There is little scope for Uganda if it provides a similar product using the same technology (Sergeant and Caiger 1993, executive summary)

There have been some optimistic predictions about the potential for floricultural exports. Sergeant and Manji (1993) suggested that it would be possible to expand current production to a target of 51 million blooms marketed per year by 1995-1996, with a value of US$10.9 million.

They estimated that in order to produce this many blooms, the area under floriculture cultivation would have to grow to about 78 ha by 1995-1996, represented by 10 to 12 growers each with 7 ha. Currently, there are two major rose-production operations, with one (Ziwa Horticultural Exporters) growing 4 ha of roses under plastic greenhouses.

Compared with other export crops, particularly coffee, this volume of production must be considered small. It is true that cut-flower production can require relatively large amounts of agrichemicals, but the single largest cost in the production and export of cut flowers is airfreight, which accounts for as much as 50 percent of total variable costs. Thus, the principal defining factor affecting the growth of floricultural exports from Uganda will be the ability to pay for airfreight. Other authors (e.g., Herlehy 1991) have examined the constraints to increasing the amount of air cargo space available for exports. Other constraints on the expansion of floriculture include the lack of technical expertise and experience in growing export quality flowers and the lack of cold-storage and handling facilities at Entebbe airport. Sergeant and Manji (1993) emphasized that "without improved airport facilities and a floricultural development advisor, Uganda will find it extremely difficult to realize its full potential for growing and exporting floricultural products."

The high cost of airfreight also severely constrains the potential to increase fruit exports. Due to the long journey time and high cost, Uganda is unable to compete with sea-freighted fruit from other countries, particularly fruit exported from West African and North African countries (Sergeant and Campbell 1993). Another serious constraint is the lack of expertise in producing some of the fruit crops judged to be the most financially viable. For example, raspberries were judged to be the most "potentially significant export fruit crop" (Sergeant and Campbell 1993). Given these constraints, it is surprising that a number of studies have been so optimistic about the potential to increase exports of horticultural crops. Even the enthusiasm for raspberries must be tempered with the fact that, in Uganda, "this crop has still to be proven on a commercial scale to check yield and cost assumption" (Sergeant and Campbell 1993).

2.1.4 Implications from the trends: Agricultural policy reform and pesticide use

Foodcrops: The conclusion from examining both the trends in foodcrop production and the growth in demand (population growth) is that foodcrop production must increase. It is logical to assume (or to hope) that an agricultural reform program in Uganda would include the implementation of policies designed to overcome the constraints to increasing production (see section 1.2 and Appendix A). Nonetheless, examining only the trends in foodcrop production is not sufficient for reliably predicting how agricultural policy reforms might affect production and thus the demand for agrichemicals. As an illustration, the authors who calculated the potential increases in production in Figure 1 and Appendix C did not address the mechanism(s) by which current constraints would be overcome. Thus, past and future trends in foodcrop production do not provide sufficient information to link potential policy reform and future agrichemical use. Other types of data are needed, particularly financial and economic returns to the farmer from using agrichemicals to produce foodcrops (see below).

Export crops: Traditional export crops, particularly coffee, are still the most important export commodities (Table 3). The rise in the relative importance of some nontraditional export crops is due to a combination of three factors: (a) drought and political instability in neighboring countries creating a demand for maize and beans, (b) a temporary reduction in sesame supplies on the world market, and (c) the drop in world prices for coffee.[1]

Several people who were interviewed saw some of these and other factors as long-term effects. For example, Kenya's rapidly growing population and that fact that only 11 percent of its land is suitable for maize production seemed to justify hypothesizing that Kenya will continue to represent a large market for Ugandan maize. This assumption depends on how much Kenya will be willing to pay for maize outside of food aid programs. Such assumptions may not be sufficient to entice a large number of farmers to adopt production-intensification technologies that would include the use of agrichemicals (see Figure 1 and Appendix C).

Not all exports of nontraditional crops have grown or even remained stable, as evidenced by the drop in export revenues over the past three and one-half years for fruits and vegetables (Table 3). There are some fundamental problems in the marketing infrastructure that give reasons for skepticism about the potential for growth in exports of these crops. In the case of vegetables, high airfreight costs leave Ugandan vegetable exports to Europe (the most important market) at a marked disadvantage compared with West African countries (Sergeant and Wauters 1993). For example, airfreight charges from Uganda to Europe are 30 percent and 40 percent greater than from Gambia and Ghana, respectively (Sergeant and Wauters 1993).

2.1.5 Summary of trends in crop production

The trends in production and exports do not suggest that either foodcrop or export crop production will increase rapidly in the short term. Large increases in the use of agrichemicals will more likely be defined by financial and economic incentives as opposed to volume of production.

2.2 How much of a constraint? Pest problems and pest management in Uganda

We can only speculate about how much pests constrain agricultural production by Ugandan small-scale farmers. Hardly any crop loss assessment data is available, and there is next to none from farms as opposed to research stations. Information on small-scale farmers'

[1] Brazil, which supplies up to 30 percent of the world's coffee, suffered two devastating frosts in as many weeks in mid-1994. Since March 1994, coffee prices on the world markets have increased dramatically, approaching the high prices received in 1986 (*Economist*, 16 July 1994, 70). The permanence of these higher prices will depend on the number of coffee trees the frost killed, which will only be known later in the year. It is also too early to estimate the proportion of the price increases that will be transmitted back to farm gates in Uganda or how farmers will react to such price increases. Furthermore, input prices have also risen as a result of the economic and policy reforms. This should temper any expectation of increased purchases of inputs such as pesticides.

perceptions of pest problems is contradictory.

In response to one questionnaire, farmers identified the three worst production constraints as shortages of land and labor and the unavailability of seeds (MUIENR 1993). Yet Tukahirwa (1991) interviewed 60 "well-known pesticide-using farmers who in Uganda constitute the group of so-called Progressive Farmers" and field extension personnel from both Agricultural and Veterinary Departments. He found that over 90 percent of both groups ranked pests as the chief biological constraint to production, far above drought, soil fertility, and varietal inferiority. Fifty-seven percent of the farmers and 90 percent of the extension staff ranked input expense or unavailability as the chief socio-economic constraint. Shortage of labor, poor marketing, poor advisory services, and lack of credit availability were ranked much lower than the input problems. (None of the extension officers, but 13 percent of the farmers, ranked poor advisory services as the main constraint.)

Health officers observing patterns of pesticide use in the countryside confirm this enthusiasm on the part of both farmers and extension staff, characterizing it as a "mania" and noting with apprehension the toxic "cocktails" being mixed (D. Ogaram and D. Shuey, personal communication, 1994). Nevertheless, pesticide use appears to be low on food crops (Baliddawa 1991), and local maize and bean cultivars and traditional vegetables are said to need little or no pesticide protection. Farmers have traditionally used local repellent plants. A Bank of Uganda document (1993) noted the low effective demand for inputs, especially for some food crops, and attributed it to the failure of research and extension to demonstrate the benefits of inputs, to lack of credit, and to high prices. The majority of pesticides applied in Uganda are insecticides. Most pesticide use is concentrated on cash crops, such as coffee and cotton, and on migratory pests. In many African countries, however, farmers divert the chemicals that governments provide for those purposes to unintended uses (Natukunda, Tickodri-Togboa, and Guwatudde 1991; FAO 1993b).

The Ministry of Agriculture's *Crop Production Handbook* (Government of Uganda 1991b), though reprinted recently, was first published in 1981 and is out of date (C. Bazirake, personal communication, 1994). Many farmers are illiterate and depend on traders and extension officers for oral advice on proper use. For the most part, the government agricultural extension services have provided inadequate coverage and quality of information (see section 5.1).

Baliddawa (1993) carried out a farm survey of insecticide availability, prices, use, and safety in seven districts in 1990 and found the range of pesticides available to be quite limited, even in Kampala District. Market prices varied considerably within and between districts and were prohibitive for small-scale farmers. Pesticides were packaged in all manner of containers, including tins, bottles, paper and plastic bags, and jerrycans, with much repackaging obvious. Remarkably, most were labeled--repackaged pesticides usually are not (Pierrard 1992).

Farmers apply pesticides from cans and basins and with knapsack sprayers, which are manufactured domestically. The availability of spare parts and the high cost of the equipment

are major constraints to sprayer use (FAO 1993a). Baliddawa's (1991) finding that the Iganga District Agricultural Office possessed one knapsack sprayer for every 547 farmers suggests that most applications are made in other ways. Lack of protective clothing is another important problem. Protective clothing is rarely used because most of it is imported, which limits supplies and makes it expensive. Further, it is often unsuitable for use in the tropical climate (FAO 1993a).

2.3 Other uses of pesticides: Controlling vector-borne diseases

2.3.1 Control of tsetse fly[2]

In Uganda, as in most sub-Saharan African countries, a number of vector-borne diseases afflict humans and livestock. For example, from 1901 to 1907, an outbreak of human trypanosomiasis (sleeping sickness), which tsetse flies spread, claimed over 250,000 lives.

Since a vaccine that will provide effective protection against this disease has yet to be developed, controlling vector populations is the only available control methodology. In Uganda, government-financed and -organized campaigns to control tsetse started in 1948, using a mixture of pesticide applications (usually DDT), game elimination (alternate hosts for the flies), and bush clearing (destruction of tsetse fly habitat).

In the 1960s due to the growing realization of the environmental problems that extensive use of DDT causes, the Government of Uganda started using a 3-percent solution of dieldrin. Bush clearing and game elimination continued, with the former receiving direct help from USAID in the form of donated tractors (Department of Veterinary Services and Animal Industry 1965). The use of dieldrin for the Ankole and Toro districts is illustrated in Table 5 Unfortunately, more recent data are not readily available.

In the mid-1970s, concerns about environmental impacts ended the use of game elimination and bush clearing. Spraying, including aerial spraying, continued. Starting in the 1980s, the FAO's Desert Locust Control Organization for East Africa began to provide aircraft for emergency aerial spraying where a quick "knock down" of the numbers of tsetse flies is needed. The Government of Uganda provides the ground-spraying crews.

In May 1988, the United Nations Development Programme (UNDP) and the FAO implemented a trypanosomiasis control program in southeast Uganda. An evaluation team noted the continued use of dieldrin, thus forcing the Ugandan authorities to switch compounds. Deltamethrin, a synthetic pyrethroid, is currently being evaluated. It is expensive, costing US$52/liter plus distribution costs.

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[2] Unless otherwise noted, much of the discussion in this section is based on a personal communication with Mr. L. Semakula.

Table 5. Control of tsetse: spraying operations in the Ankole and Toro districts

Year	Area sprayed (acres)	Total gallons sprayed	Average quantity of 3% Dieldrin (gal/acre)
1964	412,160	152,499	0.37
1966	154,432	105,014	0.68
1967	148,161	90,378	0.61
1968	179,610	96,989	0.54
1971	91,058	23,675	0.26

Sources: Department of Veterinary Services and Animal Industry, annual reports, various years.
Notes: (a) Data for 1964 reported for Central Ankole district only; (b) data for 1964, 1966 reported in square miles, converted at rate of 1 sq. mile = 640 acres; (c) data for 1971 reported in metric units, converted at 1 ha = 2.47105 acres, and 1 liter = 1.73 pints (British Imperial); and (d) 3-percent dieldrin emulsion was reported to be formulated by diluting a commercial formulation containing 18 percent dieldrin.

The Government of Uganda is currently attempting to implement an integrated approach to tsetse control, involving a mixture of tsetse traps, dipping cattle, and occasional ground and/or aerial spraying. The plan emphasizes community involvement, particularly in manufacturing and maintaining tsetse traps. As part of the plan, the government pays up to 700 Ugandan shillings per trap manufactured, with the government providing the blue and black cloth used. Extension personnel from the Ministry of Agriculture, Animal Industries, and Fisheries then impregnate the traps with deltamethrin. In the future, communities may be trained to do this task. Different traps are used in different areas depending on the species of fly involved. For example, along the Ugandan and Tanzanian border, the Nguruman trap, which the International Centre for Insect Physiology and Ecology developed, is used to control *Glossina morsitans centralis*.

The Government of Uganda will probably continue to give the control and elimination of tsetse flies a high priority. The clearing of tsetse flies from large areas of land is considered an economic benefit, allowing settlers to start agricultural production in areas previously avoided. Given the growing population in Uganda, there will continue to be pressure to control tsetse-fly infestations so that land can be either settled by farmers or to prevent reinfestation of already inhabited areas (Ogwal 1993).

2.3.2 Cattle dipping

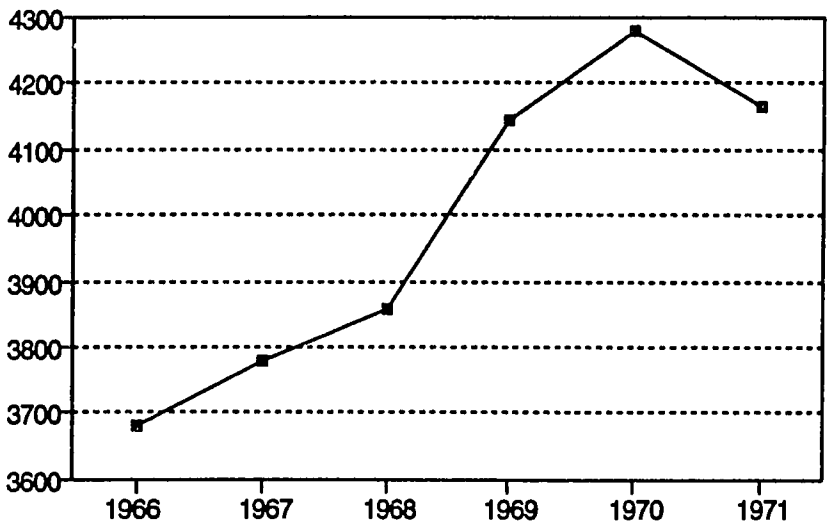
In the past large numbers of cattle in Uganda were dipped to control tick infestations and prevent tick-borne diseases, particularly East Coast Fever (causative agent: *Theileria parva*). Experiments with dipping were conducted before and after World War II. The first large-scale compulsory dipping program was started in 1964 with financing from USAID (Nyeko and

Obwoya 1993). By 1967, most of Uganda was declared a compulsory tick control area, and the overall dipping and spraying percentage had reached 28 percent of the total herd. In some districts, up to 74 percent of cattle were dipped (Department of Veterinary Services and Animal Industry 1968). USAID's Livestock Project (total value: US$4.7 million) funded the construction of 31 plunge dips in 1971, and provided a veterinarian to work on the tick control project (Department of Veterinary Services and Animal Industry 1972). Unfortunately, the dipping program collapsed during the political instability of the mid-1970s through the mid-1980s. It is only now being revived.

As part of the trypanosomiasis and tsetse control program, some cattle are being dipped in areas where human trypanosomiasis occurs. This is because cattle, pigs, and dogs carry *Trypanosoma brucei rhodesiansis*. This dipping is done free of charge to the farmers. Where the problem is primarily animal trypanosomiasis, the government has started to ask farmers to pay 50 percent of the cost of dipping. Over time, it is planned that farmers will be charged 100 percent of the costs of dipping, but few government dip tanks are currently in operation. The plan is to first "sensitize" the communities to the idea of paying/cost sharing dipping expenses (L. Semakula, personal communication, 1994).

Paying for dipping will be expensive for farmers. The government recommends dipping cattle weekly if using synthetic pyrethroids, or up to twice weekly if using organophosphates. The latter recommendation can be reduced if there is less of a tick problem. Some observers estimate that 70 percent of the total cattle herd, which numbers some five million head, is under some tsetse challenge, with 40 percent of that 70 percent under high fly challenge, particularly in midwestern Uganda (L. Semakula, personal communication, 1994). The government is keen to restart dipping programs on a large scale and has approached organizations such as the Danish International Development Agency (DANIDA) to investigate the possibility of external funding (Kagonyera 1993; A. C. Qvortrup, personal communication, 1994).

Figure 3. Uganda's cattle population over time
(Total cattle in thousands)



Source: Department of Veterinary Services and Animal Industry 1972.

2.3.3 The size of Uganda's cattle herd

The total number of cattle will obviously be an important factor determining the demand for pesticides used in dipping operations for either tick or tsetse control. Despite a rapid growth in human population, cattle populations in the late 1980s are similar to those in the late 1960s (Figure 3).

Table 6 provides a closer look at one of the reasons for the zero-to-negative growth in the cattle population. The political instability of the early 1980s resulted in widespread rustling in some districts to the point that few head of cattle were left.

This negligible growth means that, at a maximum, the demand for pesticides to control disease vectors on cattle will equal the amount used in the late 1960s and early 1970s. Nonetheless, increased awareness of the negative environmental impact, the lack of donor agencies willing to fund pesticide use on a large scale, and the total costs, make it unlikely that pesticide use in the cattle industry will reach the levels used in the late 1960s.

Table 6. Comparison of cattle populations in selected northern districts before and after widespread cattle rustling

District	Cattle population in 1983	Present cattle population	Present population as % of 1983
Kumi	134,883	6,500	4.8
Soroti	317,563	12,000	3.8
Apac	183,725	78,000	42.5
Lira	244,442	12,000	4.9
Gulu	101,786	2,000	2.0
Kitgum	155,106	8,000	5.2

Source: Agricultural Secretariat 1993a.

2.3.4 Mosquito and other pest control

Mosquitoes and other pests cause serious health problems in Uganda (Oryem-Lalobo 1993). Despite the recognition of the problem, Uganda has never had a major malaria control activity integrating spraying operations against mosquito, nor does the government intend to mount such a scheme in the future, because it is expensive and complex, there are several undesirable side effects, and the outcomes are difficult to predict (Oryem-Lalobo 1993).

Thus, outside of tsetse control, there are no meaningful and sustained vector-control programs for public health. The most noticeable mosquito control program in early 1994 appears to be a pilot program investigating the possibility of using pesticide-impregnated bed nets to control mosquitoes (J. Nyeko, personal communication, 1994).

2.4 The economics of using pesticides

Uganda's agricultural economy was once highly regulated. The government set official producer prices, taxed export crops, and imported and distributed inputs at subsidized prices (Agricultural Secretariat 1993b). The Agricultural Policy Committee (of the Agricultural Secretariat) formerly conducted a yearly review of costs and returns to crop production and then recommended to the government a range of prices to offer to farmers (e.g., Agricultural Policy Committee 1988). It is only recently that the role of such reports has been shifted from price setting to that of keeping government informed of price levels (e.g., Agricultural Policy Committee 1992). For inputs, one form of subsidization was the distribution of pesticides using government-owned and -operated vehicles, with no charge to the farmers (B. A. Tibaijuka, personal communication, 1994).

2.4.1 Returns to purchased inputs: Subsidies

A detailed examination of price control and input subsidization is beyond the scope of this paper. With output prices controlled and input prices heavily subsidized, the actual or true economic costs and returns of using pesticides were hidden to farmers. The government subsidized agricultural inputs in Uganda in a variety of ways. There does not appear to have been a coordinated effort to monitor or analyze these subsidies. Consequently their impact, individually or in combination, has not been evaluated. Some of the subsidies applied included: (a) prices--inputs that the government purchased were sold at or below cost of purchase; (b) credit--loans for the purchase of agricultural inputs were given at below market rates; and (c) distribution--government vehicles were used to distribute inputs without cost to farmers.

These subsidies are examined in detail below. The removal of these subsidies makes it difficult to use past trends concerning the economics of using pesticides to predict future economic returns. Nonetheless, a look at the historical patterns suggests the key economic indications that should be monitored in the to help gauge future demand for pesticides.

2.4.2 Returns to purchased inputs: Increase in yields

There appears to be no readily identifiable database in Uganda detailing the returns to using purchased agrichemicals:

> In Uganda, data on the relative effect of each of these [agrichemical] inputs on crop production is not available as little research has been done to evaluate the effects of the use of these inputs on crop production. Recommendations on the use and benefits derived from the use of these inputs have thus tended to be "blanket" recommendations based on research from elsewhere especially from the western world (Khaukha 1992, 12).

Even for fertilizer application, there do not appear to be any reliable or suitable production response curves (M.A. Bekunda, personal communication, 1994). As indicated in

the quotation just cited, pesticide rates that extension agents recommend appear to be based mainly on manufacturers' recommended dosages. Alternative methods of deciding when to apply pesticides do not seem to be in general use. For example, no one interviewed could readily recall an instance of using economic damage thresholds as the rationale for when and how to apply pesticides.

The lack of information regarding the relationship(s) between pesticide use and crop yields makes it difficult to determine whether farmers obtain a financial benefit from using pesticides. In the absence of such data, it can be hypothesized that one of the main factors driving farmers' decisions to use pesticides is probably the need, real or imagined, to have some form of insurance against the possible loss of their crops.

2.4.3 Returns to purchased inputs: Prices

Even if pesticides, particularly insecticides and fungicides, are used more as an insurance, the cost of such insurance will play an important role in whether they are actually purchased. Tables 7a and 7b show how the profitability of a variety of crops and the cost of pesticides have changed. Using 1988 as a base, the average prices of pesticides have risen at least as fast as average returns, the latter measured either as the average of gross margins or as the average of returns-to-labor (Figure 4). From 1988-89 to 1992-93, there was little substantive change in physical productivity (Table 2; Appendix B). Therefore, the changes in gross margins and prices must be due mainly to government manipulations (see above) or free-market effects, such as inflation and depression in world coffee prices. The latter would have a greater effect in the later years as economic reforms began to reduce the extent of government control on input and output markets.

Despite government control, the price of a specific insecticide (Ambush-permethrin) sometimes rose faster than the price of an output (cotton) (Figure 5). The ratio of the price of the fungicide Dithane-M45 to the price of beans has also fluctuated widely, with the 1993 ratio being similar to the 1988 figure. The latter is due to the fact that in 1993, the prices of many of the pesticides listed in Table 7b fell as compared their levels in 1992. The probable reason is that pesticides imported under a World Bank agriculture program and distributed through the Uganda Commercial Bank did not sell well when offered to the farmers at market prices. Eventually, a decision was made to reduce the price of the pesticides (A. Kiss, personal communication, 1994). Future large-scale shipments of government and donor sponsored pesticides distributed by organizations such as the Uganda Commercial Bank are unlikely (B. Tibaijuka, personal communication, 1994). It is important to note that not all pesticides experienced such a drop in use. There was a wide range of percentage changes in prices of insecticides and herbicides from October 1992 to May 1993 (Table 8), and some pesticide prices obviously increased sharply. As direct government influence on input markets continues to shrink, market forces, such as exchange rate fluctuations and inflation, can result in price changes at least as great as those seen in Table 8.

Table 7a. The profitability of Ugandan crops: gross margins (GM) and returns-to-labor over time

Crop	1988/89		1989/90		1990/91		1991/92		1992/93	
	GM[a]	shs/Md	GM	shs/Md	GM	shs/Md	GM	shs/Md	GM	shs/Md
Coffee (robusta)			-23.8	-86	12.3	46	79.8	347	42.2	180
Coffee (arabica)			-26.2	-106	33.7	147	164.2	597	127.1	529
Tea (green)			97.1	488	88.6	479	101.1	491	178.4	671
Cotton			27.0	154	51.4	294	88.3	570	134.2	799
Maize			57.2	440	3.0	25	66.9	572	58.9	607
F. Millet	19.8	99	80.3	401	83.9	471	112.0	629	185.0	1039
Sorghum	21.7	127	86.8	510	106.	544	107.4	639	75.5	472
Sesame			55.2	394	53.7	420	83.2	650	111.9	874
Beans			33.2	237	45.4	226	66.6	533	85.3	682
Groundnuts			81.2	427	78.4	237	153.2	786	226.1	1160
Soybeans			62.3	499	86.2	813	100.4	830	134.2	1157
Cassava	29.7	141	83.0	377	90.6	453	109.3	546	152.4	761
S. Potatoes	29.0	161	71.0	394	81.0	540	56.6	515	145.1	1319
Averages[b]	25	132	53	318	63	361	99	593	127	788

Table 7b. Market prices of pesticides in Uganda over time

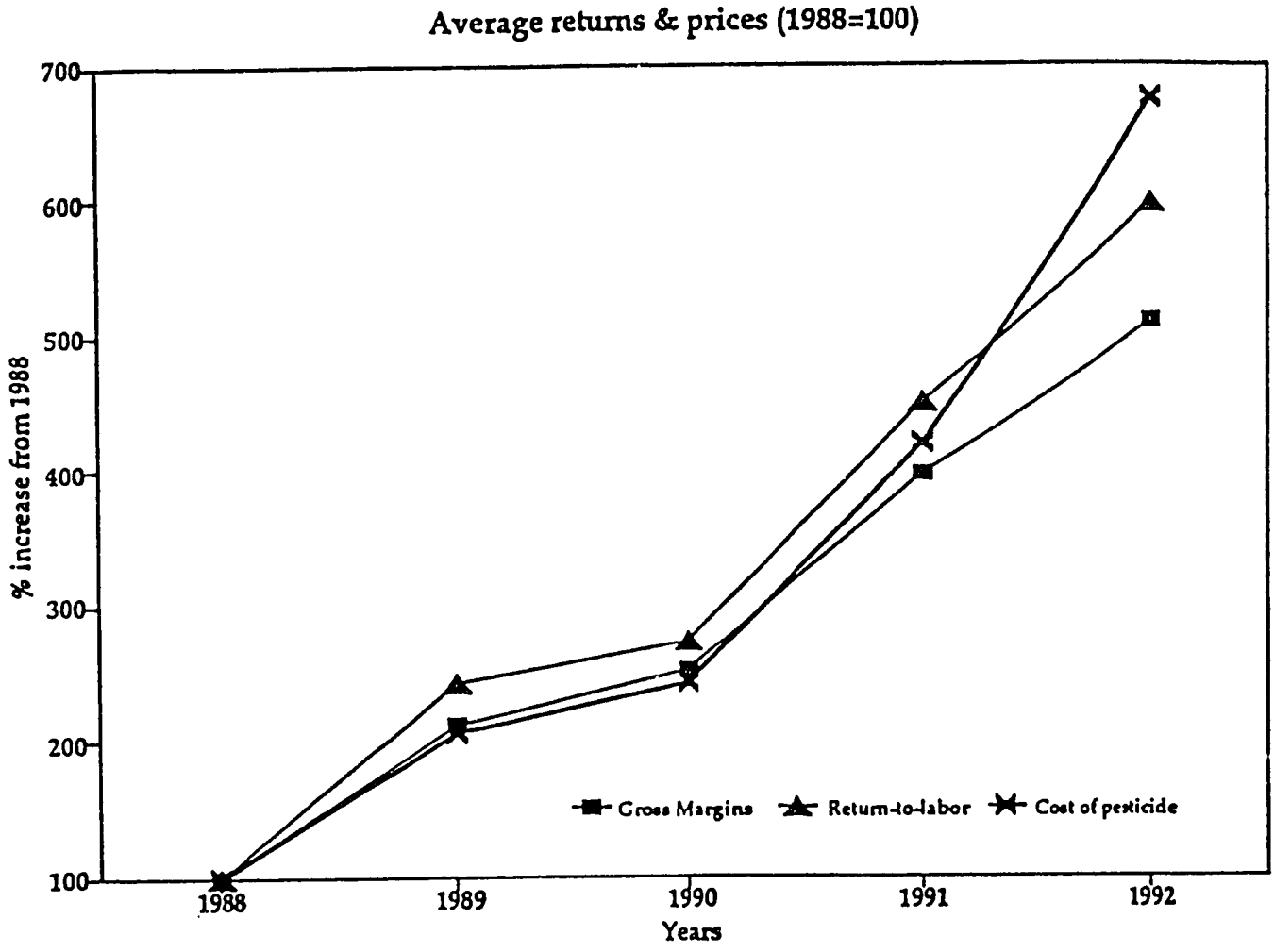
Pesticides	Unit	May shs/unit	Nov shs/unit	July shs/unit	Nov shs/unit	Oct shs/unit	May shs/unit
Ambush	lt	930	1644	2000	7500	9788	8000
Ripcord	lt		1600	1600	6429	13967	10000
Furadan	kg	520	607	700	1429	2271	2500
Dithane-M45	kg	2000	3203	3000	7944	9503	6000
Malathion	kg	150	1368	1200	2158	4040	
Round-up	lt	2500	5142	7108	8286	11056	10000
Gramoxone	lt	800	3077	3838	4833	8857	10000
Averages[b]		1150	2377	2778	5511	8497	7750

Sources: Agricultural Policy Committee, Agricultural Secretariat, 1988-92; Agricultural Secretariat, 1993.

a. GM = Gross margin in thousands of Ugandan shillings per ha, and returns-to-labor in Ugandan shs per man-day of labor.

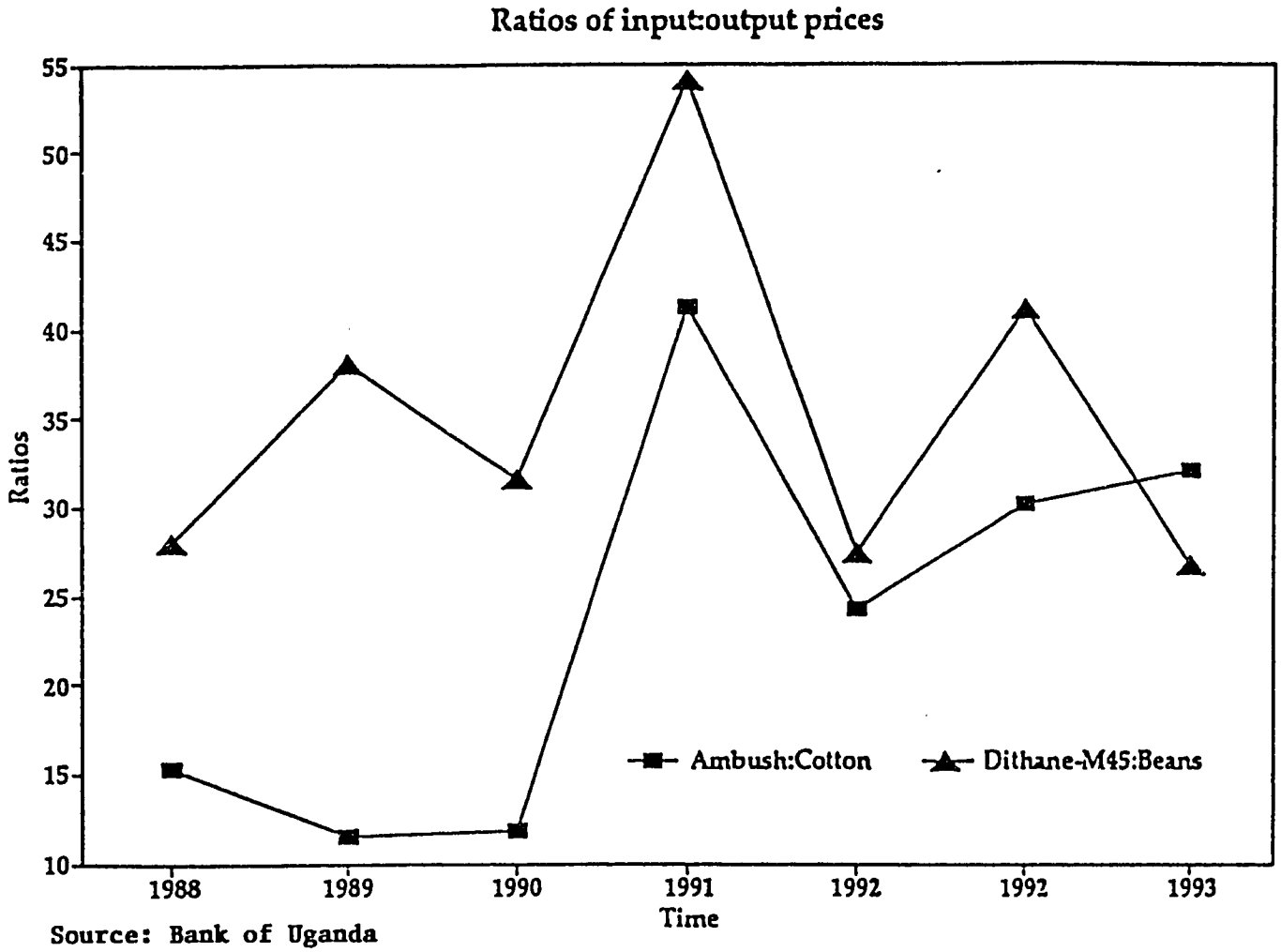
b. Averages are simple averages, rounded to the nearest whole number.

Figure 4. Average returns and prices (1988 = 100)



Source: Bank of Uganda

Figure 5. Ratios of input to output prices



Source: Bank of Uganda

Table 8. Changes in input prices, 1990/91-1992/93

Item	May 91-Sept 91 % increases	Sept 91-March 92 % increases	March 92-Oct 92 % increases	Oct 92-May 93 % increases
Seeds	20 - 66	25 - 50	9 - 60	(17) - 33
Insecticides	25 - 200	10 - 25	17 - 50	(33) - 25
Fertilizers	0 - 50	66 - 100	(25) - 0	-
Herbicides	7 - 100	43 - 150	(25) - 0	(17) - 25
Tools & Equipment	0 - 110	0 - 33	(25) - 67	(14) - 25
Tractor Hire	20 - 60	0 - 30	20 - 50	11 - 25
Oxen Hire	14 - 33	0 - 50	-	16 - 20
Transport	25 - 40	20 - 50	-	(40) - 15

Source: Agricultural Secretariat 1993a.

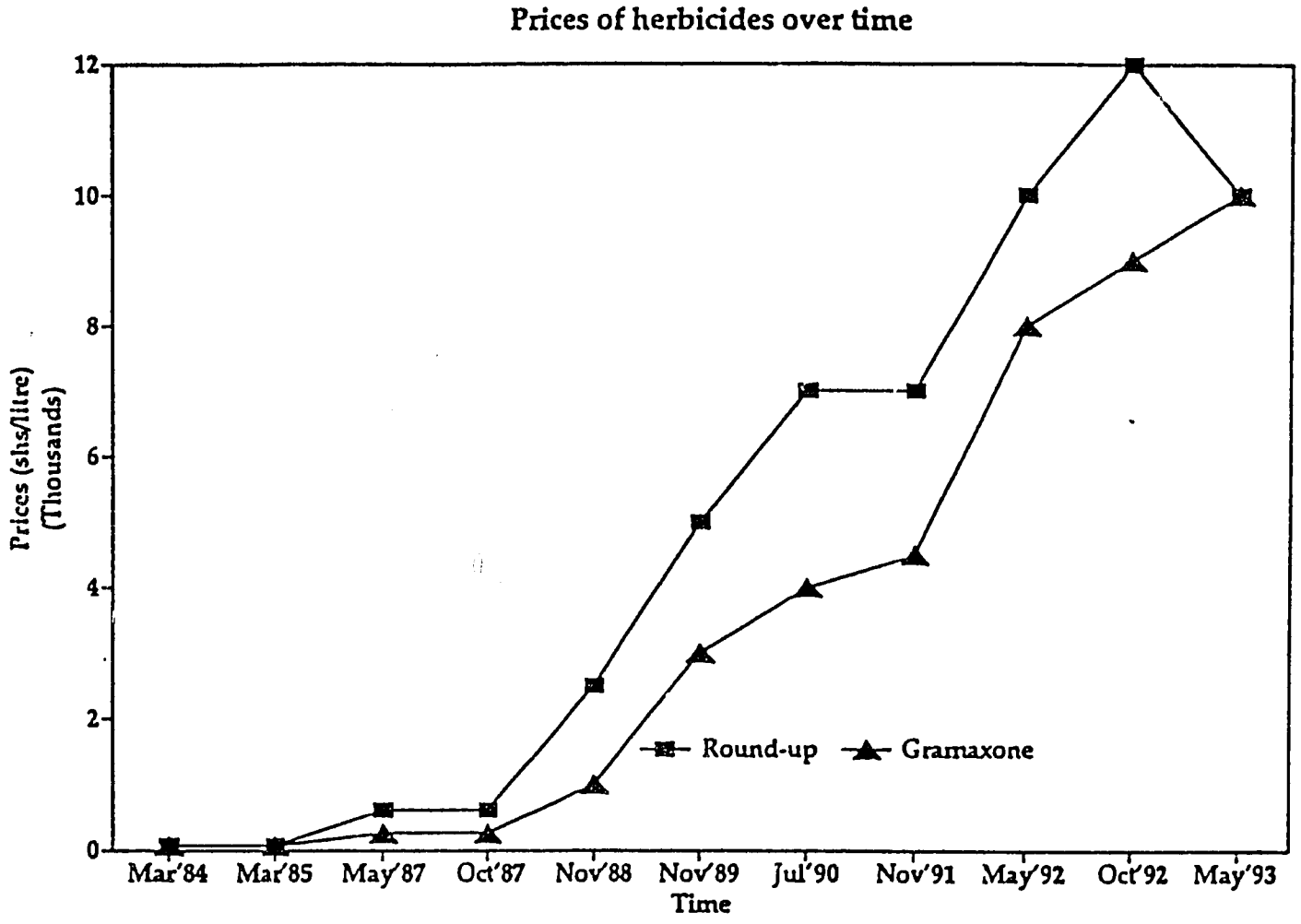
Figure 6 illustrates another price phenomenon: for several years the herbicide Gramoxone (paraquat) has had a distinct price advantage when compared with an alternative product, Round-up (glyphosate). Only recently has the price of Round-up matched that of Gramoxone, and it is unclear if this price equality will remain. The data displayed in Figure 6 is disturbing because they show that an older, more toxic pesticide (Gramoxone) is financially more attractive than a more environmentally sound, less toxic pesticide (Round-up).

2.4.4 Returns to purchased inputs: Wage-to-herbicide

Herbicides are the one category of pesticides that are unlikely to be purchased as insurance against catastrophic crop loss. Instead, their use should indicate that farmers recognize an inverse relation between weed growth and crop yield. Despite this expectation, the price of even the relatively inexpensive herbicide, Gramoxone has risen faster than wage rates (Table 9). Thus, over time, it has become comparatively more cost-effective to hire labor to control weeds than to purchase and spray herbicides.

Of course, the average wage rates used to calculate the values in Table 9 would hide any regional differences in wage rates that might indicate a shortage of labor and therefore establish a need to resort to chemical weed control. Furthermore, examining the price advantage of labor over herbicide could be further refined by analyzing seasonal availability of labor. If seasonal labor shortages occur at critical times in crop production (e.g., weeding, harvesting), herbicide applications might represent the only realistic method of ensuring that a given plot is kept well weeded.

Figure 6. Prices of herbicides over time



Source: Bank of Uganda

Table 9. Price ratios of various wage rates to a given herbicide[a]

Year	Casual labor:[b] Herbicide	Permanent labor:[c] Herbicide	Contract labor:[d] Herbicide
1987	0.40	3.00	14.0
1988	0.17	2.00	5.2
1989	0.10	0.75	4.2
1990	0.10	1.13	4.4
1991	0.11	1.56	6.7
1992	0.07	1.11	5.0

Sources: Agricultural Secretariat 1993a; Agricultural Policy Committee 1988-1992.

a. Herbicide used to compare prices over time is Gramoxone (paraquat).

b. Casual labor costed in shillings/day.

c. Permanent labor costed in shillings/month.

d. Contract labor costed in shillings/ha.

2.4.5 Returns to purchased inputs: Cash-flow considerations

Another important price factor determining farmers' demand for pesticide is whether they have sufficient funds to purchase the input at the time when they need to use pesticides. For example, the three most important factors influencing cotton farmers' decisions to purchase pesticide are (a) previous season's crop output, (b) availability of credit, and (c) size of the cotton field to be sprayed (Khaukha 1992; see Box 2). The first two factors affect the amount of cash that a farmer has available. The last factor determines how much money the farmer needs.

The size of the field to be sprayed influences patterns of pesticide use in Uganda. Many individuals interviewed stated that most farmers used little, if any, pesticide and that this was particularly true for foodcrops. It is also clear, however, that pesticides are imported and distributed to many farmers. Also, the Agricultural Secretariat's crop budgets, which use data gathered from surveys, contain evidence of pesticide usage in many crops. For example, the crop budget for groundnuts includes two liters of herbicide, while the maize budget includes two liters of insecticide (Agricultural Secretariat 1993b). Part of the reason that farmers might appear not to use a lot of pesticides is that the average plot size is small. The 1990-1991 agricultural census reported that the mean plot size for maize for the first season was 0.25 ha while the second season mean was only 0.16 ha (Ministry of Agriculture, Animal Industry and Fisheries 1992). Thus, at a rate of two liters of pesticide per hectare, the average farmer would only require 0.5 liters.

Box 2. Economic and other factors affecting the demand for pesticides among cotton farmers

Khaukha (1992) found the following variables to be important in explaining the variation in demand for pesticides among cotton farmers in Iganga District:

(a) previous season's crop output

(b) distance to site of input purchase

(c) availability of credit to farmers

(d) nature of distribution system, and

(e) size of cotton field to be sprayed.

In contrast, the following variables were not significant in explaining demand for pesticides:

(f) level of farmer's education

(g) a farmer's total crop acreage owned

(h) experience in cotton farming

(i) experience in pesticide use

(j) nature of available extension service

(k) farmers' income level, and

(i) price of the input.

It may seem surprising that price of the input was not a significant factor, but Khaukha's study was based on cross-sectional data. Thus, the relationship over time between price of input and price of output was not studied. Moreover, variables a, c, and e have a direct impact on the amount of cash available and amount of cash needed to purchase pesticides.

Farmers' perceptions of the problems that pests cause can also affect the demand for pesticides. Studies elsewhere have demonstrated that farmers' subjective perceptions of pest damage affect demand for pesticides significantly (Adesina, Johnson, and Heinrichs 1994). The relative lack of data concerning the economics of pesticide use and the damage that pests cause suggests the possibility that farmers' perceptions concerning the need to use pesticides are erroneous. Thus, there is an urgent need for research into and extension of economic damage thresholds for many crops and pests.

The data in Table 10 reveal the relative importance of pesticides in the cash flow of some crops. Pesticides are often the only input purchased. In several crops, the amount of money spent on pesticides approaches the amount spent on hired labor, which is usually the single largest category of cash expenditure. Pesticide purchases represent a noticeable portion of the total gross receipts. The latter is a measure of the working capital that will be available for purchase of inputs in the next cropping season. Thus, the data displayed in Table 10 suggest an explanation for the list of factors determining the purchase of pesticides presented in Box 2.

Table 10. Pesticides as a percentage of purchased inputs, hired labor, and gross receipts (1992)

	Purchased inputs (in thousands of shillings per ha)			Total purchased inputs[a] (pesticides as %)	Hired labor (pesticides as %)	Gross receipts (pesticides as %)
Crop	Seeds	Pesticides[b]	Fertilizers			
Arabica coffee	-	48	-	48 (100%)	65 (74%)	358 (13%)
Cotton	-	24	-	24 (100%)	30 (80%)	163 (15%)
Maize	25	24	-	49 (50%)	46 (52%)	250 (10%)
Groundnuts	60	24	-	84 (29%)	54 (44%)	500 (5%)
Sesame	3.6	-	-	3.6 (0%)	32 (0%)	160 (0%)

Source: Agricultural Secretariat 1993b.

a. Complete crop budgets also include depreciation of equipment used. This item(s) has been excluded in the total presented here.

b. Pesticides include insecticides and herbicides.

2.4.6 Returns to pesticide use: Capital and credit constraints

As noted above (section 2.1), government officials hope to increase maize production through the increased use of agrichemical inputs (see Appendix C). While the use of such inputs is projected to increase net income by 87 percent, purchased physical inputs will also increase 310 percent, and total costs of production will increase by 86 percent (Appendix C). Having noted this projection, the authors of the source report (Ministry of Agriculture 1990) did not

address how farmers would obtain working capital to pay for such increases in operating costs.

One report (Ministry of Trade and Industry 1993) listed a number of serious problems facing Uganda's financial sector: (a) a low rate of savings (2 to 4 percent), (b) lack of financial resources for extending credit, (c) the central bank's (i.e., the Bank of Uganda) lack of authority and capacity to supervise and monitor credit-granting institutions, (d) lack of control of credit expansion, which has had an inflationary effect in the past, (e) inability to assess the credit worthiness of credit applicants, (f) problems in arranging suitable repayment mechanisms, and (g) lack of confidence in the financial sector's ability to provide a reliable mechanism to record and expedite transactions and provide a secure investment(s).

The single largest bank in Uganda is the Uganda Commercial Bank (UCB) (see section 2.4). The Government of Uganda owns the bank, but privatization is being considered as part of the economic reforms. UCB accounted for almost 56 percent of all loans made and 48 percent of all monies on deposit in 1989. Unfortunately, UCB has had severe problems in managing its assets. At the end of September 1991, cumulative losses totaled 11.1 billion Ugandan shillings. Further, UCB is seriously undercapitalized with paid-in capital equal to only 0.2 percent of its total assets (i.e., UCB assets are extremely nonliquid) (Ministry of Trade and Industry 1993). Even the smaller Cooperative Bank, which was established to help cooperative societies, has experienced sustained losses and is also undercapitalized at a rate similar to that of UCB (Ministry of Trade and Industry 1993). The problems facing Uganda's financial institutions make it unlikely that Ugandan farmers can expect a large increase in funds available for credit. Lack of credit will remain a serious constraint to any attempt to increase the use of purchased inputs.

2.4.7 Returns to pesticide use: Nontraditional export crops

The newness of many of the nontraditional crops to Ugandan farmers means that data on costs of, and returns to, production are scarce. Only in 1993 did the Bank of Uganda's Agricultural Secretariat begin to include cost-of-production budgets for crops such as pyrethrum, vanilla, cardamom, citronella, and cocoon (silk). When compared with some of the prices paid for these crops, there appears to be the potential for Ugandan farmers who grow these crops to make a handsome profit.

For example, the estimated total production cost for vanilla in 1993 was 1,058 Ugandan shillings per kilogram (calculated on a per hectare basis). This estimated cost of production was comprehensive, including items such as depreciation on equipment, transportation, and the cost of family labor. These costs are well below the price received. One source (Bagala, personal communication, 1994) stated that a private firm, Sekalala Enterprises, was paying up to 7,000 shillings per kilogram for vanilla. Another source (Sergeant and Caiger 1993) assumed a farmgate price of US$4/kg, or about 4,750 shillings per kilogram. Since the export value in 1991 was about US$45/kg (Stepanek 1993), there would appear to be sufficient margins at all stages of production and marketing to provide incentive for farmers, marketing agents, and export agents.

USAID/Uganda's *Assessment of Program Impact* (1993b) provides data indicating that farmers producing exotic export crops such as silk and vanilla do indeed benefit financially. It must be remembered, however, that many farmers grow small plots of these crops. Although about 3,000 individual farmers were involved in growing vanilla in 1993, 2,903 earned an average of only US$17 from these efforts (USAID/Uganda 1993b). Using the costs of production and prices received given above, it can be calculated that most farmers produce only 2 kgs of vanilla each year. Since the potential yield is up to 400 kg/ha (Agricultural Secretariat 1993b), it is obvious that most growers cultivate only a small plot. USAID/Uganda (1993b) supports this conclusion by observing that "there is no evidence that vanilla production has displaced other crops." Similar comments were made about silk production. Farmers appear to be eager to take advantage of the extra income that these exotic crops offer but appear unwilling to make rapid, wholesale changes in their cropping patterns.

Even with positive returns from small plots, many difficulties face Ugandan farmers wishing to grow such nontraditional export crops as spices, cut flowers, and essential oils. The difficulties include the lack of infrastructure and the high cost of freight to overseas markets. Another important constraint is the lack of expertise and experience in growing many of these crops, especially when quality is a major concern. Thus, although some farmers grow these exotic crops, many grow only small amounts, and a major expansion of the number of hectares currently under cultivation for any one of these crops is fraught with difficulties.

3. FACTORS AFFECTING THE SUPPLY OF PESTICIDES

3.1 Procurement of pesticides

No pesticide manufacturing or even reformulation capacity currently exists in Uganda. Consequently, all supply-side aspects of pesticides begin with the importation of fully formulated products. The following sections focus on the quantity of pesticides imported, who imported them, and who provided the funding.

3.1.1 Pesticide imports

The quantity and value of imported agricultural pesticides increased from 1990 to 1991 (Table 11). In contrast, import declined substantially in 1992 and 1993. Imports of acaricides represent the only exception, but imports of acaricides in 1992 were approximately half the amount imported in 1990. The data for 1993 (Table 11) cover imports only through September (end of third quarter), but the authors of the source report note that "it is unlikely that the figures will change even if they are annualized, mainly because big importers such as South West Region Agricultural Rehabilitation Project (SWRARP) and Agricultural Development Project (ADP) have stopped their role of inputs procurement." It should be noted that there are some anomalies and discrepancies in the data used, such as six liters of pesticide valued at nearly $10,000. Moreover, there are many importations for which only value or quantity are recorded but not both. Nonetheless, these data can be used to gauge trends.

Table 11. Importation of pesticides, herbicides, and acaricides: Quantity and values

Category	1990		1991		1992		1993[a]	
	Qty[b]	Value[c]	Qty	Value	Qty	Value	Qty	Value
Pesticides	363	2,603	509	5,117	N/D	2,577	18	247
Herbicides	41	450	160	2,391	N/D	472	15	290
Acaricides	97	4,922	24	445	49	1,270	2	207

Source: Agricultural Secretariat, Table 3.4 and Annexure 3.4, 1993b.

a. Data for 1993 are incomplete. Quantity data are for first quarter only, and value data are for the first three quarters.

b. Quantities are given in thousands of liters. Some pesticides, herbicides, and acaricides are imported in powder form (i.e., quantity of import is in kilograms). It is not clear how the source converted kilograms to liters.

c. Values are given in thousands of U.S. dollars, present value (i.e., uncorrected for inflation).

In general, there has been a decrease of 76 percent in the value of imported inputs since 1990 (Table 12) for several reasons (Agricultural Secretariat 1993b):

(1) The Bank of Uganda's Agricultural Structural Adjustment Credit program initially required private importers to produce equivalent counterpart funds. Many private importers do not have large cash reserves to meet such a requirement.

(2) The Government of Uganda was once the single most important importer of agricultural inputs, particularly pesticides. Under the agricultural adjustment scheme, the government is withdrawing from such a role. Private importers and distributors are reacting cautiously, but optimistically, to playing a more significant role.

(3) Even with privatization, the economics of using pesticides do not appear to have changed markedly. Thus, farmers have not shown a sudden willingness to purchase more pesticides.

(4) Some of the large increases in pesticide imports reported for 1991 were due to an airlift of cotton chemicals, which the Ministry of Agriculture, Animal Industry, and Fisheries imported. That shipment represented the last major instance of directly sponsored government imports.

Table 12. Value of imports of agricultural inputs (in thousands of U.S. dollars)

Category	1990		1991		1992		1993[a]	
	Value[b]	%[c]	Value	%	Value	%	Value	%
Seeds	323	1	108	0.4	148	0.8	559	6
Fertilizers	2,100	5	1,166	5	2,745	15	683	7
Chemicals	3,053	7	7,507	29	3,049	17	537	6
Vet/Livestock[d]	7,311	18	2,175	8	4,463	25	1,590	16
Ag. Tools & Equip.	3,496	9	2,394	9	5,009	28	3,817	39
Process & Market	24,739	60	12,279	48	2,371	13	2,561	26
Totals	41,023	100	25,629	100	17,785	100	9,747	100

Source: Agricultural Secretariat 1993b, Table 3.1.

a. Data for 1993 are for January-September (three quarters).
b. Values reported in thousands of U.S. dollars.
c. Percentage of total imports, by value. Due to rounding, the sum of these columns may not add to 100 percent.
d. Category of veterinary, livestock inputs includes acaricides. Table 11 provides details of acaricide imports.

3.1.2 Role of various agencies in importing agricultural inputs

Government agencies have been the dominant importers of agricultural inputs (Table 13). These agencies include government projects such as SWRARP and quasi-government parastatals, such as Uganda Commercial Bank. Under current market reforms, however, government agencies have ended import operations. The private sector has become the single most important importer of agricultural inputs. The data in Tables 12 and 13 indicate that the private sector has only cautiously accepted this role--the value of chemicals imported remains low. This limited approach to the new, liberalized market is understandable. Private importers and distributors can no longer rely on government agencies to distribute their products. Instead the private vendors have to establish their own marketing and distribution networks, which require the investment of working capital. They are working in an environment in which market information is almost nonexistent; private companies have almost no idea how farmers will react to unsubsidized prices. Will the level of sales decrease, increase, or remain static? Thus, in the short term it is not unreasonable to expect the levels of imports to remain relatively low.

Table 13. Role of various agencies in importing agricultural inputs (in thousands of U.S. dollars)

Agency	1990		1991		1992		1993[a]	
	Value[b]	%[c]	Value	%	Value	%	Value	%
Government	7,920	19	2,559	10	2,010	11	75	0.7
Govt. projects	7,940	20	694	3	4,380	25	303	3
Parastatals	11,200	27	13,649	53	3,184	18	2,346	24
Subtotals	27,060	66	16,902	63	9,574	54	2,724	27.7
Cooperatives	330	0.8	148	0.6	-	0	99	1
Private	13,373	32	8,399	33	8,197	46	6,920	71
NGOs	260	0.6	181	0.7	16	0.1	4	0.04
Totals	41,023	100	25,630	100	17,787	100	9,747	100

Source: Agricultural Secretariat 1993b, Table 3.9.

a. Data for 1993 are for January-September (three quarters).

b. Values reported in thousands of U.S. dollars.

c. Percentage of total imports, by value. Due to rounding, the sum of these columns may not add to 100 percent.

3.1.3 Sources of funding

Donor funds have been the most important source of financing for imports of agricultural inputs (Table 14). In 1993, however, there was a large increase in the relative importance of the foreign exchange bureau (FOREX) and other category-financed imports because the government drastically curtailed its role in importing inputs. It is also important to note that, concurrent with the shift in sources of funding, the total volume of imported inputs has also decreased (see Tables 12 and 13). The private sector has found it difficult to finance imports. This situation is unlikely to change until private distributors are convinced that they can profit from large importing operations. Much depends on how farmers will react to a new system of obtaining and purchasing inputs.

3.1.4 Donors

Donor guidelines for pesticide procurement and use are discussed in section 5.2. In recent years pesticides imported into Uganda with donor support were chosen from an Agricultural Sector Adjustment Credit (ASAC) list of approved pesticides (a positive list), which was created with technical support from the World Bank's environmental staff in Nairobi. In practice, compliance with donor guidelines is often inadequate. No system of compliance monitoring exists, other than after-the-fact reports by donors' evaluation missions and field staff (A. Qvortrup, K. Loganathan, personal communication, 1994).

Government agencies originally distributed pesticides purchased with donor funds for through such projects as the ADP and SWRARP, which the IDA and the International Fund for Agricultural Development are cofinancing (Table 14). Recent consignments have been resold to private traders, private cooperatives, and community groups for distribution and marketing (Government of Uganda 1992b).

3.1.5 Nongovernmental organizations

NGOs do not appear to be much involved in purchasing and distributing pesticides. Some, such as CARE, want nothing to do with the process because they believe pesticides to be an inappropriate technology, and they are too expensive for most farmers. Most NGOs encourage the use of alternative pest management measures (see chapter 5). Some NGOs buy relatively small quantities of pesticides in-country and distribute them to project beneficiaries for income-generating projects such as gardens (C. Carlson, D. Shuey, personal communication, 1994).

Table 14. Sources of funding for importing agricultural inputs

Source	1990		1991		1992		1993[a]	
	Value[b]	%[c]	Value	%	Value	%	Value	%
ADP (IFAD/IDA)	7,190	18	109	0.4	1,378	8	-	0
SWRARP (IFAD/IDA)	950	2	79	0.3	2,494	14	1,260	13
EEC/EDF	7,550	18	1,830	7	404	2	-	0
ODA	480	1	1,395	5	6	0.04	82	0.8
Japanese Grant	2,890	7	3,444	13	1,789	10	-	0
World Bank/Bank of Uganda[d]	21,090	51	16,660	65	2,871	16	3,357	34
FOREX Bureau[d]	-	0	-	0	606	3	1,499	15
Other[e]	873	2	2,113	8	8,237	46	3,549	36
Totals	41,023	100	25,630	100	17,786	100	9,747	100

Source: Agricultural Secretariat 1993b, Table 3.9.

a. Data for 1993 are for January-September (three quarters).
b. Values reported in thousands of U.S. dollars.
c. Percentage of total imports, by value. Due to rounding, the sum total of these columns may not add to 100 percent.
d. World Bank/Bank of Uganda = World Bank/Bank of Uganda funding; FOREX = foreign exchange.
e. Other includes foreign exchange bought at auctions and own, private sources of foreign exchange. These amounts totaled US$3.07 million in 1992 and US$2 million in 1993. The category also includes relatively small grants from sources such as the Italian government (US$75,000 in 1993), DANIDA (US$335,190 in 1992), and the African Development Fund (US$467,459 in 1992).

3.2 Distribution and marketing

3.2.1 The UCB: A case study of the role of government agencies in the distribution and marketing of pesticides[3]

The activities of the Uganda Commercial Bank (UCB) in distributing and marketing

[3] Unless otherwise noted, this section is based on a personal communication with B. Tibayuku, 1994.

pesticides, via its Rural Farmers Scheme, provide a good case study of the role of government and quasi-government agencies in distributing pesticides. From inception in the late 1980s to December 1993, the UCB has provided credit to 32,748 farmers to obtain a variety of inputs. As part of the privatization and adjustment program, the scheme is being closed, and the UCB may be privatized.

The loans were loans-in kind, with the UCB distributing actual inputs, as opposed to providing a line of credit for the farmer to use at a supply store. The qualifications were not stringent and included the following criteria:

(a) applicant had to be an experienced, full-time farmer, living and working in a rural area, under the age of 65 years;
(b) women farmers were preferred (approximately 45 percent of the loans were made to women), though they had to have their husbands cosign the loan agreement(s);
(c) no collateral was required, though if it was provided, the borrower received a reduction in the interest rate charged; and
(d) guarantors were required in the absence of collateral.

The interest rates were subsidized, being 80 percent of the official fixed lending rate. If the applicant provided collateral, the rate was 70 percent of the official fixed rate. As part of the adjustment program, rates now float. The Rural Farmers Scheme had up to 120 agricultural officers, placed in 51 branches, whose duties were to make loan appraisals and provide advice regarding the proper use of inputs. The Rural Farmers Scheme arranged for the bulk purchase and distribution of inputs financed by these loans, with the inputs delivered to the UCB's branch offices. During interviews, UCB officials stressed that the inputs were not subsidized. It was admitted, however, that the inputs distributed were cheaper than those sold on the open market. Respondents claimed that prices were lower because the UCB operated more efficiently than the private sector and because the UCB's mark-up only covered actual distribution costs. Moreover, there was no effort to make a profit.

Even relatively cheap inputs did not guarantee financial success for the UCB. Recovery rates were low, recently reaching an average of 50 percent. This rate varied considerably depending on the crop or enterprise financed and the actual growing conditions in any given season. Bottlenecks in the system included the inability to appraise all loan applications in time, difficulties in delivering inputs on time, and problems in collecting loan repayments at the end of the season.

The UCB is currently changing its operations so that it will provide only loans to farmers, and they will purchase inputs from private dealers. Thus, UCB will no longer import, warehouse, and distribute inputs. The UCB has already sold or removed from operation many of its trucks used to distribute inputs.

3.2.2 Private companies

One of the most important reasons the private sector is cautious about importing pesticides is that most importers and distributors have weak or small distribution networks. Before the economic reforms, the government-subsidized distribution of pesticides meant that private companies often lost the incentive to invest resources into developing large distribution systems. In 1990, as an illustration, Twiga Chemical Industries (U), Ltd., found itself trying to sell a liter of Ambush (permethrin) for 8,000 shillings per liter while government extension agents were selling it for 6,000 shillings (Kalsi, personal communication, 1994). Another private distributor, Sekalala Enterprises, found itself trying to sell the herbicide Round-up at 13,000 shillings per liter when the government was selling it at 10,000 shillings per liter.

The government's subsidization of pesticide distribution often meant that when a private company did import pesticides, it had trouble selling all its stock. For example, Twiga Chemical Industries imported Karate (cypermethrin) at 12,000 shillings per liter in 1990. The company is currently trying to sell the same stock at 10,000 shillings per liter. Farmers are accustomed to the lower, subsidized prices, and there is apparently resistance in the marketplace to the higher prices that private companies would like to charge.

Limited working capital prevents private distributors from implementing innovative concepts to improve distribution networks, such as the concept of mobile delivery and distribution centers. Unfortunately, the operating costs of mobile centers would be high, and it is uncertain whether the volume of sales would warrant such an investment. In addition, there are incentives to import bulk quantities, but this too presents problems for distributors and, eventually, for users (see Box 3).

Box 3. The consequences of importing pesticides in bulk: Improper Repackaging

Pesticides are typically imported in bulk or in relatively large packs. This presents a problem in the open market because farmers often have small plots and require only small amounts. Thus, most pesticides require repackaging into smaller amounts to accommodate farmers' commensurate needs. Repackaging presents health and environmental problems because individual distributors do much of the repackaging. They will purchase pesticides in large containers and then repackage into ordinary plastic bags without proper identifying labels, instructions for use, or hazard warnings. This practice was observed during a brief site visit to the main bus terminal in Kampala. Many people who were interviewed and who are knowledgeable about the use of pesticides in Uganda agreed that such unregulated repackaging and distribution is common.

3.3 Summary of factors affecting the supply of pesticides

Government agencies previously dominated the importation of agricultural inputs, usually accounting for over 60 percent of all imports. Not only did government agencies import

pesticides, but they arranged for the distribution, marketing, and sales of the pesticides at subsidized prices. Private distributors found it difficult to operate independently. The result of market liberalization of the agricultural input sector has resulted in the government agencies withdrawing rapidly from their role in supplying inputs.

To date, private distributors have lacked the resources to fill the void left by the government withdrawal. The result has been a drastic decline in the total amount of inputs imported and the amount of pesticides imported. Although local distributors appear eager to expand their operations, the amount of working capital needed to establish or expand their own distribution networks restricts them from doing so. There is reason for the distributors to proceed with some caution. Farmers are accustomed to subsidized prices. How they will react to higher prices is unclear. In an unsubsidized marketplace, some farmers may resist purchasing the newer, more expensive pesticides and revert to older types that are often cheaper. Since some of these older types are more toxic than newer brands, this price resistance could cause a significant negative environmental impact. The transition to a liberalized market is too recent for there to be sufficient data to determine if such an impact might actually occur.

4. CONSEQUENCES OF PESTICIDE USAGE

4.1 Public health effects

Pesticide poisonings are not systematically recorded in Uganda, and few data exist on the public health impacts of pesticide use. Morton, Sergeant, and Smedley (1993) cite a figure of 270,000 cases of acute pesticide poisoning annually (1 percent fatal) but do not provide a source for that figure. The government is still without sufficient funds to provide even rudimentary health services. Uganda's public health system was destroyed in recent decades. Medical staffs are rarely able to recognize poisoning symptoms. Moreover, government, donors, and NGOs are preoccupied with other health concerns such as AIDS, malaria control, immunizations, and family planning (AMREF 1993; D. Shuey, personal communication, 1994).

Ugandan farmers typically wear no protective clothing when using pesticides and are generally ignorant of proper safety practices. Thus the risk of applicator poisoning is high. Organophosphate pesticides constitute the worst acute danger because of their relatively high toxicity coupled with farmers' enthusiasm for using them (D. Ogaram and D. Shuey, personal communication, 1994). Synthetic pyrethroid insecticides appear to be implicated in some serious cases of intoxication even though they are believed to be relatively safe to humans (Forget 1991). The widely used herbicide paraquat has recently been linked with impotence among male workers, in addition to skin damage (Aryamanya-Mugisha 1993).

Accidental ingestion of dressed seeds is another source of poisoning, as is the re-use of inadequately rinsed pesticide containers for water, juice, and other drinks. Fishermen who fish with lindane poison consumers, who also suffer through their purchase of smoked birds killed in rice paddies with lindane-laced termites (Aryamanya-Mugisha 1993).

The long-term health effects of excessive exposure to organophosphate pesticides and the widespread and continuing use of organochlorine pesticides in Uganda can only estimated. A study conducted in the Philippines, where farmers apply pesticides under roughly similar conditions, found that farmers exposed to pesticides had significantly greater impairments of the eyes, skin, respiratory tract, cardiovascular system, kidneys, and nervous system (Rola and Pingali 1993). Recent studies indicate that even single episodes of organophosphate poisoning can cause harmful medium- and long-term effects in humans (Senanayake and Johnson 1982; Senanayake and Karallidde 1987; Rosenstock et al. 1991). The carcinogenicity, reproductive effects, and other chronic effects associated with a high body burden of organochlorine residues are a threat to humans and wildlife (U.S. Environmental Protection Agency 1990). One study completed in Uganda is said to have found high levels of DDT in human milk and blood (E. Tukahirwa, personal communication, 1994).

4.2 Hazardous pesticides

The hazards of pesticides commonly used in Uganda are summarized in Table 15.

Table 15. Summary of pesticide hazards

Use pattern	Pesticides	Main hazards
seed dressings, food storage (lindane) for maize, dry beans, groundnuts	Organochlorine insecticides, mercury	Carcinogenicity. Bioaccumulation. Hazard to wildlife, other chronic effects. Acute toxicity (lindane, mercury).
cotton, other crops	Organochlorines DDT, dieldrin	same as above
maize, dry beans, groundnuts, vegetables, flowers cotton, coffee	Some organophosphate and carbamate pesticides	Acute toxicity. Toxic to nontarget species.
maize, dry beans, cotton, vegetables, flowers	Synthetic pyrethroid insecticides	Toxic to nontarget species.
cattle dipping	Organophosphate insecticides	Acute toxicity
vegetables, flowers, coffee	Some fungicides	Oncogenicity, and/or toxic to nontarget species
maize (estates only)	Triazine herbicides	Can leach to groundwater. Can cause tumor growth or birth defects
general use	Paraquat herbicide	Irreversible lung damage or fatal if swallowed, skin irritation.
tea, maize	Some other herbicides	Various adverse health effects
flowers	Soil sterilants	Acute toxicity and/or chronic health effects, hazardous to nontarget species. Can leach to groundwater (aldicarb).
maize, coffee, sesame	Storage pesticides, fumigants	Acute toxicity and/or hazardous to nontarget organisms

A recent pesticide health and safety survey that the Occupational Health Commission conducted among field-level extension and health-care workers and farmers found grossly inadequate knowledge and skills among health care staff. Of all the district medical officers, nurses, and public health officers questioned (those on the front line of poisoning treatment), only 3 of 54 medical doctors achieved adequate scores. This finding may be due in part to the fact that the subject is adequately covered at the Institute of Public Health but not in Ugandan medical schools or in continuing education courses for public health workers. Although atropine is on the essential drugs list for district health centers, the African Medical and Research Foundation (AMREF) Training Manual for Operational Level Health Workers mentions pesticide poisoning briefly and does not cover first aid or antidotes (D. Ogaram and D. Shuey, personal communication, 1994).

The Commissioner of Occupational Health sees a need for several layers of training, from national and regional clinical toxicology workshops for medical personnel to toxicology refresher training for agricultural officers and community-based, locally adapted instruction for farmers (Ogaram, personal communication, 1994).

Uganda is a member of the East African Pesticide Research Network, which the International Development Research Centre funds, and further information on the health impacts of pesticide use is being collected. Makerere University's Institute of Environment and Natural Resources (MUIENR) and the Occupational Health Commission are collecting data on the kinds and sources of pesticides used at village level in East Africa. This effort involves the investigation of stocks at the Ministry of Agriculture, at private shops at the district level, and the contents of farmers' stores. In collaboration with Tanzania's Tropical Pesticide Research Institute, blood and urine samples taken from farmers when applying pesticides are being tested for organochlorines and organophosphates. graduate student at the University of Nairobi is investigating the possible association of endosulfan used for tsetse control with increased incidence of miscarriages and underweight babies in Ugandan treatment areas (D. Ogaram and E. Tukahirwa, personal communications, 1994).

4.3 Environmental impact

Pesticide pollution is not being monitored in Uganda and the resources and expertise to do so are not currently available. Thus there is little pesticide-related environmental data (A. Karekaho, personal communication, 1994).

Lack of data does not mean the absence of problems. Organochlorines, notorious for their environmental persistence and harmful bioaccumulation, were the agricultural, veterinary, and medical insecticides of choice for many years. Although they have been banned, they are still in general use. Replacement compounds, though less persistent, are still widely applied with little or no attention paid to nontarget effects. Many insecticides, herbicides, and fungicides that are widely used and considered relatively safe for applicators are extremely toxic to nontarget species such as birds, bees, and fish. Moreover, replacement compounds are generally applied at more frequent intervals than organochlorines.

Records from the Iganga District show that DDT and dieldrin were sold to farmers in 1986 and 1987 (Baliddawa 1991), and a survey conducted in seven other districts in 1990 found the organochlorine pesticides BHC, dieldrin, aldrin, and lindane on sale for general use (Baliddawa 1993). In 1992, dieldrin was reported to be one of the pesticides used most in Uganda during the three preceding years, 80 percent of it in agriculture and 20 percent for vector control (Pierrard 1992). Examples of past dependence on organochlorines for pest management on major crops are the application of DDT against seedling and foliage pests of cotton, DDT, BHC, and endrin against cotton bollworm, and dieldrin for banana weevils.

First arsenical compounds, then the organochlorines BHC (Gamatox), lindane, and toxaphene (Coopertox, Pfizertox) were the standard acaricides for cattle treatment in Uganda. They have been prohibited now due to resistance and environmental hazard. The organophosphates and pyrethroids that have replaced them are biodegradable, but an estimated 500,000 liters of dip solution are added annually to the natural drainage system without any treatment (Aryamanya-Mugisha 1993; Kagonyera 1993). No information is available about acaricide residues in milk, meat, and soil in Uganda (D. Dahlhelm, personal communication, 1994).

DDT was the main insecticide used against tsetse flies before 1960. Dieldrin, which was recently banned, replaced DDT, but then endosulfan became the primary weapon against these flies. A country-wide campaign to eradicate *Anopheles* mosquito vectors of malaria was conducted with DDT in 1964; large-scale antimalaria spraying has since been discontinued. Molluscicides are applied to bodies of water to control snails that vector bilharzia and larvicides are applied to control blackflies that spread river blindness.

Little information exists about the impact of pesticides on nontarget species in Uganda. Kizito (1989, cited in Tukahirwa 1991) reported deleterious effects of pesticides on macro-invertebrates on a rice farm where pesticides had been used intensively for many years. A second reported case occurred because people often wash pesticide containers in streams and lakes. In 1990, near the source of the Nile, empty endosulfan drums from the tsetse-control campaign were given to the public, who took them to the river for washing. This caused a large fish kill (Aryamanya-Mugisha 1993).

Endosulfan, which is highly toxic to fish and honeybees, is sprayed intensively (five times, biweekly) over large tracts, including populated areas and bodies of water, for tsetse control. Muller (1989) reported high fish mortality from Zambia and Zimbabwe in 1986-1988 at 14 to 20 g/ha dosage. Latigo, Magala, and Nyeko (1990) noted dead insects (Diptera, Coleoptera, Hemiptera, Hymenoptera) and a few dead birds (perhaps killed by the airplane) after an endosulfan treatment in Uganda. There appeared to be no effect on bees, domestic animals including poultry, reptiles, or mammals.

5. OTHER FACTORS AFFECTING SUPPLY AND DEMAND

5.1 Uganda's ability to regulate and monitor pesticide use

5.1.1 Agricultural extension

Reports and informants are unanimous in declaring that Uganda's extension system has been inadequate (see Box 4). It has functioned best where NGOs provide support (training, expense allowance, bicycles) and direction and in coffee-growing areas where the European Union's (EU) Coffee Rehabilitation Project and now the EU's Farming Systems Support Program have strengthened extension for coffee and associated crops.

Pesticide training for Ugandan extension agents has been conducted at 17 District Farm Institutes. The institutes and extension training specialists from Makerere University develop the courses (Latigo 1992).

Extension agents' knowledge and skills tend to be weak. In any case, insufficient logistical support and low salaries have prompted them to charge for services rendered. This includes awarding themselves a markup on government-subsidized pesticides, which has given the officers a vested interest in pesticide use (D. Shuey, personal communication, 1994).

Such problems have led NGOs such as CARE and the Uganda National Farmers' Association (UNFA) as well as input dealers to propose their own extension initiatives (see section 5.2; Natukunda, Tickodri-Togboa, and Guwatudde 1991; W. Bagala, personal communication, 1994). Improvement can be expected because the World Bank's training and visit-extension system is being introduced through the country. A seven-district pilot program started in 1987, and 16 of 39 districts are now covered.

Box 4. Lack of resources for extension

Iganga District had no libraries in 1987, and extension officers depended on the district agricultural office as their sole source of information. The office possessed six pamphlets, five of which were on general crop production. The sixth, on pests and management methods, was an old booklet that had been reprinted last in 1975. In this area of poor roads and few communications facilities, there was a ratio of 2,124 farmers for each extension officer posted at subcounty level (Baliddawa 1991).

5.1.2 Legislation and enforcement of regulations

The 1989 Control of Agricultural Chemicals Statute (Statute No. 8 of 1989) governs pesticides and other agricultural chemicals in Uganda. Corresponding regulations are in the Agricultural Chemicals (Registration and Control) Regulations 1993. The latter contains provisions pertaining to the registration of chemicals, fumigators and commercial applicators,

and premises; labeling, packaging and transportation; advertising; disposal; and environmental considerations. These provisions are in full accordance with the FAO's *International Code of Conduct on the Distribution and Use of Pesticides* (FAO 1993a). It is worth noting that pesticides used for other than agricultural purposes remain unregulated in Uganda.

The MAAIF's Plant Protection Service (PPS), created in 1990, is responsible for administering and enforcing pesticide regulations. Under a proposed management structure for the MAAIF, plant protection would be a commission under a Directorate of Crop Resources.

Pesticides are registered on the basis of efficacy trials and supporting data from other countries. A 13-member registration board is composed of representatives from several ministries plus a farmer, a chemicals dealer, and a lawyer who the minister appoints (Bazirake and Okoth 1992). Uganda is in the process of re-registering pesticides and no definitive list of registered products is presently available (J. Komayombi, personal communication, 1994). Pesticides already registered under the earlier Pharmacy and Drugs Act No. 39 of 1970 retained their status. A temporary registration for new products can be obtained while they undergo mandatory field evaluation by government researchers (Government of Uganda 1993). A partial use of local language on labels is required (Pierrard 1992).

The National Agricultural Research Organization (NARO) is chiefly responsible for crop protection research but the PPS will be responsible for efficacy testing for pesticide registration. Since 1988-1989, this testing has included some economic analysis (profitability as compared with a control and with the current pesticide check) and monitoring of impact on natural enemies.

In addition to the testing of pesticides' efficacy, the PPS is also to provide: (1) advice, including technical support to the extension service; (2) regulation—registering pesticides, applicators and premises, inspecting premises, and checking residues and pesticide quality; (3) collaboration with projects having crop protection concerns; and (4) emergency spraying services. Many training, funding, and logistical needs must be filled before the PPS will be able to implement its mandate effectively.

Although the new legislation, regulations, and registration procedures represent progress, pesticide use in Uganda is not actually under any form of control at present. As is the case in most African countries, the enforcement of pesticide regulations is unlikely to be realized without significant additional support and technical assistance. The main reasons are inadequate funding, lack of experience in pesticide registration and its control, shortage of trained staff, and lack of facilities for pesticide analysis (Schaefers 1992; Bazirake 1993; FAO 1993a). The 29 members of the newly formed Uganda Pesticide and Chemicals Association are hoping to improve pesticide management in Uganda by raising professional standards (W. Bagala, personal communication, 1994).

Until recently, the National Inputs Coordination Unit (NICU) attempted to ensure that only tested and registered pesticides on the World Bank's Agricultural Sector Adjustment Credit

(ASAC) positive list (Bank of Uganda 1991) were officially imported. Currently, control has broken down. No system exists for screening license applications or shipments although Uganda is a signatory to the international Prior Informed Consent (PIC) agreement whereby exporting firms must notify importing countries of proposed shipments of hazardous pesticides (see section 5.1). Certain chemicals are officially banned and those on the PIC list are to be imported only for restricted uses (J. Komayombi, personal communication, 1994).

Subregional collaboration among neighboring countries facing similar problems would help them implement the International Code of Conduct. Possibilities include the harmonization of regulations and registration data requirements, the sharing of data collected on topics of mutual interest, exchange of information on unwanted but unexpired pesticide stocks, and the optimum use of scarce expertise. Despite obvious advantages to such a system, it has not yet been developed (FAO 1993a, 1993b).

5.1.3 Pesticide laboratories

Only the government chemist's laboratory (Ministry of Internal Affairs) has the capability to analyze pesticide residues. This laboratory is devoted mainly to forensic problems, but it can do other work for a fee. Five other laboratories in Uganda, including Makerere University's chemistry laboratory, have partial equipment and expertise (Erone 1993). No equipment maintenance or pure gases (nitrogen and compressed air) are available in-country, and spare parts are scarce. The PPS sends residue samples to Tanzania's Tropical Pesticide Research Institute.

Uganda has no pesticide quality control laboratory. Some informants suggested that quality control might be an appropriate task for the new National Bureau of Standards. Pesticide adulteration and mislabeling (or lack of a label) are widespread, especially at dealers' and users' levels. The Uganda National Farmers' Association regards fraudulent pesticides as such a serious problem that it is considering awarding a seal of approval to responsible companies (Erone, 1993; J. Nyeko, E. Niyongira, and C. Bazirake, personal communication, 1994).

5.1.4 Disposal

There are no facilities in Uganda for disposal of obsolete pesticide stocks and used containers. This is of special concern in African countries such as Uganda, where tropical heat hastens deterioration and improper storage practices and inadequate storage facilities are common (Jensen 1991; Pierrard 1992).

Dealers are tempted to sell accumulated stocks of outdated chemicals and may also do so unintentionally. Just four of 24 agrichemicals (mostly pesticides) on inventory for the Rural Farmers Scheme had the expiry date included on their labels in January 1993 (Niyongira and Byekwaso 1993; Uganda Commercial Bank 1993).

The bulk of obsolete pesticides in East Africa is made up of organochlorine insecticides (Pierrard 1992). About 49,000 liters of dieldrin supplied by the United Nations Development Programme remained after the 1988 cancellation of aerial spraying of that chemical for tsetse control in Uganda. An FAO monitoring team repackaged the stock and shipped to the United Kingdom for incineration in late 1993. The Shell Chemical Company assumed responsibility for most of the costs (Aryamanya-Migisha 1993; Anonymous 1994).

5.2 Policies and projects affecting pesticide use

Donors and NGOs are providing financing, guidance and technical assistance for rebuilding Uganda's agricultural sector and to national environmental initiatives. Their policies, as reflected in project and nonproject assistance and pest management approaches, will influence the importance of selected commodities and the potential demand for, and role of, pesticides.

Donor coordination is increasing in international aid programs (USAID 1993), and in Uganda a complementary division of roles combined with policy consensus is perceptible. In the policy arena, donors are supporting structural adjustment (including the discontinuation of many parastatal agencies and subsidies, e.g., subsidized agricultural inputs), market liberalization, privatization, and agricultural trade as well as the formulation of National Environmental Action Plans. Aid is often conditional on such initiatives.

5.2.1 Agriculture

Between them, donors operating in Uganda are rehabilitating the coffee, tea, cotton, and sugar sectors (with privatization) and supporting the rebuilding of the national livestock herd and the development of nontraditional agricultural exports, particularly horticultural crops. This can be expected to increase the demand for pesticides used on those commodities. Credit made available through donor and NGO support will enable farmers to purchase inputs, including pesticides, more easily.

A factor that would decrease pesticide use is the development and application of integrated pest management (IPM) systems. Donors' IPM projects exist for cotton, vegetables, and storage pests, and most NGOs are promoting low-input or organic agriculture. Donors and NGOs alike seek to improve extension services, an important prerequisite for effective pest management of any sort at farm level. Brief summaries follow on the roles and activities of several major donors and NGOs.

<u>The World Bank and International Development Association</u> (IDA). The African Development Bank (ADB) and the IDA are cosponsoring the rehabilitation of the Kakira Sugar Works, Ltd., with loans totaling $65.9 million over a five and one-half year period (i.e., October 1988 to March 1994). Likewise, the World Bank and the International Fund for Agricultural Development (IFAD) are supporting a $10 million "Smallholders' Cotton Rehabilitation Project" in the north and east that will run concurrently with a $36 million, 5-year World Bank/IDA "Cotton Subsector Development Project" beginning in July 1994. Among

other things, the cotton projects aim to revive animal traction and develop and apply IPM. The World Bank is also providing some support for the Export Policy Analysis Development Unit (EPADU), which promotes the exportation of horticultural crops. Finally, the World Bank and the EU are supporting the privatization of veterinary services through the Livestock Services Project (Kagonyera 1993).

The World Bank formulated pesticide guidelines in 1985, and they prohibit the procurement of banned or severely restricted products in bank-financed projects. The guidelines also require that safe-use measures and IPM approaches be incorporated into relevant Bank-sponsored projects. "Additional Guidelines for Project Appraisal and Supervision in Relation to Pesticides and Pest Management" were added in 1987, and the 1992 Operational Directive 4.03, Agricultural Pest Management, strengthened the Bank's requirements on IPM and pesticide management (World Bank 1992c, 1992d; Fleischer 1993). Efforts are being made to put those principles into practice; the aforementioned IPM component of the World Bank/IFAD cotton project is an example.

A $17 million Agricultural Extension Project (1993-1997), with possibility of a follow-on project, is to strengthen extension services through the countrywide implementation of a training-and-visit extension system.

IFAD. IFAD funds the above mentioned cotton rehabilitation project as well as the Hoima and Kibaale Integrated Project, covering most grassroots development activities in that area. The Fund's Environmental Principles and Criteria include a strong recommendation for implementation of IPM and reduced reliance on pesticides, but no more specific guidelines exist. Guidelines for Natural Resources Management for Poverty Alleviation are being prepared and will refer to the FAO's *Code of Conduct*. Guidelines for the procurement of pesticides do not yet exist, leaving the procedure to national agencies (Fleischer 1993).

The United Nations Development Programme (UNDP). The UNDP is providing funding so that the FAO can elaborate a master plan for the Ugandan horticultural sector. Major issues include research, marketing, financial analysis, and the development of infrastructure. The plan should identify Uganda's competitive advantages and the strengths and interests of potential donors including the UNDP, which would like to improve the quality and quantity of fruit, vegetable, spice, and flower production. The UNDP procures pesticides only for research and training, not for distribution to farmers (J. Mukoza-Kifuse, personal communication, 1994).

An orientation toward grassroots empowerment that supports agricultural production is planned, including financial "Support to Rural Community Enterprise Development," probably channeled through the Ministry of Finance and community-based organizations. The grants and community revolving funds that may be made available would help farmers afford agricultural inputs.

FAO. The FAO implements some UNDP-funded projects, including the master planning for the aforementioned "Strengthening the Development of the Horticulture Subsector" and a

project to strengthen crop protection and plant quarantine. This project recently ended. A planned UNDP-funded project for "Improvement of Food Crop Post-Harvest Systems at Farmers' Level" is to review existing technologies and assess their appropriateness. It may influence the use of storage pesticides, and the environmental aspect is to be considered.

Uganda is participating in the FAO's regional project on "Improving Phyto-sanitary Conditions in East and South African Countries at Risk from the Larger Grain Borer." This project focuses on the beetle *Prostephanus truncatus*, a serious introduced pest of stored maize and cassava. Its proper management and hindrance of its spread is important for maintaining a free and safe regional grain trade (Tyler et al. 1990).

The FAO is a major source of guidance for developing countries with regard to pest and pesticide management. An *International Code of Conduct on the Distribution and Use of Pesticides* was adopted unanimously in 1985 and has been an important reference point for pesticide regulation in many countries, including Uganda. The code was amended in 1989 to include the Prior Informed Consent (PIC) procedure, which the FAO and United Nations Environment Programme (UNEP) implement jointly. PIC allows designated national authorities in potential importing countries to decide on the basis of informed consent whether they wish to accept shipments of hazardous chemicals. UNEP's International Register of Potentially Toxic Chemicals and Decision Guidance Documents for compounds subject to the PIC procedure (12 pesticides as of March 1993) serve importing countries' information needs (Fleischer 1993).

The FAO has a long history of involvement in research and development on IPM, including African projects for cotton in the Sudan and for food crops in the Sahel. A vegetable IPM program is proposed for Africa.

A 1992 Field Program Circular on the procurement of pesticides provides criteria for selecting relatively safe pesticides for the FAO's project activities. In the case of procurement by the host country, *Guidelines on Tender for the Procurement of Pesticides* apply, and there is a negative list of pesticides not to be financed and procured (Fleischer 1993). The FAO does not generally supply agrichemicals except in emergencies. Some equipment and pesticides, which the FAO's Plant Protection Service selected, were procured for armyworm control in Uganda.

European Union (EU). The EU funds activities to market cotton and to rehabilitate tea and coffee as well as a Farming Systems Support Program within the MAAIF that covers construction, vehicles, equipment, a tissue culture laboratory, and recurrent costs. The MAAIF program applies to research, extension, management, and technical assistance.

It is mandatory for EU countries to apply PIC procedures. Pesticide-related problems are approached mainly within the framework of environmental impact assessment; *Guidelines on Assessment of Environmental Impact* include a checklist on pesticides and fertilizers The checklist refers to the FAO's *Code of Conduct* and the World Health Organization's (WHO) *Recommended Classification of Pesticides According to Hazard* (Fleischer 1993).

The Danish International Development Agency (DANIDA). DANIDA has no cropping programs and concentrates on livestock. DANIDA commissioned a recent study that proposes continuing the government's acaricide-zoning scheme for cattle dipping and importing ethion (Cethion 1010), a second-generation organophosphate acaricide produced in Denmark, for cattle-dipping on about two-thirds of Uganda's land area (Kagonyera 1993).

DANIDA has funded government procurement of pesticides in the past (Table 14) and is currently weighing a request to furnish ethion. An environmental impact assessment of ethion's use in Uganda was completed as a desk study in Denmark (A. Qvortrup, personal communication, 1994).

Gesellschaft für Technische Zusammenarbeit (GTZ). GTZ Uganda, like DANIDA, does not place a high priority on agriculture except for veterinary projects. GTZ's single national-level crop-based project supports the Biological Control Unit at Namulonge Research Station jointly with the International Institute of Tropical Agriculture, which is located in Benin.

Uganda is included in a GTZ regional "IPM Horticulture" project that is headquartered at the Kenya Agricultural Research Institute (H. Scholl and B. Lohr, personal communication, 1994). This project seeks partnerships with a variety of institutions (including private ones) in order to improve and introduce IPM systems for horticultural production. The project emphasizes biological control methods and the necessity for African exporters to meet European maximum residue level (MRL) standards. An IPM package is to be developed for export green beans, with research carried out primarily in Kenya (Lohr 1993).

GTZ has two veterinary research projects, both of which involve insecticidal dipping for control of disease vectors: support to the Animal Health Research Centre, Entebbe and work with Makerere University on goats at the Buyana Stock Farm. Another project involving pesticides is joint work with the University of Munich for malaria control through house spraying with pyrethrum insecticide in spray cans.

Germany's national pesticide legislation has incorporated the FAO's *Code of Conduct* including the PIC procedure, and that legislation governs the nation's development assistance. The Ministry of Economic Cooperation and Development implements the legislation through policies on plant protection and guidelines for IPM, adoption of the *Code*, and a negative list of pesticides not to be financed.

GTZ provides technical assistance related to pest and pesticide management to many developing countries. Judicious choice and use of pesticides in projects, including the monitoring of host country compliance, is the responsibility of individual project officers briefed from headquarters in Germany. Any pesticides used with GTZ funding must be registered in Germany (H. Scholl and M. Moeschel, personal communication, 1994).

The Kreditanstalt für Wiederaufbau (KfW; Bank for Reconstruction) does not have an explicit policy on the use of pesticides, but attention is paid to good practice in the projects it

finances. A negative list of pesticides ineligible for procurement under commodity aid and adjustment programs has been in force since 1992 (Fleischer 1993).

USAID. USAID's Development Fund for Africa seeks to improve agricultural production and productivity while protecting and managing the natural resource base, with particular emphasis on biodiversity. Agricultural priorities include the creation and transfer of improved agricultural technology, better infrastructure (especially for marketing), increased market participation by farmers and traders, and agribusiness development including the growth of nontraditional agricultural exports (Herlehy 1992; Seckler 1993; USAID 1993).

In Uganda, USAID devotes both project and nonproject assistance to nontraditional agricultural exports, through the five-year, $38 million Agricultural Nontraditional Export Promotion Program (ANEPP) and the planned six-year (1994-1999), $25 million Investment in Developing Export Agriculture (IDEA) project. Such assistance helped increase the real value of nontraditional exports from $8.1 million in 1987 to an estimated $61.4 million in 1992. French beans, snow peas, asparagus, and vanilla have received special emphasis. Makerere University's involvement with USAID's global IPM Collaborative Research Support Project (IPM CRSP) should further IDEA's and ANEPP's goals. The IPM CRSP has a strong emphasis on export horticulture.

USAID's livestock portfolio consists of two small veterinary research projects, Bovine Babesiosis Mass Screening and Diagnosis and Rapid Diagnosis of Bovine Theileriosis (East Coast Fever).

The Cooperative Agriculture and Agribusiness Support Project (CAAS) (1988-1995) encourages market-based behavior. CAAS support to the Cooperative Bank, which enables district unions to offer small production loans, makes resources available to farmers for inputs purchases. Pesticides are explicitly excluded from eligibility (D. Eriksmoen, personal communication, 1994).

USAID supports reforms in national agricultural research programs, including greater accountability to clients, demand-driven research agendas, broader institutional participation in research, and a range of collaborative arrangements with NGOS, international agricultural research centers, regional organizations, input supply companies, and organizations in donor countries. USAID was a major force behind the recent reorganization of Ugandan agricultural research that resulted in the creation of NARO (see chapter 7).

USAID's $17 million Manpower for Agricultural Development Project (MFAD), which ran from 1987 to 1993, supported the MAAIF's On-Farm Research Program as well as technology development and transfer for maize, soybeans, sunflower, rice, yams, cassava, and animal traction. In accordance with USAID's IPM approach to crop protection, several advances in maize pest management were realized, including the evaluation of insecticides for the control of stem borers and of herbicides, the 1991 release of the high-yielding, fast-maturing, leaf streak-resistant cultivar "Longe 1," and the incorporation of blight resistance in promising

germplasm materials. USAID funds IPM work related to beans through the Centro Internacional de Agricultura Tropical's regional bean program. Further IPM research, primarily at Kawanda Agricultural Research Institute and in concert with NARO, may be funded under the IDEA project.

On the premise that lack of power for land tillage is one of the most important constraints to the development of agriculture in Uganda, the animal traction component of USAID's MFAD project supports a resumption of Uganda's tradition of employment of oxen, reduced in recent years due to civil unrest. Project research found that animal traction is possible with most soils and crop conditions in Uganda (USAID/Uganda 1993c).

In addition to requiring an IPM approach, USAID's 1991 *Pest Management Guidelines* contain the agency's environmental procedures as well as guidance for pesticide procurement and management and pesticide use in emergencies and disasters. Projects involving the procurement or application of pesticides undergo an Initial Environmental Examination to determine whether a full Environmental Assessment should be completed before implementation. The latter considers the requested pesticides' registration status in the United States, the criteria for their selection, the degree to which they will be used in an IPM context, application methods, toxicological hazards and nontarget effects, availability of alternative control methods, host country capabilities for pesticide regulation and management, and provisions for training as well as for monitoring the use and effectiveness of the pesticides. Research is proposed when necessary to ensure an IPM orientation (Fleischer 1993). USAID does not fund a recipient government's procurement of pesticides except in emergencies, and then only with the written approval of the agency's administrator.

Japan International Cooperation Agency (JICA). In 1990, grant aid, provided to 42 out of 46 countries, constituted 53.5 percent of Japan's net outlays for bilateral official development assistance to sub-Saharan Africa. Assistance to the agricultural sector for rural and agricultural development is a high priority.

Grant Aid For Increased Food Production is drawn from the budget of the Ministry of Foreign Affairs. JICA distributes such aid, and grants can include agrichemicals as well as fertilizer, machinery and equipment (see chapter 7) (Government of Japan 1990; 1992c, 1993a, 1993b; Tobin 1994). The recipient country can request pesticides from a "Standard List" of approved chemicals that are registered in Japan and manufactured in countries that are members of the Organization for Economic Co-operation and Development (C. Bazirake, personal communication, 1994).

The Uganda National Farmers' Association (UNFA). This association, which is now two years old and the only large Ugandan farmers' organization, is independent but receives funding from the government as well as from donors (chiefly DANIDA, USAID, and the World Food Program). UNFA works closely with USAID/Uganda's ANEPP and IDEA projects and NARO to provide credit, marketing, and research information to its 55,000 registered members.

Members must be farmers willing to entertain visitors and must pay 500 shillings on joining plus an annual fee of 1,500 shillings. Elected volunteers from each district constitute a national Farmers' Assembly, and a National Management Executive Committee directs the Secretariat in Kampala.

The UNFA hopes to establish a domestic and international marketing information system and has a five-district pilot project that provides for-payment, demand-driven extension services to farmers grouped according to subject-matter interests. Farmer leaders are to be trained as paid consultants. A magazine, "The Farmer's Voice," is available for 2,000 shillings per copy.

The UNFA is represented on the NARO board and facilitates its on-farm research. UNFA is also helping NARO, the MAAIF, and Makerere University develop training curricula (E. Niyongira, personal communication, 1994).

World Learning. This NGO, which coordinates USAID's Natural Resource Management Support Project's small grants to Ugandan NGOs, does not deal directly with pesticides. Project NGOs are encouraged to try botanical pesticides and other low-cost management practices and are referred to government staff for advice.

World Vision Uganda. World Vision-Uganda formerly distributed pesticides without charge to its community development projects, but liaison with the International Federation of Agricultural Organic Movements, established through World Vision's International Office in late 1991, caused World Vision to stop all purchases and distributions of pesticides. Now, World Vision-Uganda encourages natural pest-management methods such as neem use and host-plant resistance (HPR) to pests, drawing technical information from foreign sources including the Kenya Institute of Organic Farming and international sustainable agriculture magazines and newsletters (A. Esenu, personal communication, 1994).

CARE. CARE does not provide or promote pesticides, in part because its clients cannot afford them. As an alternative, CARE assists the national biological control program in its southwest and west Nile project areas, distributing wasp parasitoids of the cassava mealybug and extending simple cultural methods (better tree spacing, sanitation) that control banana weevil successfully. CARE also distributes pest-resistant crop cultivars including mosaic-resistant cassava and is studying organic cotton production (see section 7.1.4). Nevertheless, CARE is trying to educate its staff in pesticide management because its West Nile Credit Project, which runs through 1997, will enable small-scale farmers to purchase more inputs (CARE 1993). CARE's principal information source is NARO, drawing on research that had not yet reached farmers.

The African Pest and Environment Management Foundation (APEMAF). This NGO's information-gathering, networking, and research activities may become increasingly important as a resource for policy makers. Proceedings of an APEMAF-coordinated, USAID-funded Uganda National Symposium on Pesticide Information Network (APEMAF 1993) is the best available compendium of information on pesticide use and management and its environmental

and health impacts in Uganda.

APEMAF is proposing initiatives on training, information networking, and disposal of hazardous wastes based on recommendations of the symposium and is currently implementing a community-based malaria control program using insecticide-impregnated bed nets and mats. APEMAF could supply sampling and analysis support to programs for monitoring pesticide residues if Makerere University's laboratory to which APEMAF has access were upgraded, particularly with further equipment.

5.2.2 Environment

All major donors are committed to environmentally sustainable development and require environmental assessments or environmental analyses to ensure that their projects will not cause unacceptable environmental damage. As an illustration, noting that environmental degradation and pollution most often affect the poorest people and countries, the IDA has a stated commitment to ensure that economic development is complementary to sound environmental management and that potential adverse environmental impacts from IDA-financed projects are addressed. Borrowers from the IDA, including Uganda, are preparing national environmental action plans to set environmental priorities and map investment and other strategies for achieving them (World Bank 1993).

The UNDP, USAID, DANIDA, other donors, and many NGOs including APEMAF, CARE, and World Learning are supporting and participating in the elaboration of Uganda's National Environmental Action Plan (NEAP) and the necessary institutional capacity-building. USAID's assistance is channeled through its Action Program for the Environment (APE).

Represented on the National Environmental Action Plan Advisory Committee, the organizations involved have contributed technical input, review, and comment to Task Force working papers covering major areas of environmental concern. CARE's priorities are biodiversity and community management of environmental programs. USAID's PVO/NGO Natural Resources Management Support Project was represented on the NEAP Land Management, Agriculture, Livestock, and Rangelands Task Force by a delegate from World Learning. This task force's areas of concern included the use of pesticides and fertilizers in agricultural production and crop storage (World Learning 1993).

In addition to involvement with the NEAP process, DANIDA's other major environmental thrust is water quality, particularly the integration of water and land use management. A proposal is being developed for "Rehabilitation of Water Resources Monitoring and Assessment Services in Uganda," which would provide laboratories for monitoring water quality and a network of water-sampling stations. DDT and other pesticides may be covered in a second phase; water is not now monitored for pesticide residues in Uganda (A. Qvortrup, personal communication, 1994).

Japan's Official Development Assistance Charter (Government of Japan 1992a) mentions environmental conservation as one of its philosophies and a priority issue. Forest conservation, air and water pollution, and the protection of ecological systems are designated as major areas of JICA's environmental involvement. Environmental guidelines were developed with respect to agriculture in 1992 (Government of Japan 1992a, 1992b, 1992c). Nevertheless, pesticide pollution is not explicitly mentioned in agency documents and environmental assessments are not required for pesticide donations provided through JICA's Grant Aid for Increased Food Production (Tobin 1994).

6. THE IMPACT OF THE FACTORS AFFECTING SUPPLY AND DEMAND

6.1 Projected trends in pesticide use

Table 16 shows projections for pesticide use made by considering the trends in crop production, the problems associated with expanding crop production, the economics of using pesticides, the factors affecting the supply (import) of pesticides, and donor and government policies relating to pesticide use. The projections are only for the short run, three to five years. Many of the agricultural trade and policy reforms in Uganda are too new to determine what their long-term effect will be on crop production, market prices, and the consequent demand for pesticides.

Overall pesticide use is unlikely to change dramatically in the next three to five years (Table 16). The central reasons are (a) the inability to overcome constraints, particularly marketing related problems, which will prevent rapid expansion of many nontraditional crops (e.g., floriculture), and (b) the uncertainty of the returns to using pesticides, coupled with an anticipated rise in pesticide prices as private distributors take over from government-subsidized operations.

The predicted relatively minor changes in overall volumes of pesticide use says nothing about the potential environmental and health impacts of future trends in use. In some localities, there may be large increases in pesticide use to produce new export crops that require frequent pesticide applications (e.g., floriculture). Such changes in pesticide use might be almost unnoticeable when measured at a national level but could potentially cause a localized environmental problem. Similarly, volumes of pesticides used might remain unchanged, but increased prices might encourage farmers to switch to older, cheaper pesticides, which may be more toxic than newer pesticides.

6.2 Consequences of projected trends in pesticide use

6.2.1 The key role of policy implementation

The health and environmental impacts of projected pesticide use in Uganda will depend greatly on whether government policies and regulations concerning pesticide use are implemented effectively. There are potentially two main sources of regulations that could affect pesticide use. The first is MAAIF's regulations that directly concern pesticide registration and dictate when and where pesticides can be used. The second source of regulations is the National Environmental Management Plan (NEMP), which is a broad-based approach to managing and regulating a wide variety of factors that affect the environment. There is great scope for collaboration between the ministries charged with enforcing each set of regulations. The collaborative network could be expanded usefully by including the Ministry of Health.

Table 16. Projected trends in use of pesticides for crops, livestock, and human health

Crops	Potential to expand area cultivated[a]	Incentive to intensify production[b]	Overall likely increase in current pesticide use[c]	Comments
Coffee	medium	low-medium	low	price of coffee?
Tea	low	low	low	price low
Cotton	medium	low	low-medium	
Maize	medium	low-medium	low-medium	exports driven by disasters
Sesame	medium	low	negligible	few pesticides used
Beans	low-medium	low	negligible	few pesticides used
Groundnuts	medium	medium	low-medium	oil crop exports are down
Fruits	low	low	negligible	marketing difficulties
Essential oils	low-medium	low	low	very competitive market
Vegetables	low	low-medium	low	
Horticulture	low	low-medium	low	lack & cost of airfreight

Cattle: Vector-borne Diseases	Potential to increase herd size	Potential to intensify production	Overall change in pesticide use in livestock	Comments
Tick control	medium	low	low	high cost of dipping
Tsetse control	medium	medium	low-medium	subsidized due to impact on human health

Human: Vector-borne Diseases	Potential to increase population being treated	Potential to intensify pesticide use for vector control	Overall change in pesticide use for vector control	Comments
Tsetse control	high	low	low	greater use of traps
Malaria	low	low	negligible	impregnated nets possible
Other	low	low	negligible	

a. Includes switching of area currently cultivated from one crop to another.
b. Intensification of production is defined as increasing yields, utilizing agrichemical inputs (see Tables 1 and 2 and Appendix B).
c. Overall change is defined as the potential to change or increase the volume of pesticides used compared with current usage patterns.

6.2.2 Pesticide regulations

Uganda's new pesticide regulations (Government of Uganda 1993) must be enforced in order to avert continuing or even greater harm from pesticide misuse. For instance, all further importation and sale of organochlorine insecticides, now banned in Uganda but apparently still in general use on crops and in seed dressings, should be stopped. This will require surveillance of formal and informal importation, regular checking of dealer premises, and the ability to conduct laboratory analyses of imported pesticides.

Regulation 35, part 4, if properly interpreted and enforced, could provide an opportunity for the Plant Protection Service to support implementation of pollution monitoring sections of the new National Environmental Action Policy (NEMP): "Monitoring of agricultural chemicals shall be mandatory by agents of manufacturers and distributors concerned to assess the impact on the environment."

6.2.3 The National Environmental Management Policy

The draft National Environmental Management Policy (NEMP) of October 1993 includes several cross-sectoral policy objectives that would affect pesticide management if implemented (Morton, Sargeant, and Smedley 1993): (a) to conserve and manage biological diversity; (b) to provide water of acceptable quality; (c) to integrate environmental costs and benefits into economic planning and development at all levels; (d) to provide a system of environmental impact assessment and environmental monitoring; and (e) to control the pollution of water and promote environmentally sound management of wastes and hazardous materials.

The NEMP proposes that sectoral ministries would have responsibility of day-to-day implementation of environmental management activities, with each ministry operating under sectoral policies developed within the framework of the above objectives. The objective for the agricultural sector is to promote farming systems and land-use practices that conserve and enhance land productivity in an environmentally sustainable way. Among the strategies for achieving it are: (a) placing greater emphasis on environmentally friendly means of increasing agricultural production and (b) supporting research to develop farming systems that combine optimum production with the conservation of land resources and that are compatible with the target population's socioeconomic conditions.

Other relevant sectoral policies include: (a) the conservation of biodiversity outside the Protected Areas system, linked with land use, sustainable agriculture, and crop production policies and (b) the establishment and enforcement of adequate regulation of agricultural chemicals and other hazardous materials, including training of farmers and extension workers in the safe use of agrichemicals.

6.2.4 Health and environmental concerns

By linking projected trends in pesticide use in crops, livestock, and human health (Table

16) with the summary of pesticide hazards by use pattern given in Table 15, it is possible to identify areas of concern with relation to human health and the environment.

It is wise, where potential problems are recognized, to monitor for their occurrence, so that harmful pesticide use patterns can be recognized and changed before serious damage is done. Policy makers must know the geographic extent and degree of pesticide pollution and poisoning, as well as changes over time, if they are to produce sound plans for remedial action.

Current patterns of pesticide use (for which health and environmental impacts have not yet been measured), the projected moderate increase in pesticide use in cotton, maize, and groundnuts over the next three to five years, and probable longer-term growth of the agricultural sector as a whole present the potential problems described below.

Continued use of organochlorine insecticides. Unless Uganda's pesticide regulations are enforced promptly and effectively, the continuing sales and use of these banned pesticides cannot be dismissed as a temporary exhausting of outdated stocks. Should these banned pesticides remain on the market, persistence in the environment, residues in foodstuffs, and bioaccumulation in the tissues of humans and wildlife are likely to cause health and reproductive disturbances.

Use patterns that have persisted at least until the recent past include seed treatment of maize, beans, and groundnuts and crop application in cotton and perhaps other crops. Mercury, a highly poisonous and undesirable substance, is part of the standard seed treatment mixture. Safer seed treatment compounds should be identified and substituted. Other insecticides, most recently synthetic pyrethroids, are already more widely used in cotton and other crops and provide effective pest management.

When organochlorine pesticides are used, monitoring should track residues in human and animal milk and tissues and other foodstuffs and on the populations and reproductive success of vulnerable wildlife species (elsewhere birds and other predatory species high on the food chain are known to have been severely affected). Agriculture, health, and environmental agencies should cooperate in monitoring and in planning and implementing mitigative measures.

Acute applicator poisoning. Acute poisoning of farmers and other people who frequently handle or apply pesticides will continue to be an issue. Two situations present danger: application of pesticides in the field and the use of fumigants and other storage pesticides in warehouses.

Many of the pesticides applied in Uganda can poison applicators if not handled properly. Phosphamidon, a highly toxic and dangerous insecticide, is used in groundnuts. Other organophosphorus products and even synthetic pyrethroid insecticides applied to maize, cotton, and many other Ugandan crops are also hazardous when applied as Ugandan farmers generally do--without protective clothing or appropriate precautions. Soil sterilants used in flower growing (e.g., aldicarb, phenamifos) are highly toxic and are generally applied only by certified

applicators in the United States. The herbicide paraquat can cause severe skin symptoms when not handled safely.

An increase in maize production, particularly for export, means greater use of pesticides to treat or fumigate stored products. The compounds used in Uganda present the risk of acute poisoning or inhalation toxicity and are restricted-use pesticides in the United States.

Farmers should be given good quality, regular training in pesticide health and safety, as well as in judicious and effective use of pesticides. Appropriate clothing and protective devices should be recommended and made widely available.

Pesticide regulators should establish a certified training program for pesticide applicators as soon as possible, teaching trainees how to apply dangerous pesticides safely and effectively. Access to highly hazardous compounds should be restricted to applicators possessing a regularly updated certificate showing successful completion of training. Those qualifications should be required of staff responsible for pest management in storage facilities, application of soil sterilants and other jobs involving the use of highly toxic pesticide products. Only relatively nontoxic compounds should be registered for sale to farmers for general use.

Farmers, storekeepers, and other people who frequently stock and apply highly toxic organophosphates, carbamates, and other cholinesterate-inhibiting pesticides should have regular blood tests. Significant depression in cholinesterase levels is a sign that exposure should be curtailed.

Prompt and appropriate treatment should be provided to victims of pesticide poisoning through the public health system. Field and hospital staff should be trained to recognize poisoning symptoms and to administer first aid and antidotes. Health officers should participate in awareness campaigns on pesticide safety aimed at farmers and homeowners who use pesticides.

A systematic record of pesticide poisoning should be initiated. Information collected should shed light on the number and distribution of people affected, the severity of poisoning, which products and use patterns are causing major problems, and the loss of productivity involved (e.g., work days lost, permanent disability).

Chronic poisoning of applicators and consumers. Many pesticides that do not present much risk of acute poisoning may cause chronic deleterious effects on human health. Ugandan examples include: triazine herbicides (e.g., atrazine) used at maize estates, which may cause tumor growth or birth defects; other maize and tea herbicides, including 2,4-D (implicated as a carcinogen) and 2,4,5-T (suspected oncogenicity, mutagenicity, and fetotoxicity); and certain fungicides such as captafol, used on coffee (suspected oncogenicity). The government has banned 2,4,5-T, one of the several other pesticides besides the organochlorines that will be removed from use if Ugandan pesticide regulations are implemented. After removal of the worst offenders from the pesticide market, good quality pesticide application and safety training for

farmers is the measure most likely to protect human health.

Pesticide residues on foodstuffs. Improper application of pesticides often causes excessive residues to remain on marketed agricultural produce. The use of such highly persistent compounds as organochlorines, failure to observe a sufficient interval between the last application and harvest, and improper post-harvest application of pesticides for cosmetic purposes, pest repellency, or storage pest management can all play a role. Both acute and chronic poisoning of consumers can result.

A newer adverse result is commercial: Exported produce that importing countries find to contain excessive pesticide residues will be rejected, resulting in financial harm to exporters and farmers and their possible exclusion from the market. This issue is of considerable concern to Uganda's embryonic nontraditional export crop sector. The European Union, for example, requires imported French beans, snow peas, and asparagus (three crops for which expanded Ugandan exports are being projected) to be without any detectable residues of many pesticides used in Uganda, including the insecticides DDT and chlorpyrifos, the herbicides glyphosate, paraquat, and atrazine, the fungicides benlate and mancozeb, and the fumigant methyl bromide (EC 1993).

It is important that farmers and exporters be well-informed about importing countries' maximum residue level standards and how to protect their crops without exceeding MRLs. Proper training for farmers is essential.

Health and agriculture ministries and Ugandan growers and exporters should have access to analytical laboratories capable of measuring residues of all pesticide products in frequent agricultural use. Produce destined both for the domestic market and for export should be screened routinely for excessive residue levels, and the data shared with agriculture and public health officials so that appropriate training and enforcement can mitigate potential problems.

Groundwater and surface water contamination. Certain agricultural pesticides are persistent and move in soil and water so that under certain circumstances they can contaminate ground and surface water. Among the pesticides used in Uganda, triazine herbicides applied in maize estates and the soil sterilant aldicarb, used in flower production, fall into this category.

If areas in which these and similar pesticides are used regularly have a soil or water configuration that might allow groundwater contamination, regular monitoring of water quality should be initiated. Good information sharing between agriculture and environmental agencies is necessary for effective planning and monitoring. Appropriate applicator training will help reduce the threat.

Toxicity to nontarget species. Many commonly applied pesticides that are reasonably safe for human applicators are acutely toxic to fish, birds, bees, and other beneficial insects, and other desirable nontarget species. Pesticides used in Uganda are no exception. Proper applicator training should stress the importance of safety measures that lessen risk to nontarget

species. Among them are the avoidance of spraying flowering crops (bees), observing buffer zones around bodies of water, and not washing sprayers or discarding pesticide containers into streams or lakes.

7. THE FUTURE

7.1 Alternative technologies, approaches, and enterprises to promote reduced pesticide use in Uganda

With appropriate interpretation and enforcement, certain environmental provisions in Uganda's pesticide regulations (Part IX, Regulation 35) could be an effective tool for promoting newer, environmentally desirable pest-management approaches including integrated pest management (IPM). These regulations specify that: (a) agricultural chemicals shall be used only when they cannot be avoided; (b) the use of the least damaging agricultural chemical materials to the environment shall be encouraged; and (c) nontarget species shall be protected.

7.1.1 Status of IPM

Much of IPM's potential in Uganda is still unrealized. Reliance on frequent cattle dipping to control tick-borne diseases continues although economically superior IPM systems are being explored elsewhere in Africa (e.g., Meltzer and Norval 1993). Pesticide use in tea, coffee, and groundnuts is considerable, and farmers typically rely on intensive pesticide protection to produce cotton as well as horticultural crops such as nontraditional vegetables and flowers (see Box 5).

Unfortunately, a lack of resources sometimes means that the use of alternative control methods is often reduced to pilot projects. For example, a pilot malaria control project is testing the efficacy of pesticide-impregnated bed nets and room mats in place of extensive spray campaigns (Nyeko, personal communication, 1994). The government's tsetse control program has had success with the introduction and use of traps, often relying on area spraying only initially to "knock down" the fly population (see chapter 5). It is unknown whether the local populace has sufficient will and the resources to maintain the traps for an extended period.

The Ugandan government has not explicitly endorsed IPM. Nevertheless, for over two decades reliance has been placed on nonchemical pest management methods when possible. In arabica coffee, the *Antestia* bug and the coffee mealybug *Planococcus kenyae* were controlled through pruning to reduce shade in combination with pest surveillance and pesticide application by extension agents. The applications were made according to an economic threshold level (an average of one bug per tree, which currently is of debatable economic relevance), the only one used in Uganda, and only once a year, in the dry season, when natural enemies of the pests are dormant.

Cotton bollworm (*Heliothis armigera*) and the cotton stainer (*Dysdercus nigrofasciatus*) have been managed with an IPM system. Pheromone traps and an economic threshold level were used for the bollworm. Stainers can be controlled through the destruction of old cotton seed at buying centers, ginneries, and mills, the uprooting and burning of old cotton plants, observance of a closed season, growing sorghum as a trap crop, spraying with pyrethroid insecticides when populations are high, and spraying around cotton stores. Host-plant resistance

(HPR) and cultural and biological pest control are major research thrusts. Good progress has been made toward IPM systems for banana, cassava and sweet potato (Bazirake 1993b).

Box 5 Floriculture and IPM in Uganda

Harriet Ssali is a progressive small-scale farmer, owner of J. H. Floricultural Growers (U) Ltd. and of a flower shop. She employs 12 people on about 0.75 ha, producing field-grown roses, carnations, and summer flowers. Most of her flowers are sold in Kampala, but she occasionally supplies exporters. She would like to keep expanding her enterprise and export more. As chairwoman of the Uganda Floriculture Association, she is in good communication with NARO researchers, but she often answers their questions about pest control because they have no IPM expertise with flowers.

With two years' floriculture training in Israel, Harriet is her own expert, drawing on reference books as far as possible. Unfortunately, many books lack information on pest management that is relevant to growing conditions on her farm. She relies on intensive spraying of a wide variety of insecticides and fungicides to produce her flowers, and pesticides account for a large share of her expenses. She is interested in nonchemical alternatives, but information is difficult to locate. So far all she has been able to do is follow PPS advice not to clear the bush around her fields, thus leaving a source of immigration for natural enemies.

Ziwa Horticultural Exporters, Ltd., a partly foreign-owned large-scale firm, is one of Ssali's competitors. There, detailed advice on pest management geared to European MRL requirements is not a problem. An experienced expatriate manager is in place, working for Standard Chartered Estate Management. The management firm's in-house chemicals advisor is at his service. A rose-production expert from the Netherlands monitors Ziwa's roses, which are grown under a nylon tent. For each hectare of flowers, forty workers are employed, their relatively low wages being one of the major reasons flowers for the European market can be produced profitably. A recently installed sulfur fogging system protects the roses from fungal infection. A variety of other IPM measures are being taken to reduce pesticide application on Ziwa's crops, including hand-picking of chafer grubs and crickets and the use of specially imported insecticidal soaps.

Government and donor promotion of nontraditional crops for export, combined with a paucity of IPM research on those crops, have led to a technology gap that now hampers farmers and presents health hazards. Almost total reliance on pesticides to produce high-quality crops such as French beans and flowers is not only expensive but also invites difficulties meeting European MRL requirements. Donors finance almost all agricultural research at present, so the absence of any current or planned bilateral programs supporting IPM for nontraditional crops means that this situation will not change much in the short or medium term.

It is worth noting that this technology gap gives large-scale, internationally financed

operations an important edge over ordinary Ugandan farmer-entrepreneurs. This tends to diminish the equity of benefits derived from donor support of nontraditional agricultural exports and the portion of proceeds that remain in Uganda.

7.1.2 Crop protection research

Current reorganization and revitalization of Uganda's agricultural research should help produce appropriate and safer pest management technology. The National Agricultural Research Organization (NARO) was created in 1992 to involve farmers, cooperatives, agribased industries, and scientists in coordinated planning and efficient execution of agriculture, livestock, fisheries, and forestry research. Attached to the MAAIF and operating in cooperation with the Uganda National Council for Science and Technology, NARO is a semi-autonomous entity with a budget that includes $14 million in annual support from the World Bank's Agricultural Research and Extension Project as well as revenue from USAID's local currency grants, plus project financing from donors such as GTZ and the International Development Research Centre.

Donors, including USAID, have rehabilitated several major research stations. A special administrative unit and seconded extension officers posted at each research institute provide research-extension liaison (Government of Uganda 1992; Aluba 1993; M. Kalunda, personal communication, 1994). Under USAID's Manpower for Agricultural Development project (MFAD), many scholarships for graduate study were awarded to scientists at the MAAIF and at Makerere University. All the MFAD scholars are expected to have returned home by mid-1994 (USAID/Uganda 1993c).

Makerere University's first priority is teaching and the supervision of graduate students, and its second priority is research. The university collaborates with NARO (the vice-chancellor is a member of the NARO board), conducting experiments at the University Farm Institute, NARO facilities, and in farmers' fields. Most work is on-station because it is less expensive. The Department of Crop Science emphasizes biological control and IPM in its crop protection work. Two entomologists and two plant pathologists, all Ph.D.s, but no weed science or nematology specialists, are on staff. University research committees decide which subjects merit investigation; coordination with NARO, faculty expertise and interests, and the availability of donor funding are considered. At present, research focuses largely on upland rice and cowpeas, with emphasis on HPR. The government has designated these crops as medium- and low-priority research topics, respectively (Government of Uganda, 1991a; E. N. Sabuti, personal communication, 1994).

The Government of Uganda's highest priority research areas include control of pests of banana, plantain, millet, maize, cassava, sweet potato, beans, groundnut, vegetables, coffee, and cotton (Government of Uganda 1991a). Kawanda Agricultural Research Institute has primary responsibility for IPM research.

7.1.3 Regional cooperation

Uganda is a member of the African Regional Pest Management Research and Development Network for the integrated control of crop pests and livestock disease vectors, better known as Pestnet, coordinated from the International Centre of Insect Physiology and Ecology, Nairobi. Pestnet promotes collaboration in research, training, and information exchange in order to use scarce resources to full advantage. It publishes a newsletter, *Network News*, and convenes biannual conferences, but has been inactive recently in Uganda (Pestnet 1991; C. Bazirake, personal communication, 1994).

7.1.4 Pesticide-free enterprises

Several agricultural industries that do not require pesticides now exist on a small scale in Uganda, and there appears to be room for expansion. USAID is promoting these enterprises in Uganda through its IDEA project.

Silk. Silk production, which depends on the *exclusion* of insecticides, is a traditional industry practiced in about 500 Ugandan households (USAID/Uganda 1993b). Silk is produced by moth caterpillars, which are kept in shelters and constantly fed clean leaves of their host plant. After the caterpillars spin their silk cocoons, the cocoon filaments are unwound and spun into thread.

Beekeeping. This is another enterprise that depends on the avoidance of pesticides, many of which can cause severe depletion or even die-off of bee colonies. In addition to producing honey that can be sold, bees provide a valuable service by pollinating agricultural crops. USAID helped to present a honey production seminar in Kampala in late 1993 (Michaud 1994).

Vanilla. The production of vanilla has been rehabilitated in Uganda with USAID's support. A Ugandan entrepreneur has organized production by nearly 2,000 households, for sale to a U.S. spice company. The price received for green vanilla is high, and both women and households as a whole are benefiting from increased income. Market demand does not appear to be satisfied yet (USAID/Uganda 1993b).

With funding from ANEPP, EPADU has produced a handsome, full-color vanilla production manual for farmers' use. Pesticides might harm the odor and flavor of the crop, so the manual advises farmers to keep their vanilla robust through good management practices, which are described in detail. Diseases do not appear to be severe, and affected plants are simply eliminated. Healthy plants do not appear to suffer from significant insect problems.

7.1.5 Producing for the organic market

The organic growing of produce for export is still in its infancy in Uganda. It has been undertaken thus far by a few innovative farmers with the assistance of private market contacts. As an illustration, Sun Trade Ltd., the only exporter focusing mainly on fruit, is an organic

producer. Another exporter is developing a market for organically produced passion fruit, apple bananas, and pineapples. Entrepreneurs who have been expanding solar fruit-drying operations are also considering organic certification (Morton, Sergeant, and Smedley 1993; Michaud 1994). Twincafe, London, has been teaching direct marketing methods to small-scale coffee producers' cooperatives in southern Uganda. The company is now looking into the possibility of marketing organic coffee that these growers produce (Michaud 1994).

CARE is investigating the production of organic cotton, for which the United Nations Capital Development Fund has identified a market in Europe. With the cotton, female entrepreneurs in Kampala would make garments for export (C. Carlson, personal communication, 1994).

Donor projects have made little effort to investigate potential markets (European or domestic) for Ugandan organic produce or to provide organic growers with specialized information, training, or technical assistance. Recently, however, an inspector from Naturland, a German organic certification organization, gave a seminar on the exportation of organic produce. It appears that government-controlled programs in the exporting country will have to certify organic products from outside the European Union (Michaud 1994).

7.2 Conclusions and recommendations

7.2.1 The impact of removing subsidies

Due to a rapidly growing population, Uganda needs to increase food production. Government policies and plans to increase production include promoting the use of agrichemicals. An examination of the economics of using pesticides (see section 2.4) found, however, that removing many of the subsidies and decontrolling crop prices has not significantly altered the price incentives to use pesticides. For example, although output prices for most crops are now decontrolled, thus allowing gross margins and returns to labor to rise over time, pesticide prices have also risen rapidly in the last few years. The net result has been that, over time, the ratio of input to output prices does not indicate that pesticides have become relatively cheaper to use. Likewise, the removal of subsidies from herbicides has made herbicides more expensive relative to labor costs, which should discourage their use, at least in the short- to medium term. If these examples are indicative of similar effects, then economic reforms associated with sectoral and structural adjustment programs have not yet changed the economic incentives to use pesticides, nor are there any clear indications that this will change in the near future.

7.2.2 The impact of changing the system of supplying pesticides

Privatization and the associated decrease in subsidized procurement in Uganda have contributed to a striking reduction in the importation and consumption of pesticides, at least for the short to medium term. This reduced access to pesticides is the result of limited demand and purchasing power and the private sector's limited ability to respond to or to develop effective

marketing channels in the absence of infrastructure. For the next three to five years, it is estimated, pesticide prices will continue to rise, and the insufficiency of distribution channels and farmers' limited purchasing power will constrain the availability and consumption of pesticides.

This conclusion contrasts with the conventional wisdom that pesticide use has increased significantly as African economies begin to recover and as agricultural transformation proceeds. If, however, historical patterns in Asia and Latin America are of any relevance to Africa, then the use of external inputs will increase substantially in Africa as well in the next five to ten years. This period presents a window of opportunity for governments and donors to address the issues outlined in this report preemptively, thereby capitalizing on the full benefits of pest-management technology while minimizing the risks.

An increased role for the private sector implies changes in the public sector. While the reduced role of government in the provision of pesticides is necessary and appropriate from a fiscal and governance perspective, it is instructive to remember that, until recently, parastatals often provided for the judicious choice of pesticides, safety gear, application equipment and maintenance, and the supervision and training of applicators.

Discontinuance of this function has produced a vacuum that the private sector has yet to fill adequately. For example, under the previous system in Uganda, all imported pesticides had to be chosen from a donor-approved positive list. At present, the selection of imported pesticides and their subsequent (mis)use are not monitored. Moreover, although much progress is being made in establishing regulatory frameworks, the Government of Uganda is presently unable to insure proper management and safe use of pesticides.

With the government's diminishing role in the procurement and distribution of pesticides comes the need to re-emphasize the proper role of the public sector to: (a) ensure proper investments in basic research to provide for a continuing stream of knowledge to inform the development of options, and (b) to create a policy and regulatory environment that encourages relevant private investments and promotes safe use of pesticides.

An example of a challenge that arises is in the oversight of credit institutions. With the removal of the government's role in the provision of pesticides and in the absence of proper regulations and enforcement in Uganda, having intermediate credit institutions provide loans for pesticides without any reference to environmental or health consequences could bring its own risks.

7.2.3 The impact of promoting agricultural exports

Although agricultural exports account for over 90 percent of the value of all exports from Uganda, coffee, tea, cotton, and tobacco account for approximately 80 percent of all agricultural exports. Maize and sesame compose the bulk of the nontraditional agricultural exports, but Ugandan sesame faces strong competition from other producers. Purchases from the World

Food Program dominate exports of maize. Attempts to increase significantly exports of other nontraditional crops, such as vegetables, fruits, and cut flowers, face problems such as the high cost of airfreight and lack of cold-storage and handling facilities (Sergeant and Manji 1993). Lack of credit and expertise are also significant problems preventing rapid increases in exports of many nontraditional crops. Thus, as exemplified by vanilla, although few farmers may markedly increase their output of a given crop, most farmers are more likely to produce only small amounts without noticeably changing their current cropping patterns.

7.2.4 Addressing the focus of this study

In brief, economic reforms have altered dramatically the environment under which pesticides are imported and distributed and the input and output markets that determine if pesticides are profitable to use. The net effect of all these changes has often been that the relative prices of inputs and outputs are largely unchanged. We found no quantitative data that showed that the economic reforms have effectively lowered the price of pesticides or that farmers have increased their use of pesticides in response to altered price incentives. Nor did we find any data to suggest that the economic reforms have caused a noticeable change in cropping patterns that has resulted in an increase in pesticide use. In the case of the promotion of export crops, the multitude of problems facing an exporter are such that many farmers may not be able to deliver to the overseas markets those products requiring an increased reliance on pesticides. No data were found suggesting that encouraging of export crops leads to a de facto increase in the use of pesticides. There may be small, localized increases in pesticide use, but these were not detectable using aggregated, national data.

Given the private sector's inability to replace the government subsidized distribution program rapidly, it is likely that many farmers who formerly applied pesticides will no longer be able to do so for lack of locally available supplies. Even those farmers who still have access to pesticide supplies and are able to pay for pesticides are likely to find that the quantities and frequency of delivery much reduced. In the short term, therefore, the private sector's limited ability to import and deliver pesticides may limit pesticide use to those farmers near large urban centers (ease of delivery) and to those few areas where there are sufficient farmers producing high value crops (able to pay high transport costs).

Over the longer term, evidence from elsewhere in Africa indicates that the promotion of cash and export crops permits increased access to external inputs (Gardner and Reintsma 1994; Reardon et al. 1994). As the present study demonstrates, this phenomenon applies to pesticides as well, at least in regions where high-value agricultural exports are promoted. Consequently, promotion of such exports may encourage the increased use of pesticides as a productivity-enhancing technology. At the same time, however, increased use of pesticides requires exporters to be conscious of maximum residue levels for products they send overseas. In contrast, as farmers in transition systems gain increased access to cash and credit, they rarely have comparable access to alternative crop protection tools, including IPM. This is noteworthy because no evidence exists to suggest that the use of, or research into, alternative pest-management technologies (especially IPM), has been encouraged in Uganda as a direct result

of the policy reforms associated with structural adjustment.

7.2.5 Economics and the need for change

Policy reforms have not significantly changed the economic incentives to use pesticides, but this does not imply the absence of problems with pesticide use and management in Uganda. In fact, the incentives and disincentives to use pesticides are essentially the same as they were before the policy reforms were initiated. Therefore, current problems associated with pesticide use predate the advent of the policy reforms. The economics associated with pesticide use point to an urgent need to provide alternatives to intensive use of pesticides to manage pests and maintain the quality of crops for export. Farmers can be viewed as being caught between the need to intensify production (foodcrops), or maintain quality (export horticulture), and the economic necessity of keeping input costs as low as possible. At present, the intensive use of pesticides is something of an insurance payment. When available, pesticides are applied intensively because no other technology has been presented to the farmers.

Therefore, there is an economic imperative for the Government of Uganda and donor organizations to invest in research on pest-management technologies and to support extension to reduce significantly the amount of pesticide required to manage a given problem. The following section contains recommendations on how that can be accomplished. The recommendations anticipate some of the changes that may occur in the supply and demand of pesticides as a result of the economic reforms. Due to the nature of this study, most of the recommendations are general, and detailed plans about how to implement the recommendations would require further research.

7.2.6 Economic evaluation: Research, dissemination, and data gathering

Information on the returns to pesticide use. In Uganda there are few data on the returns, financial or otherwise, to using pest-management technologies. Without valid data on this issue, farmers and extension agents do not have a rational basis for changing patterns of pesticide use or for adopting alternative approaches. If the rates of return on improved agricultural technologies are positive, and they are likely to be if research on the impact of such technologies in Africa (e.g., Oehmke and Crawford 1993) is applicable to Uganda, then data on rates of return would be important in justifying sizeable increases in budgets for further research and dissemination.

As noted above, private companies will soon dominate the importation and distribution of pesticides. This might mean that, over time, extension agents that private companies hire will provide advice to farmers about which pesticides to use. Such advice might be sound, but it is unlikely to be impartial or based on a full assessment of the economic and health-related costs to Ugandans. Accordingly, there is need for an unbiased assessment of the value of various methods for managing insect pests, weeds, and diseases.

Recommendation: Donors and the Government of Uganda should support research into the costs and benefits of various technologies to manage insect pests, weeds, and diseases. This research should go beyond financial crop budgets and include such variables as the valuation of the pesticides' environmental impact and rates of return on investments in alternative approaches to pest management. Such research is the foundation of any attempt to change patterns of pesticide use.

This recommendation does not mean that the private sector's role in this area is of little relevance. To the contrary, a business environment in which competition is on an equal basis will enable the private sector to develop the distribution linkages and product development and stewardship characteristic of a privatized market.

Responsible firms recognize that collaborative efforts to introduce suitable products and to implement rigorous and uniform standards are in the interest of a stable business environment. The time and environment seem right for the collaborative promotion of innovations in production, marketing, processing, and policy. Potential areas for collaboration include: (a) harmonization of product registration and licensing; (b) technology development and product stewardship; (c) privatization of product delivery and use and capitalization of input delivery; and (d) providing for a healthy business environment.

Need for extension of information. Just as it is important to research the costs and benefits of pest-management technologies, it is also important to ensure that such information is disseminated rapidly and widely.

Recommendation: Donors should assist the Government of Uganda to strengthen its current extension operations. A specific goal should be to provide information that will allow farmers to make economically and environmentally sound decisions regarding which technology to use to manage insect pests, weeds, and diseases. The extension system should be able to present to farmers financially viable alternatives to intensive pesticide use (e.g., IPM and organic production), which can be implemented as quickly as possible while satisfying market demands for quality agricultural products. Small-scale farmers growing horticultural crops for export should be targeted to receive information concerning maximum residue levels permitted by overseas importers and how to comply with these requirements.

Database needs. It is essential to have available a database that allows researchers, government analysts, and decision makers to evaluate the trend in factors affecting demand and supply of pesticides. Such a database must consist of a time series of variables important to determining the use of pesticides, including prices of inputs, farmgate and market prices of outputs, wage rates, transportation costs, and import and export data on agricultural inputs and outputs.

The Bank of Uganda's Agricultural Secretariat is responsible for collecting and analyzing data relating to crop inputs and outputs. Among other activities, this unit collects primary data through surveys on a regular basis. Not only are data collected and tabulated, but these data are

analyzed in innovative ways that provide insight into incentives for agricultural production in Uganda. The quality of the secretariat's output is high. Indeed, it is rare to see such a unit operate so well.

Unfortunately, several ongoing (i.e., time-series) data-gathering projects are facing curtailment or even termination due to lack of funds. If this data gathering unit is severely restricted in its ability to gather and analyze data, then the ability to predict important factors affecting pesticide use will be lost. The one problem observed with this unit is that not many agencies and researchers seem to be aware of its activities and the databases it has compiled.

Recommendation: Donor agencies should actively support and encourage the continuation of the Agricultural Secretariat and its portfolio of data gathering and analysis.

7.2.7 The policy and regulatory environment

Recommendation: In order to establish collaboration among donors, NGOs, and government agencies that deal with pesticides, an Ugandan pesticide information network should be established. This network would disseminate data to the health, agricultural, and environmental sectors using newsletters and small meetings. To minimize costs, the network should be as informal as possible. The primary goal should be to link relevant parties and to publicize appropriate data sources. Agencies that are part of such a network should find it easier to collaborate on the areas of policy making, regulation, enforcement, research, training, and mitigation.

Recommendation: To enhance the effectiveness of the regulation of the importation, distribution, and use of pesticides, donors and governments should assess the feasibility of a regional pesticide management network. A principal goals of such a network would be to enhance collaboration among regulatory authorities in neighboring countries, thus reducing the movement and use of illegal pesticides. The sharing high-quality laboratory facilities for pesticide quality control and residue analysis should also be considered.

Recommendation: Donors and government, with the participation of the private sector, should provide adequate resources and expertise to ensure the prompt and effective enforcement of Ugandan pesticide regulations.

Recommendation: The development of the National Environmental Management Plan offers a significant opportunity to ensure that appropriate new programs for monitoring pesticide residues and legislation and regulations governing pesticides are formulated. Therefore, donors and government agencies should collaborate to continue developing this planning and should work toward enabling the implementation and enforcement of environmental monitoring and legislation.

Recommendation: Donors and international lenders should continue to support the elimination of subsidies in Uganda (and elsewhere) that encourage excessive or inappropriate use of pesticides.

7.2.8 Research and development of alternative technologies

Farmers in Uganda and elsewhere correctly believe they need pesticides to protect and insure yields, but the relations between the use of pesticides and improvements in yield are complex. Yet, extension services have tended to encourage the uncritical "recipe" approach to promoting high-input agriculture. Without investments in research, development, and extension to identify and promote alternative pest-management practices and technologies, there is little chance of altering existing, undesirable patterns of pesticide use in any meaningful way.

In contrast, rising prices and reduced access to pesticides could motivate farmers to rely less on pesticides, encouraging them to consider adopting IPM or organic farming practices. This expectation must be tempered by the recognition that African research institutions have not yet identified adequate nonchemical measures for managing pests that pillage most of the region's crops. In addition, overburdened, underfunded, and inefficient national extension systems have largely failed to extend existing IPM technologies to most farmers. There is an immediate need to develop safer, alternative pest-management practices and extend them effectively. If these alternatives are not available, the increasing cost of pesticides will not provide a compelling incentive for farmers to convert to less toxic pest-management practices.

Recommendation: Concurrent with research on the economics of using pesticides, donors and government should support research on IPM technologies that will provide farmers with alternatives to intensive use of pesticides. Two related areas of research should be given the highest priority: (a) research on ecological pest-management measures (e.g., HPR, biological control, cultural and mechanical control) that will be equally useful to organic producers and (b) development of IPM systems for nontraditional export crops, including flowers. Both research priorities should concentrate on developing technologies appropriate for small-scale Ugandan farmers. USAID's IDEA project and its IPM CRSP should support this research effort in coordination with other donor activities such as the GTZ's IPM Horticulture Project.

7.2.9 Training in health and safety

The toxic properties of pesticides raise special concerns for human health and environmental protection. This creates a predicament for African policymakers: decentralization and privatization of pesticide provision can increase hazards to public health and the environment because neither the public nor the private sector currently insure the proper management and safe use of pesticides. Both sectors lack the funds, expertise, and laboratory facilities necessary for the enforcement of applicable environmental regulations. For similar reasons, public health systems do not provide adequate prevention and treatment of pesticide poisoning. Governments and donors have not made the sizeable, long-term commitment of resources that are required to meet those needs.

The decentralization and privatization of pesticide importation, distribution, and marketing can reduce the amount of pesticides used in the near future, but pesticide use still represents a significant health and environmental hazard. Moreover, other factors related to market liberalization can also increase hazards:

--Increased attractiveness of dangerous but relatively inexpensive illicit, substandard, or outdated pesticides.

--Smuggled chemicals can be used widely near international borders, especially when such areas are not well served by commercial firms.

-- Strengthening of the trend toward small areas with intense production of heavily treated crops. Donors' and governments' promotion of the production and export of nontraditional horticultural crops (e.g., fruits, flowers, and exotic vegetables) can also reinforce this trend. The current alarm about pesticide pollution of Kenya's Lake Naivasha, which is bordered by large-scale flower farms, exemplifies the problems that can arise.

Recommendation: In conjunction with the effort to improve the extension of the economics of using pesticides and alternative technologies, training in the safe use of pesticides should be extended as soon as possible. Particular attention should be paid to crop protection that will avoid exceeding importing countries' MRLs and to environmental protection measures such as respecting buffer zones around bodies of water when applying pesticides. The Export Policy Analysis and Development Unit should support the information dissemination and training effort related to MRLs.

7.2.10 Prioritizing the recommendations

In the short-term (two to three years), the recommendations for maintaining and improving databases and for establishing an information network should be the highest priorities. Without the collection and distribution of data, many other recommendations and obvious needs cannot be implemented effectively.

In the long-term (10 to 20 years), priority attention should be given to the research, development, and extension of alternative technologies to manage pests. Without new tools, there is unlikely to be sufficient incentives for farmers to change existing patterns of pesticide use. Enforcement of pesticide regulations will be more effective than at present if extension agents can offer farmers alternative methods of managing pests.

7.2.11 Funding the recommendations

It is important to realize that, unless long-term goals are funded, then the Government of Uganda and donors cannot expect to see substantive changes in pest management and use of pesticides. In contrast, donors and the government will do so to the extent they perceive a

priority set of opportunities related to IPM. Problems regarding the use of pesticides in Uganda existed before the economic reforms began, and the reforms are unlikely to alter such problems substantively. Thus, the Government of Uganda should develop a 10- to 20-year plan that will ensure the funding of research, development, and extension of new pest-management technologies as well as of pesticide regulation and environmental monitoring and regulatory programs. Such a plan can build on or supplement NARO's existing strategic research plan.

The key feature of such collaboration is that both the donors and the Government of Uganda would make firm commitments to support the programs for the long term. Without such commitment, producing viable alternatives to current practices of managing pests and ensuring proper pesticide management will be difficult.

7.2.12 A final note

When used wisely, pesticides and other inputs (e.g., seeds, fertilizers, animal and mechanical traction) contribute to the improved productivity and agricultural intensification that is essential to Africa's food security and economic development. Nonetheless, the linkages between pesticide use and enhanced productivity are not as direct as they are with other agricultural inputs like fertilizers.

Productivity and the quality of Africa's environment are inseparably linked: environmental degradation and growing pressures on marginal lands cannot be halted without raising farm-level productivity. Despite widespread acceptance of this assumption, conservation investments, such as IPM, must accompany interventions to improve farm-level productivity if such improvements are to be sustainable. Intensification can reduce pressures to expand cultivation onto fragile lands and thus lead to sustainable use of resources and the economic development that is vital to Africa's future.

More generally, as this report suggests, sectoral and structural adjustment programs create critical challenges for Africa's agriculture and for those responsible for its success. An emphasis on cash crops for exports will eventually increase producers' access to cash and credit to acquire additional inputs. At the same time, however, policy reforms intended to reduce or eliminate government staffs and programs devoted to agriculture and the elimination of government subsidies place many Africans on the horns of a dilemma. Improved access to cash can create dependence on pesticides that continue to be used inappropriately while governments finds themselves unable to provide the research and extension that could ensure that such pesticides are used only as an integral component of IPM. An approach to solving this dilemma, as Reardon et al. (1994) suggest, is a

> middle path between fiscally unsustainable government outlays and complete government withdrawal from support to agriculture. This middle path implies substantial public and private investment in agricultural research, human capital and production and market infrastructure.

The challenge for donors and African governments is to seek this middle path in their mutual pursuit of food security and economic development. In regard to pest management and pesticide technology, this will necessarily involve attention to strengthening and stabilizing the regulatory environment. For a limited investment in appropriate public regulations and education, development agents would be sure to be on the correct side of the proper-use-of-chemicals issue. Due to pesticides' potential for damage to human and ecological health, more so than for any other technology, it is imperative to recognize the proper and complementary roles of the public and the private sectors in ensuring the availability and safe use of pesticides and related crop-protection technologies.

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Appendix A. Ten factors crucial to increasing yields

The following material is adapted from Ministry of Trade and Industry Development (1993), pp. 22-24.

The development potential for the eight crops examined in this project depend on many variables. The most important relate to fulfillment of the potential offered by the increase in yield to a level considered feasible, assuming certain conditions are met at least in part. These conditions have been analyzed above and are summarized as follows:

1. Research into improved strains. New strains that are more resistant to the common diseases are available according to the information obtained. If yields at farm level are only one-third of the magnitude achieved under research conditions, the results for maize, groundnuts, and soya will be significant. Furthermore, an emphasis on quality needs to be built into research efforts on potential export crops.

2. Dissemination of field-tested new strains. Assuming that the process from research to field trials is satisfactory, the supply of improved seeds to farmers is in need of substantial reorganization.

3. Spread of improved methods of cultivation. Improvements in yields are possible with the adoption of some elementary procedures, such as the spacing of plants, optimum planting times, regular weeding, rotation, intercropping to increase yields and to reduce incidence of disease and pests, and more intensive cropping to take fuller advantage of the bimodal rainfall pattern. Emphasis should be placed on quality of produce especially when there is export potential.

4. Availability of additional arable land. The lack of a well-documented survey of land capabilities, which also indicates the relative fertility of soils, is a serious handicap to agricultural planning. It is not possible to know the limits farmers in each district face when they attempt to increase crops in response to market signals or in order to increase production of crops that may be suitable for export. The entire balance of crop production is thus a matter of speculation rather than of informed estimates of reaction to supply and demand. This is a considerable disadvantage in planning a level of production of crops that satisfies national, regional, and district needs for food security and the need for traditional and nontraditional export crops. If, as seems likely, the area under cultivation has been underestimated by as much as 20 percent, the lack of data on land capability data an acute problem.

5. Extension services. Much of the increase in production up to the mid-1990s and increasingly after that time is expected to come from increased yields. The potential offered by traditional methods has yet to be exploited fully, and the range of advice to farmers has yet to achieve the level of dissemination that would allow this cost-effective method of increasing yields to become operational. If, however, the option of increasing yields significantly is limited to additional inputs of chemical fertilizer and pesticides, then the extension service will have an

important role in ensuring that appropriate advice is provided to farmers. The absence of an effective extension service keeps production below levels that could be achieved easily, given the natural advantages prevalent in Uganda.

6. Land tenure. The Agricultural Secretariat's Technical Committee on the Recommendations relating to Land Tenure Reform Policy recommended the repeal of the 1975 Land Reform Decree and the introduction of a universal system of freehold tenure. The relation between farmers and the land cultivated is of prime importance. The committee's conclusions indicate that the lack of an acceptable and equitable tenure system creates an unsatisfactory situation that has adverse effects on fulfillment of production potential. At the least, insecure tenure creates an unpredictable future for farmers, and this leads to an unwillingness to accept the risks of extending planted areas or introducing new crops. Moreover, without titled tenure, financial institutions are not likely to offer credit.

7. Trade statistics. Ideally, any country embarking on a planned progression toward a higher standard of living would examine trends of imports and exports. Although import substitution may have been overemphasized as a sole means of moving toward self-sufficiency, it remains a potent method of establishing home-based production that can eventually be extended into export-led growth. Equally important, the study and analyses of export markets, volumes, prices, quality, and delivery times provide an important basis for future export success. In Uganda, it appears that the most recent, complete set of import statistics is from 1976. Data on "traditional" exports are available, but that for nontraditional exports have been processed for 1990-1991 and only for value. All indications are that Uganda s future is linked closely to the success of expanding exports and of a well-balanced program of import substitution.[4] To achieve this objective, Uganda's agricultural potential must be realized. This will require reliable trade statistics covering internal and export markets that will allow analyses of the prospects of extending linkages to further processing of agricultural-based raw materials, with the consequent benefits of increased value added.

8. Chemical inputs. Not many fertilizers or pesticides are used on food crops as compared with cash crops. Although this conclusion is difficult to document, the nature of food crops indicates that chemical inputs, even if widely available, would be unlikely to form part of the system. Moreover, there is not the technical support to give advice on optimum usage for these inputs in terms of crops, frequency of use, or quantities. With the fulfillment of the traditional farming system's potential, supported by an effective extension service and with the decrease, perhaps more rapid than previously anticipated, of additional arable land, the pressure of population and the desire to benefit more from cash crops will create a demand for chemical inputs. Despite this statement, significant increases in inputs are unlikely to occur before the mid-1990s.

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[4] The Agricultural Secretariat estimates that an average growth of 5 percent per year in Gross Domestic Product in the 1990s will be linked to a 10-percent growth in imports. This implies that export earnings must increase from US$259 million in 1989 to US$2.26 billion by 1999. This would represent an eight-fold increase.

9. Tools and implements. The National Inputs Coordination Unit (NICU) has estimated the requirements for inputs needed to support agriculture to 1993-1994. There does not seem to be information on the absorption levels, although one NICU report notes "a drastic decline in importation of basic tools such as hoes, pangas and axes, presumably because the markets for these are now saturated and their requirement is being met by local production." Field trips to the east and south of Uganda as part of the fact finding for this report heard complaints of the lack of availability of basic tools, which suggests an unfulfilled effective demand. The results of the Agriculture and Livestock Census 1991 will clarify the position.

10. Credit. Most commentators agree that the lack of both production and crop finance is a major hinderance to expanding production. Insufficient credit prevents purchase of appropriate inputs, but it also limits farmers' ability to expand beyond the scope of what can be safely accommodated within the family, i.e., by purchasing such labor-saving alternatives as oxen or tractors.

Appendix B. Foodcrop Production in Uganda: 1970-1995

Year	*Maize*			*Millet*			*Sorghum*			*Sweet Potatoes*		
	Prd.[1]	Area[1]	Yld.[1]	Prd.	Area	Yld.	Prd.	Area	Yld.	Prd.	Area	Yld.
1970	389	300	1.30	783	582	1.35	462	311	1.49	1570	444	3.54
1971	421	280	1.50	650	714	0.91	348	307	1.13	1425	495	2.88
1972	500	415	1.20	594	497	1.20	419	318	1.32	1224	508	2.41
1973	419	314	1.33	643	636	1.01	380	287	1.32	1232	400	3.08
1974	430	388	1.11	591	510	1.16	345	367	0.94	1786	506	3.53
1975	570	475	1.20	682	484	1.41	467	311	1.50	1953	550	3.55
1976	674	527	1.28	567	498	1.14	390	326	1.20	2002	564	3.55
1977	566	429	1.32	578	527	1.10	344	280	1.23	1659	467	3.55
1978	594	450	1.32	561	510	1.10	351	286	1.23	1689	476	3.55
1979	253	272	0.93	481	313	1.54	316	187	1.69	1272	256	4.97
1980	286	258	1.11	459	279	1.65	299	167	1.79	1200	231	5.19
1981	342	260	1.32	480	294	1.63	320	170	1.88	1300	340	3.82
1982	393	285	1.38	528	330	1.60	258	200	1.29	1487	372	4.00
1983	413	295	1.40	545	341	1.60	407	207	1.97	1843	457	4.03
1984	280	346	0.81	264	332	0.80	221	206	1.07	1791	386	4.64
1985	343	289	1.19	480	300	1.60	148	186	0.80	1142	347	3.29
1986	286	322	0.89	350	342	1.02	280	208	1.35	1865	407	4.58
1987	363	307	1.18	518	324	1.60	315	203	1.55	1674	398	4.21
1988	560	393	1.42	626	372	1.68	378	257	1.47	1716	417	4.12
1989	624			609			347					
1986[2]	*291*			*371*			*271*					
1987[2]	*322*			*449*			*305*					
1988[2]	*396*			*501*			*333*					
1989[2]	*560*			*529*			*336*					
1990[2]	*523*			*489*			*348*					
1990/91	584	389	1.50	564	376	1.50	360	240	1.50	1780	414	4.30
1990/91[3]	433	267	1.60	342	240	1.40	259	134	1.90			
1993	531			438			456			2205		
1995 (est)	*735*	*490*	*1.50*	*618*	*702*	*0.88*	*382*	*319*	*1.20*			

Sources: 1970-1988 Ministry of Agriculture, 1990; 1990/91 Agricultural Secretariat, 1991; 1989, 1990, 1995 estimates Ministry of Trade and Industry, 1993. 1993 estimates Ministry of Agriculture, Animal Industry and Fisheries, reported in New Visions, January 31, 1994.

Notes: 1) Prd. = Production in 000 MT; Area in 000 Ha; Yld. = Yield in Mt/Ha.

2) Estimates in *italics* are based on the Household Budget data (1990), Ministry of Planning and Economic development, reported in Ministry of Trade and Industry, 1993.

3) These estimates are from the 1990/91 National Census of Agriculture and Livestock, Volume III. Crop area, yield and production. Ministry of Agriculture, Animal Industry and Fisheries, 1992. Due to difficulties in reaching some districts, the census was undertaken in only 26 of Uganda s 33 administrative districts.

Appendix B: (Continued) Foodcrop Production in Uganda: 1970-1995

Year	*Bananas*			*Beans*			*Cassava*			*Groundnuts*		
	Prd.[1]	Area[1]	Yld.	Prd.	Area	Yld.	Prd.	Area	Yld.	Prd.	Area	Yld.
1970	7657	909	8.42	388	300	1.29	2578	539	4.78	244	251	0.97
1971	7557	905	8.35	222	459	0.48	2417	508	4.76	251	291	0.86
1972	7634	916	8.33	237	309	0.77	2650	371	7.14	234	291	0.80
1973	8126	974	8.34	170	359	0.47	2132	483	4.41	212	222	0.95
1974	8879	1063	8.35	196	408	0.48	2350	485	4.85	200	267	0.75
1975	9106	1097	8.30	326	408	0.80	2992	618	4.84	194	243	0.80
1976	8137	1180	6.90	337	436	0.77	2838	512	5.54	177	213	0.83
1977	8531	1240	6.88	253	338	0.75	2993	540	5.54	193	234	0.82
1978	8840	1287	6.87	291	388	0.75	2028	529	3.83	187	234	0.80
1979	6090	1173	5.19	182	227	0.80	2100	322	6.52	80	122	0.66
1980	5699	1173	4.86	133	224	0.59	2072	302	6.86	70	95	0.74
1981	5900	1179	5.00	240	289	0.83	3000	310	9.68	80	110	0.73
1982	6595	1199	5.50	300	361	0.83	3117	331	9.42	89	120	0.74
1983	6647	1209	5.50	314	398	0.79	3239	372	8.71	99	124	0.80
1984	6461	1209	5.34	265	385	0.69	1866	398	4.69	118	172	0.69
1985	5552	1209	4.59	267	334	0.80	1673	387	4.32	107	124	0.86
1986	6660	1210	5.50	267	396	0.67	1871	362	5.17	118	177	0.67
1987	7398	1336	5.54	299	373	0.80	3101	345	8.99	85	126	0.67
1988	7784	1396	5.58	352	445	0.79	3271	361	9.06	176	270	0.65
1989				338						146		
1986[2]				*359*						*117*		
1987[2]				*394*						*120*		
1988[2]				*439*						*131*		
1989[2]				*503*						*142*		
1990[2]				*513*						*165*		
1990/91	7791	1379	5.65	396	495	0.80	3339	371	9.00	172	191	0.90
1990/91[3]	4717	642	7.3	507	312	1.60				162	142	1.10
1993				355			8363			207		
1995 (est)				*610*	*772*	*0.79*				*224*	*187*	*1.20*

Sources: 1970-88: Ministry of Agriculture, 1990; 1990/91: Agricultural Secretariat, 1991; 1989, 1990, 1995 estimates: Ministry of Trade and Industry, 1993. 1993 estimates: Ministry of Agriculture, Animal Industry and Fisheries, reported in New Visions, 31 January 1994.

Notes: 1) Prd. = Production in '000 MT; Area in '000 Ha; Yld. = Yield in Mt/Ha.

2) Estimates in *italics* are based on the Household Budget data (1990), Ministry of Planning and Economic development, reported in Ministry of Trade and Industry, 1993.

3) These estimates are from the 1990/91 National Census of Agriculture and Livestock, Volume III. Crop area, yield and production. Ministry of Agriculture, Animal Industry and Fisheries, 1992. Due to difficulties in reaching some districts, the census was undertaken in only 26 of Uganda's 33 administrative districts.

Appendix C. Maize: cost of production and net income with present and improved technology (Area: 1 ha)

		Present technology		Improved technology	
	Unit Price	Qty	Value (shs)	Qty	Value (shs)
Costs of production					
Physical Inputs					
Hoes	1,400	0.33	462	0.33	462
Rakes	2,500	0.33	825	0.33	825
Pangas	1,800	0.50	900	0.50	900
Spray pump	13,000		0	0.2	2,000
Packaging Bags	568	16	9,088	28	15,904
Seeds (kgs)	250	30	7,500	30	7,500
Fertilizer (kgs)	130		0	300	39,000
Herbicide (lts)	5,500		0	2	11,000
Subtotal			18,775		78,191
Labor and Traction					
Land Clearing	450	20	9,000	20	9,000
Plowing	900	20	18,000	20	18,000
Planting	450	20	9,000	20	9,000
Weeding	450	45	20,250	45	20,250
Fertilizing	450		0	10	4,500
Spraying	450		0	5	2,250
Harvesting and	450		0		0
Threshing	450	18	8,100	32	14,400
Subtotal			64,350		77,400
Total			83,125		155,591
Contingency (15%)			12,468		23,338
Total Cost of Production			95,593		178,929

Income	Price (shs/kg)	Yield (kgs/ha)	Value (shs)	Yield (kgs/ha)	Value (Shs)
Gross Income	116	1,500	174,000	2,800	324,800
Net Income			78,406		145,870

Source: Cited in Accelerated Foodcrop Production Strategy Project, Ministry of Agriculture, 1990, Annex B.

Appendix D: Importation of agricultural chemicals: 1990–93

Period	Type of Chemicals	Importers	Country of Origin	Quantity ('000 L)	Value ('000 US$)	Source of Funding
1990						
Jan–March	Pesticides	ADP/MOA	U.K.	10.000	60.920	IFAD/IDA
			Germany	7.500	148.000	IFAD/IDA
			Kenya	8.500	149.050	IFAD/IDA
		SWARP/MOA	Kenya	6.000	30.200	IFAD/IDA
			Germany	13.300	50.560	IFAD/IDA
		Twiga	U.K.	47.600	131.840	ODA/U.K.
	Herbicides	Twiga	U.K.	17.280	79.363	ODA/UK
		UCB/RFS	Netherland	5.000	32.360	EDF/EEC
		SWARP/MOA	Germany	0.600	4.800	IFAD/IDA
April–June	Pesticides	SWARP/MOA	U.K.	1.000	3.650	IFAD/IDA
			Malasia	3.100	44.450	IFAD/IDA
		SCOUL	EEC	0.200	0.670	ADB
		MOA	Japan	209.990	1,457.530	Jap.Grant
		Twiga	Australia	12.500	115.850	WB/SIP111
	Herbicides	UCB/RFS	Germany	13.200	162.200	EDF/EEC
		SWARP/MOA	Malasia	0.170	1.350	IFAD/IDA
July–Sept.	Pesticides	Shell	France	10.560	101.290	WB/SIP111
		UCB/RFS	Netherlands	5.000	29.020	EDF/EEC
		May–Baker	France	3.970	116.580	Jap.Grant
	Herbicides	Shell	Belgium	4.800	67.200	BOU/SIP111
Oct–Dec.	Pesticides	SWARP/MOA	Kenya	4.000	6.580	IFAD/IDA
		CMB	Singapore	20.000	156.920	WB/SIP111
	Herbicides	Kakira	Kenya	0.410	102.950	ADB
Total				404.680	3,053.333	

PERIOD	COMMODITY	IMPORTER	QUANTITY ('000)	UNIT	COUNTRY OF ORIGIN	VALUE ('000 US $)	FUNDING
1992							
JAN-MAR	DIMECRON	ADP	250.000	LITRES	SWITZERLAN	199.720	IFAD/IDA
	ROUND UP	SHELL CHEMICALS (U) LTD	24.000	CTNS	BELGIUM	26.400	F/BUREAU
APR-JUN	PESTICIDES						
	ACTELLIC DUST	MAAIF	200.000	KG		51.240	JAP GRANT
	ALUMIN.PHOSPHIDE	PRODUCE MARKETING BOARD	15.000	KGS	U K	30.000	FOREX A/C
	CARBOSULFAN 20EC	MAAIF	60.000	LITRE		147.820	JAP GRANT
	CARBOSULFAN 5G	MAAIF	150.000	KG		92.596	JAP GRANT
	DELTAMETHRIN	UCB/DFG/RFS	65.000	LTS	FRANCE	97.900	UCB/RFS
	DELTAMETHRIN	UCB-DFG	50.000	LITRES	ZIMBABWE	42.850	IDA-ARP
	DIMECRON	CIBA-GEIGY	20.000	LITRE	SWITZERLAND	12.027	BOU
	DIMETHOATE	MAAIF	193.000	LITRE		231.411	JAP GRANT
	DITHANE	MAAIF	480.000	KG		422.142	JAP GRANT
	DITHANE M45	UCB-DFG	200.000	KGS	ITALY	106.330	ITCOF
	DITHANE M45	SHELL	48.000	KGS	ITALY	35.520	ASAC
	DURSBAN	MAAIF	50.000	LITRE		85.092	JAP GRANT
	FENITROTHION	MAAIF	150.000	LITRE		203.360	JAP GRANT
	MICOXAN	MAAIF	40.000	VIAL	FRANCE	44.252	IDA AF A2
	RIDOMIL	CIBA-GEIGY	100.000	KGS	SWITZERLAND	143.501	ADB
	RONSTER	MAAIF	70.000	LITRE		89.640	JAP GRANT
	ROVRAL	MAAIF	50.000	KG		50.128	JAP GRANT
	HERBICIDES						
	GESAPAX	KAKIRA SUGAR WK	50.000	LITRES	SWITZERLAND	40.203	ASAC
	GESATOP	KAKIRA SUGAR WK	50.000	LITRES	SWITZERLAND	40.203	ASAC
	ROUND UP	UTGC	19.740	LITRE		17.332	EEC
	ROUND UP	UTGC	8.370	LITRE	EUROPE	7.340	EEC
	ROUND-UP	SHELL	24.000	LITRES	BELGIUM	26.400	ASAC
	DIURON 80% WP	SUGAR CORP. OF (U) LTD	0.000		GERMANY	54.604	EEC STABEX
JUL-SEP	PESTICIDES						
	AGRIC CHEMICALS	UCB/RFS	0.000		U.K	134.504	UCB/RFS
	SALUT	GTZ	1.000	LT	GERMANY	0.000	BOU
	DECIS	UCB-RFS	65.000	LITRE	NETHERLAND	37.800	ADB
	MALATHION DUST	SWRARP MBARARA	44.875	KGS	GERMANY	8.500	IFAD
	CARBOSULFAN	SWRARP MBARARA	8.320	KGS	UK	3.037	IFAD
	HERBICIDES						
	BASAGRAM	UCB-RFS	50.000	LITRE	GERMANY	10.100	ADB
	GRAMAXONE	TAMTECO	84.000	LITRE	UK	7.234	OWN
	DALAPON	SWRARP MBARARA	4.410	KGS	GERMANY	2.134	IFAD
	ROUND UP	UTGC	11.440	LITRE		10.044	EEC
	ROUND UP	TAMTECO	38.970	LITRE	BELGIUM	34.500	OWN
	ROUND UP	UTGC	16.260	LITRE		14.276	EEC
	ROUND UP	UTGC	7.980	LITRES		7.006	EEC
OCT-DEC	PESTICIDES						
	ACTELLIC	SWRARP MBARARA	100.000	KGS	HOLLAND	0.000	IFAD
	AGROCHEMICALS	SWRARP MBARARA	0.000		HOLLAND	105.295	IFAD
	AMBUSH	TWIGA CHEMICALS	100.080	LITRES	KENYA	76.060	OWN
	AMBUSH	TWIGA CHEMICALS	100.080	LITRES	KENYA	76.060	OWN
	FERNITROTHON	SWRARP MBARARA	10.000	LITRE	HOLLAND	0.000	IFAD
	FERNITROTHON	SWRARP MBARARA	25.000	LITRE	HOLLAND	0.000	IFAD
	KARATE	TWIGA CHEMICALS	5.000	LITRES	UK	40.032	OWN
	LINDANE	SWRARP MBARARA	20.000	LITRE	HOLLAND	0.000	IFAD
	MACOZEB	SWRARP MBARARA	100.000	KGS	HOLLAND	0.000	IFAD
	PRIMICID	TWIGA CHEMICALS	30.000	KGS	UK	10.000	OWN
	HERBICIDES						
	AGR. CHEMICALS	SUGAR CORP. OF (U) LTD	0.000		EEC	15.647	AUCTION
	AGR. CHEMICALS	SUGAR CORP. OF (U) LTD	0.000		EEC	21.719	AUCTION
	AGR. CHEMICALS	SUGAR CORP. OF (U) LTD	0.000		ITALY	8.503	AUCTION
	GLYPHOSPHATE	TAMTECO	0.000		TAIWAN	110.500	FAMV.
	GRAMOXONE	TWIGA CHEMICALS	0.008	LITRES	KENYA	9.907	OWN
TOTAL						3,040.434	

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Period	Type of Chemicals	Importers	Country of Origin	Quantity ('000 L)	Value ('000 US$)	Source of Funding
1991						
Jan–March	Herbicides	UCB/RFS	Denmark	21.000	160.510	DANIDA
		UTGC	Belgium	18.000	220.802	EDF/EEc
April–June	Pesticides	Ciba–Geigy	Switzerland	2.000	15.670	WB/SIP111
		UCB/RFS	Switzerland	1.000	5.870	DANIDA
		MOA	Japan	83.970	1,078.300	Jap.Grant
	Herbicides	MOA	Japan	49.060	873.600	Jap.Grant
		May–Baker	France	44.070	861.800	Jap.Grant
		Kakira	Switzerland	10.000	87.330	Jap.Grant
Jul–Sept	Pesticides					
	Fenitrothion	UCB/RFS	Kenya	10.000	66.398	EDF/EEC
	Dimethoate	UCB/DFG	Germany	20.000	124.000	ASAC
	Cypermethrin	UCB/DFG	France	100.000	614.830	ASAC
	Decis	UCB/DFG	France	100.000	1,372.200	ASAC
	Salut	UCB/DFG	Germany	100.000	1,373.790	ASAC
	Cuprous Oxide	UCB/DFG	Norway	40.000	133.000	ASAC
	Actellic Dust	ADP	Kenya	20.000	108.600	IFAD/IDA
	Herbicides					
	Gesapax 500 FW	Kakira SW	Switzerland	5.000	8.190	ASAC
	Gesapax H500 EC	Kakira SW	Switzerland	5.000	8.190	ASAC
	Tabmax	BAT	France	1.000	10.800	SIP III
	Round up	UTC	USA	1.580	14.960	ASAC
Oct – Dec	Pesticides					
	Dusban	May & Baker	Kenya	7.000	7.000	ASAC
	Orthane	May & Baker	Kenya	1.500	46.000	ASAC
	Dithane M45	UCB/UDB	Italy	20.000	106.330	ITCOF
	Orthane	BAT	Kenya	1.500	52.970	Bureau
	Herbicides					
	Ronstar 2D	May & Baker	France	6.000	63.380	ADB
	Tordon	May & Baker	Kenya	2.000	30.770	ADB
	Round up	UTC	USA	2.400	19.000	EEC
	Gesatop 500 FWC	Kakira SW	UK	1.000	2.750	ASAC
	Gesatop 500 FWC	Kakira SW	UK	1.000	2.750	ASAC
	Actril DS	Kakira SW	UK	1.000	12.430	ASAC
	Karmex	Kakira SW	Columbia	1.000	13.310	ASAC
Total				676.080	7,496.110	

PERIOD	TYPE OF CHEMICAL	IMPORTER	QUANTITY (000)	COUNTRY OF ORIGIN	VALUE ('000 US$)	FUNDING
1993						
JAN - MAR	CHEMICALS (PRIMICID)	TWIGA CHEMICAL INDUSTRY	0.000	U.K	6.840	AUCTION
	KARATE	TWIGA CHEMICAL INDUSTRY	5.004 LTS	UK	32.578	F/BUREAU
	GLYPHOSPHATE	TAMTECO	15.000 LTS	TAIWAN	145.500	MCECA
APR - JUN	DITHANE M-45	SHELL (U) LTD	0.000	ITALY	31.230	AUCTION
	PESTICIDES	UCB-DFG	0.000	HOLLAND	105.184	ADB/SWIAFP
	ROUND UP HERBICIDE	TWIGA CHEMICAL INDUSTRY	0.000	KENYA	30.400	AUCTION
JUL - SEPT						
	FERTILISERS & AGRO-CHEM.	ZIWA HORTICULTURE EXPORT	0.000	KENYA	42.343	F/INVESTMENT
	DIURON 80% W.P.	SUGAR CORP. OF (U) LTD	0.000	HUNGARY	86.000	AUCTION
	DITHANE AGRIC. CHEMICALS	TWIGA CHEMICAL IND. (U)	0.000	FRANCE	20.273	CONSIGNMENT
	CHEMICALS & FERTILIZERS	SUGAR CORP. OF (U) LTD	0.000	KENYA	14.323	AUCTION
	GRAMOXONE	TWIGA CHEMICAL IND. LTD	0.000	U.K	24.520	F/BUREAU
	DIURON 80% W.P.	SUGAR CORP. OF (U) LTD	0.000	HUNGARY	86.000	AUCTION
TOTAL					537.130	

People Contacted

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Harriet Ssali, owner and chairperson, Uganda Floricultural Association

Ziwa Horticultural Exporters, Ltd.
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