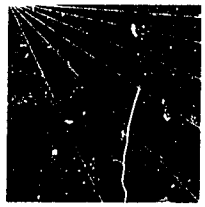

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ENVIROMENTAL ASSESSMENT OF PESTICIDE USE IN USAID/GUATEMALA OFFICE OF RURAL DEVELOPMENT PROJECTS

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INTEGRATED PEST MANAGEMENT AND ENVIRONMENTAL PROTECTION PROJECT

Contract No. DAN-4142-C-00-5122-00
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SUMMARY OF MITIGATIVE ACTIONS

In order to mitigate the environmental effects of pesticide use in ORD projects, the CICP/ECOTECNIA EA Team has formulated a set of short, medium and long term actions. They are discussed below and presented in Table A in a calenderized form, in Table B by project and in Table C by cooperating institution.

I. SHORT-TERM MITIGATIVE ACTIONS

They can be implemented within three months and preced ORD support of pesticide procurement and/or use.

1. Circulate Pesticide Guidelines (presented under separate cover) to Intermediate Credit Institutions (ICI's) and ORD and specific project officers, technicians and consultants. At least one copy each for all ICI agencies likely to channel ORD agricultural production credits should be provided.

2. Modify existing credit agreements to exclude restricted and cancelled pesticides and include purchase of protective equipment. In some cases (Cooperative Strengthening project), modify Cooperative Agreement to specifically exclude the purchase of pesticides, if this policy, stated by Project Officers, is to be officialized.

3. Train ORD Project Officers and key project personnel on pesticide use and safety (one week course).

4. Obtain and distribute copies of J.E. Davies, V.H. Freed and F.W. Whittemore, Enfoque Agromedico sobre Manejo de Plaguicidas, (PAHO/WHO, n.d.) or equivalent agromedical handbook to all Ministry of Public Health, Social Security Institute and ICI agencies in projects' areas.

5. Conduct search for and identify best available pesticide protective equipment appropriate for Guatemalan rural conditions. Assist ICI agencies in locating and obtaining complete outfits for sale in their own locales and as part of production credits.

6. Obtain list Public Health and Social Security clinics: exact location and person in charge. Distribute relevant portions of this list to ICI agencies.

II. MEDIUM-TERM MITIGATIVE ACTIONS

They are to be initiated and completed within one year.

7. Prepare and distribute a "crop by crop" pesticide handbook based on Technical Guidelines, J.E. Davies (op. cit.) or equivalent handbook and health information specific for Guatemala. Handbook should be distributed to all Public Health and Social Security clinics as well as project offices and ICI agencies.

8. Develop, test and distribute a video film on pesticide use and safety, to be shown through ICI agencies to all ORD credit beneficiaries in screens provided under the Institutional Strengthening Plan (presented under separate cover). Credit checks can be paid on specified days and with the concurrence of the nearest Public Health or Social Security representative (with a per diem payment provided for under the Institutional Strengthening Plan). The health specialist will further explain pesticide use/safety procedures and demonstrate protective equipment use as part of a "pesticide information stop."

9. Train ORD Project Officers and key project personnel on Integrated Pest Mangement principles (one week).

10. Strengthen the National Plant Health Directorate (DTSV) to enable it to coordinate the pest/pesticide management program (see Institutional Strengthening Plan).

III. LONG-TERM MITIGATIVE ACTION

These are to be started within a year and should go on as long as ORD/G supports the procurement and/or use of pesticides.

11. Carry out, under the coordination of DTSV and with the participation of DIGESA, AGMIP, GREPAGRO/private sector and Public Health officers, a pesticide information workshop in different critical areas of pesticide use at least once every two months. The CICP/ECOTECNIA EA Team conducted a pilot "pesticide information workshop" in Retana, Jutiapa (see pg. 52).

12. Conduct IPM demonstrations in crops supported by ORD credits and for which technology is already available (3-5 new crops per year), in conjunction with a "Validation and Testing" activity (see 13. below) and a

"Research Activity" (see 14. below). Crops considered ready for IPM demonstration at the present time are: tomato, snow pea, potato and broccoli. The Demonstration Program is further discussed below (see pg. 75).

13. Arrange, support, and monitor a program for the validation and testing of IPM technology in crops for which some but not enough deocumented research is available. It is recommended that actual validation/testing be supported through ICTA, Universidad de San Carlos, Universidad del Valle, Universidad Rafael Landivar and the Guatemalan Integrated Pest Management Association (AGMIP). Some specific support will have to be provided by ORD through some or all of its projects. It is recommended that at least 3-5 crops be validated/tested evry year to keep pace with the demonstration program and cover the totality of crops currently being supported by ORD within 5-10 years.

14. Arrange, support and monitor IPM research in crops not ready for testing/validation. The same institutions mentioned above can be supported to carry out basic IPM research in crops that may be supported by ORD projects.

15. Provide "on-the-job" training for DIGESA, DANDESA, AIFLD, FUNDACEN, FEDECOAG, FECOAR, DTSV, "Agricultural Representatives" and agronomy students (under the Supervised Professional Practice program) as part of the demonstration program. Each IPM specialist is to have two or three assistants/trainees from these institutions per crop term, and as trainees are made available from the institutions themselves.

16. Support Pest/Pesticide Management training (long-term) for as long as pesticide procurement and/or use is supported. This implies coordinating with ongoing scholarship and other educational programs to provide for training at the Master's and Doctorate levels (se Training Plan presented under separate cover).

17. Set up a Pest/Pesticide Monitoring program with the possible participation of CATIE and ICAITI to detect changes in crop protection, pesticide use trends, intoxications, wildlife and habitat status and pesticide residues.

18. Evaluate Pest/Pesticide Management component periodically (external evaluations to monitor performance in recommended activities).

EXECUTIVE SUMMARY

This Environmental Assessment covers four ORD/USAID/ Guatemala projects: Agribusiness Development (520-0276), Cooperative Strengthening (520-0286), Pilot Commercial Land Market II - OPG (520-0343) and Agricultural Production and Marketing Systems Project (520-0363). It makes reference to two other projects, Small Farmer Diversification Systems (520-0255) and Highlands Agriculture Development (520-0274), whose EA is presented under separate cover (CICP/ECOTECNIA 1988). The Small Farmer Diversification Systems project is to be incorporated into the amended Highlands Agriculture Development project (HAD-II).

All of these projects have direct or indirect agricultural production credit components under which pesticides may be procured by individual farmers or farmer groups. They are contemplated in 22, Code of Federal Regulations, Part 216.3(b), Pesticide Procedures.

The four ORD projects are operational throughout most of the country. The Agribusiness Development project has had moderate activity in regions I and V and no activity in the remainder of the country. The Cooperative Strengthening project has had some activity in region V and none in other regions. The Commercial Land Markets II project has had moderate activity in regions I, II and IV, slight activity in regions V, VI and VII and no activity in the rest of the country. The Agricultural Production and Marketing Services project has had slight activity in region V and, and to date, no activity in the rest of the country.

As stated by project officers and personnel interviewed by the CICP/ECOTECNIA EA team, these projects plan to intensify their activities in the future. The Agribusiness Development project plans to have intensive activity in regions I and V, moderate activity in regions II, VI and VII, slight activity in region IV and no activity in region VIII. The Cooperative Strengthening project supports federations that work in all of Guatemala. Commercial Land Markets II project plans to have moderate activity throughout the entire country (minus region III). The Agricultural Production and Marketing Services project plans to have intensive activity in regions I, IV and VI and no activity in the rest of the country.

Guatemala's intertropical position between two oceans in close proximity and its rugged volcanic topography make for a wide variety of climates. This is reflected in the richness and complexity of its natural resources (see Chapter II).

The ORD projects are developed with the participation and assistance of the following institutions: DIGESA, DTSV/DIGESA, ICTA, BANDESA, CARE, The Penny Foundation (Fundacion del Centavo - FUNDACEN), The American Institute for Free Labor Development, CATIE and cooperatives and cooperative federations (FECOAR, FECOMERO and FENACOAC in particular). Additionally, other institutions regarded as important for the implementation of mitigative environmental measures are: CONACOMIP, the Ministry of Public Health, Permanent Commission on the Safe Management of Pesticides, National Environmental Commission - CONAMA, the Guatemalan Association for Integrated Pest Management - AGMIP, the universities of San Carlos and del Valle, ICAITI, GREPAGRO, and the Social Security Institute - IGSS.

Existing and proposed Guatemalan laws were analyzed in reference to the environment, pesticides, natural heritage, water and forest resources in relation to the ORD projects. Revision of the HAD Amendment, mid-term evaluations and the project papers of the other five projects showed that their basic focus is adequately within the context for, or does not conflict with, watershed management and resource conservation.

Several analytical tools were used to develop the data on which the Environmenal Assessment of pesticide use in ORD projects was based. They were:

a) A general survey of 469 farmers, including 351 ORD project beneficiaries and 118 controls; the questionnaire used in this survey is presented as Appendix 1.

b) Collection of various available statistics on human pesticide poisonings, production costs and pesticide imports.

c) Collection and laboratory analysis of environmental samples to detect presence of pesticide residues.

d) An epidemiological survey of 145 farmers in intensive and non intensive crops; questionnaire used is presented as Appendix 2B.

e) An in-depth agroecological/economic survey of 14 farmers to detect specific pest and pesticide problems; questionnaire used is presented as Appendix 3.

f) An experiment of pesticide effects on non target organisms (see Appendix 4).

g) A workshop to identify pesticide problems and solutions at the farmer's level (see page 53 and Appendix 5).

Under Regulation 16, a proposed action has a significant effect on the environment if it does significant harm to the environment [216.1(c)(11)].

The CICP/ECOTECNIA EA team identified two major causes of potential pesticide effects in ORD projects. They are:

a) Inadequate crop protection technology.

Crop protection technology, especially in intensive export crops, was found to rely for the most part on a nonecological and unsafe use of chemical pesticides; and,

b) Insufficient knowledge and/or resources to identify, prevent and solve human health pesticide problems.

Insufficient knowledge and/or resources to identify, prevent and solve problems of pesticide contamination of the environment in general was also apparent but the CICP/ECOTECNIA EA team did not find this to be a source of significant environmental harm.

Three alternative courses of action or strategy components, available to USAID/Guatemala in order to comply with 22 CFR Part 216 and/or mitigate significant environmental effects stemming from pesticide use in agricultural activities supported directly or indirectly by ORD projects, were identified: A) No action; B) developing an "umbrella" IPM/Pesticide management program to serve all ORD projects; and, C) Development of individual IPM/Pesticide management components under each project. The Scope of Work for this Environmental Assessment specified the development of option B).

According to surveys, ORD projects are supporting, directly or indirectly, about 40 crops, including traditional and non traditional, for both export and local markets.

Several cropping practices emerged as important from the crop protection standpoint. They are: i) Year-round or nearly year-round cultivation; ii) Different plant/harvesting times for the same and different crops in neighboring fields; and, iii) inconsistent practices for disposal of crop residues. These practices are conducive to the development of high pest populations unless extreme care is exercised in the total management scheme.

Some of the environmental effects of pesticide-use studied by the CICP/ECOTECNIA EA team include:

- Little evidence of pesticide-induced mortality in wildlife, domestic animals and other vertebrates, the

highest of which occurred along the southern coast,

- Water with no evidence of contamination; soil samples with consistent residues of metamidophos; and, product samples with significant residue levels of metamidophos and traces of methyl parathion and cypermethrin,

- Circumstantial evidence of the development of insect resistance,

- Variable human health effects ranging from trace contamination of human tissue to fatalities,

- Pesticide poisonings to be most often caused by metamidophos, other organophosphates and paraquat,

- Traditional, non-export small farmer crops such as corn, beans and wheat utilized a much smaller proportion of total production costs for pesticides than did high value export crops such as snow peas, broccoli, cauliflower and lettuce,

- Potential kills of fish and shellfish, and potential pesticide residues in export and local consumption products,

- Potential increased foreign currency demands to finance pesticide imports, and

- Potential pesticide misuse problems at the farm level.

The different participants identified in the pesticide procurement-distribution process are: the farmer and farm worker, the retailer, the distributor or chemical company, as and the public sector agencies and USAID/G itself. Several ways of "accessing" these participants were identified.

Two major areas were identified as requiring substantial training efforts. They are: Integrated Pest Management as it relates to crops that use pesticides intensively and Pesticide Agromedicine in general and for high pesticide use crops in particular. In addition, some training in pesticide registration, residue analysis, formulation regulation, monitoring environmental toxicology and safe handling and disposal of pesticides and containers was found to be of use.

Mitigative measures are not included in this Executive Summary, as they have been presented under a separate heading above.

LIST OF ACRONYMS

A.I.D.	U.S. Agency for International Development (Agencia de los Estados Unidos para el Desarrollo Internacional)
APROFAM	Pro-Family Welfare Association (Asociación Pro-bienestar de la Familia)
AGA	Guatemalan Farmer Association (Asociación Guatemalteca de Agricultores)
AGMIP	Guatemalan Association for Integrated Pest Management (Asociación Guatemalteca de Manejo Integrado de Plagas)
AIFLD	American Institute for Free Labor Development (Instituto de los Estados Unidos para el Desarrollo del Sindicalismo Libre)
AIFLD/CUSG	American Institute for Free Labor Development/ Confederation of Guatemalan Labor Unions (Instituto de los Estados Unidos para el Desarrollo del Sindicalismo Libre/ Confederacion de Unidades Sindicales de Guatemala)
BANDESA	National Agricultural Development Bank of Guatemala (Banco Nacional de Desarrollo Agrícola)
CATIE	Tropical Agricultural Research and Training Center (Centro Agronómico Tropical de Investigación y Enseñanza)
CEDIA	Center of Agricultural Information and Documentation (Centro de Información y Documentación Agrícola)
CICP	Consortium for International Crop Protection (Consorcio Internacional para la Protección de Cultivos)
COGAAT	German Food-for-Work Assistance Program (Cooperación Guatemalteco-Alemana de Alimentos por Trabajo)
CONACAJ	National Council of Agricultural 4-H Clubs (Consejo Nacional de Clubes Agrícolas 4-S)

CONACOMIP	National Integrated Pest Management Consulting Committee (Comité Nacional Consultivo sobre el Manejo Integrado de Plagas)
CONAMA	National Environmental Commission of Guatemala (Comisión Nacional del Medio Ambiente de Guatemala)
COREDA	Regional Committee for Agricultural Development (Comité Regional de Desarrollo Agrícola)
COSUCO	Superior Coordinating Commission, composed of th heads of all MAGA General Directorates and Institutes (Comisión Superior de Coordinación)
CUSG	Guatemalan Confederation of Labor Unions (Confederación de Unidades Sindicales de Guatemala)
DIGEBOS	National Directorate for Forestry and Wildlife (Dirección General de Bosques y Vida Silvestre)
DIGESA	General Directorate of Agricultural Services (Dirección General de Servicios Agrícolas)
DIGESEPE	General Directorate of Livestock Services (Dirección General de Servicios Pecuarios)
DTSV	Technical Plant Health Directorate (Dirección Técnica de Sanidad Vegetal)
EA	Environmental Assessment (Evaluación Ambiental)
EPA	Environmental Protection Agency (Agencia de los Estados Unidos para la Protección del Medio Ambiente)
EPS	Professional Supervised Practice (Ejercicio profesional supervisada)
FAO	Food and Agriculture Organization of the United Nations (Organización de las Naciones Unidas para la Alimentación y Agricultura)
FENACOAC	Cooperative Federation of Saving and Credit (Federación Cooperativa de Ahorro y Crédito)

FECOAR	Federation of Agricultural and Regional Cooperatives (Federación de Cooperativas Agrícolas Regionales)
FUNDACEN	Penny Foundation (Fundación del Centavo)
FSR/E	Farming System Research and Extension; methodology used by ICTA (Cultivo, Sistemas de Investigación y Extensión; metodología utilizada por ICTA)
GIFAP	International Group of National Associations of Producers of Agro-chemical Products (Agrupación Internacional de Asociaciones Nacionales de Fabricantes de Productos Agroquímicos)
GOG	Government of Guatemala (Gobierno de Guatemala)
GREPAGRO	Farm Supply Distributor's Guild (Gremial de Proveedores de Productos Agrícolas)
HAD-II	Highlands Agriculture Development Project, as amended in 1988 (Proyecto Desarrollo Agrícola del Altiplano, después de la enmienda de 1988)
ICATA	Environmental Science and Agricultural Technology Institute (Instituto de Ciencias Ambientales y Tecnología Agrícola)
ICAITI	Central American Research Institute for Industry (Instituto Centro Americano de Investigación y Tecnología Industrial)
ICI	Intermediate Credit Institution (Institución Intermediaria de Créditos)
ICTA	Agricultural Science and Technology Institute (Instituto de Ciencia y Tecnología Agrícola)
IDB	Inter-American Development Bank (Banco Interamericano de Desarrollo)
IICA	Interamerican Institute for Agriculture Cooperation (Instituto Interamericano de Cooperación para la Agricultura)
IGSS	Guatemalan Social Security Institute

	(Institute Guatemalteco de Seguridad Social)
INACOP	National Institute for Cooperatives (Instituto Nacional de Cooperativismo)
INAFOR	National Foresty Institute (Instituto Nacional Forestal)
INAP	National Public Administration Institute (Instituto Nacional de la Administración Pública)
INCAP	Institute for Nutrition of Central America and Panama (Instituto de Nutrición de C.A. y Panamá)
INDECA	National Agricultural Marketing Institute, mandated to assist with all agricultural marketing activities, but so far, deals mostly with stabilizing basic grain prices through a storage program (Instituto Nacional de Comercialización Agrícola)
IPM	Integrated Pest Management (Manejo Integrado de Plagas)
OIRSA	Regional Animal and Plant Protection Organization (Organización Internacional Regional de Protección Agropecuaria)
PVO	Private Voluntary Organization (Organización de Voluntarios Privada)
LUCAM	Unified Laboratory for Control of Food and Medicine (Laboratorio Unificado de Control de Alimentos y Medicamentos)
MAGA	Ministry of Agriculture, Livestock and Food (Ministerio de Agricultura, Ganaderia y Alimentación)
NGO	Non-Government Organization (Organización no Gubernamental)
ORD	USAID Office of Rural Development (Oficina de la AID para el Desarrollo Rural)
PACD	Project Actual Completion Date (Fecha Prevista de Finalización de un Proyecto)
PCV	Peace Corporation Volunteer

	(Voluntario del Cuerpo de Paz)
PID	Project Identification Document (Documento de Identificacion del Proyecto)
PP	Project Paper (Documento del Proyecto)
ppm	parts per million (partes por millón)
P/PM	Pest and Pesticide Management (Manejo de Plagas y Plaguicidas)
PROAG	Project Agreement (Acuerdo del Proyecto)
Q	Currency of Guatemala (Quetzales)
ROCAP	Regional Office for Central America and Panama (Oficina Regional para Centroamérica y Panamá)
SFD	Small Farmer Diversification Project (Proyecto de Diversificación del Pequeño Agricultor)
TCS	Technical and Coordinating Secretariat - Project Execution Unit at COSUCO (Secretariado de Coordinación Técnica - Proyecto legalizado en COSUCO)
UCPC	Unit of Projects and Agreement Coordination (Unidad de Coordinación de Proyectos y Convenios)
UNEPAR	Executer Unit of Rural Sewage Projects (Unidad Ejecutora de Proyectos de Alcantarillado Rural)
USAID	AID Mission in Guatemala (Mision de AID en Guatemala)
USDA	U.S. Department of Agriculture (Depto. de Agricultura de los Estados Unidos)
USPADA	Sector Planning Unit for Food and Agricultural Development, responsible for MAGA planning, evaluation and statistics (Unidad Sectoral de Planificación para la Alimentación y el Desarrollo Agrícola, entidad de planificación, evaluación y estadistica del MAGA)

TABLE OF CONTENTS

I. INTRODUCTION

This Environmental Assessment covers principally four ORD/USAID/Guatemala projects: Agribusiness Development (520-0276), Cooperative Strengthening (520-0286), Pilot Commercial Land Market II - OPG (520-0343) and Agricultural Production and Marketing Systems Project (520-0363). It makes reference to two additional projects, Small Farmer Diversification Systems (520-0255) and Highlands Agriculture Development (520-0274) whose environmental assessment is presented under separate cover (CICP/ECOTECNIA 1988). Small Farmer Diversification Systems is to be incorporated into the amended Highlands Agriculture Development project (HAD-II).

A. Agribusiness Development (520-0276)

The purpose of this project is to provide small farmers with profitable outlets for their fruit and vegetable production. A total of $ 9.5 million in loan funds and $ 3.0 million in grant funds was authorized in late 1984. BANDESA was to receive $ 1.5 million, of which $ 0.75 million would finance production credits for small farmer groups and agricultural cooperatives.

Production credits are to be used to finance direct production costs (labor and inputs) of small farmers. BANDESA sub-lends based on crop plans provided by the groups. A.I.D. is providing assistance for the procurement and/or use of pesticides under this project component and the project is subject to the pesticide procedures under 216.3(b)(i).

B. Cooperative Strengthening (520-0286)

The purpose of this project is to help develop a more viable, efficient and effective Guatemalan cooperative movement by working with selected federations and their affiliated cooperatives to enhance their managerial and service delivery capabilities and by improving their performance and profitable enterprises.

Up to $3.8 million in credit can be provided to selected cooperative federations who will then lend to their members (i.e., cooperatives and small farmer groups) for a variety of purposes, including crop production. The crop production financing activity may include pesticide procurement and provisions must be made for the project to comply with Regulation 16, part 216.3(b)(i).

C. Commercial Land Markets II (520-0343)

The purpose of this project is to establish and expand the Penny Foundation's voluntary land purchase/sale program as a self supporting activity capable of increasing agricultural productivity and incomes to the rural poor. This project enables the Penny Foundation to purchase larger nonutilized farms and resell them to small farmers in smaller tracts (average 2.8 ha per family).

The policy of the Penny Foundation is to provide the necessary working credit to each farmer. The credit is for farm materials, such as fertilizer, pesticides, seed and root stock, and a subsistence wage. The small farmers apply as a group through their Committee of Representatives to the Foundation for credit. The Penny Foundation purchases the farm materials which it delivers to each farm.

A total of $ 4.35 million has been obligated for this component, which also includes credits in the form of partial "salaries" for the beneficiaries.

Procurement of pesticides is subject to Regulation 16, Part 216.3(b)(i). Monitoring safe and effective pesticide use is simpler in this project since pesticide purchasing is done centrally by the Foundation's technical staff, who also supervises its use through a technical assistance program.

D. Agricultural Production and Marketing Services (520-0363)

The purpose of this project is to provide the "Confederación de Unidad Sindical de Guatemala" (CUSG) with the institutional capacity to administer a service delivery system to its affiliate farm unions. These services will consist of production credit, technical assistance, marketing and education.

The credit component is deemed central to the success of the project. The project anticipates the processing of approximately 800 individual loans for approximately $106 per ha. per farmer in 1988, its first year of operation. The project will work with sesame, corn, wheat, coffee, vegetables and fruit in the southeastern and southwestern areas of Guatemala. The American Institute for Free Labor Development (AIFLD) technical advisory group will supervise products that can be given to farmers. As the credit may be used for the procurement of pesticides, the project is covered by the pesticide procedures in 216.3(b)(i).

II. DESCRIPTION OF AFFECTED AREA

The four ORD projects are operational throughout most of the country (areas identified in Figure 1). The Agribusiness Development project has had moderate activity in regions I and V and no activity in the remainder of the country. The Cooperative Strengthening project has had some activity in region V and none in other regions. The Commercial Land Markets II project has had moderate activity in regions I, II and IV, slight activity in regions V, VI and VII and no activity in the rest of the country. The Agricultural Production and Marketing Services project has had slight activity in region V and no activity in the rest of the country yet.

As stated by project officers and personnel interviewed by the CICP/ECOTECNIA EA team, these projects plan to intensify their activities in the future. The Agribusiness Development project plans to have intensive activity in regions I and V, moderate activity in regions II, VI and VII, slight activity in region IV and no activity in region VIII. The Cooperative Strengthening project plans to extend its activities to most of the country through FENACOAC. The Commercial Land Markets II project plans to have moderate activity throughout the entire country (minus region III). The Agricultural Production and Marketing Services project plans to have intensive activity in regions I, IV and VI and no activity in the rest of the country.

Following is a brief description of affected regions and relevant projects' activities.

A. Region I

This is the Western portion of Guatemala. It has the highest elevations of the country and a markedly irregular topography. Land pressures are highest in this region (191 persons/km - country average: 80 persons/km) and farm sizes are smallest (0.2 ha/person - country average: 7.9 ha/person) (AID 1988). It has the highest percent of below-subsistence-level farms (33.2% of total number of farms in the entire country) and subsistence farms (11.4% of total), which together comprise only 5.6% of the country's agricultural area (ICATA/AID 1984).

It covers approximately 18,127 km and about 17% of the country's entire territory. Its 1988 population is 2,386,366 inhabitants distributed in 110 municipalities (APROFAM 1988). Its altitude ranges between 900 and 3,400 meters above sea level with an average temperature of 18 C. The average annual rainfall is 1,500 mm and the rainy season lasts approximately six months.

REGION I

Quetzaltenango
San Marcos
Totonicapán
Huehuetenango
El Quiché
Sololá

REGION V

Guatemala
Chimaltenango
Sacatepequez
El Progreso
Salamá

REGION VI

Jutiapa
Jalapa
Santa Rosa

REGION VII

Zacapa
Chiquimula
Izabal

REGION II / VIII

Cobán
Izabal
Purulhá (Baja Verapáz)
Uspantán (Quiché)

REGION IV

Escuintla
Suchitepequez
Retalhuleu
Quetzaltenango (parte baja)
San Marcos (parte baja)
Chimaltenango (parte baja)

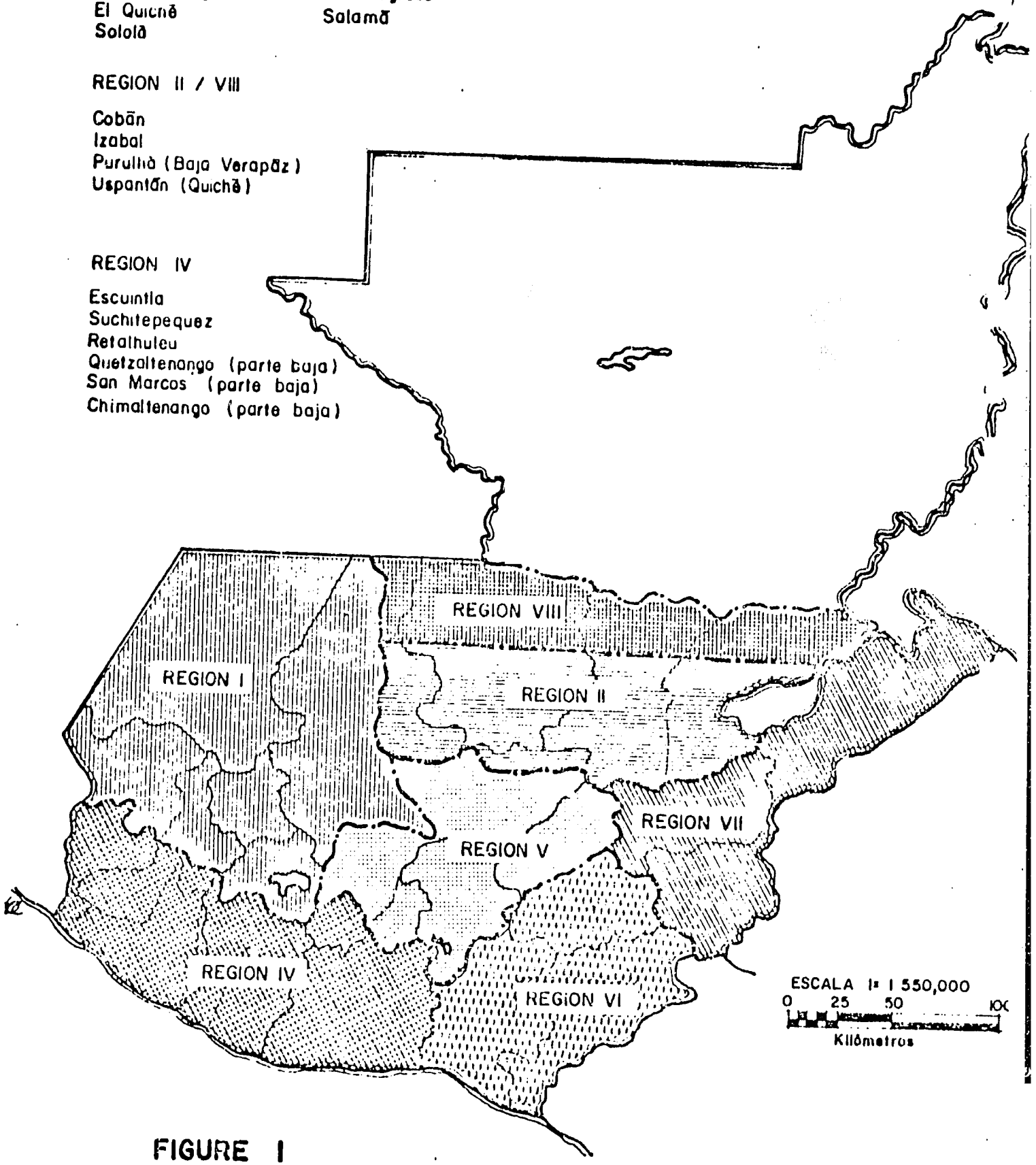

FIGURE 1
MAGA REGIONS PARTICIPATING IN ORD PROYECTS

Three ecological zones predominate in this region:

- Humid mountainous low sub-tropical forest;
- Humid sub-tropical forest (temperate);
- Very humid mountainous low sub-tropical forest.

The predominant crops in this region are: coffee (Coffea spp.), wheat (Triticum spp.), apple (Malus spp.), pear (Pyrus spp.), peach (Prunus spp.), avocado (Persea americana), banana (Musa spp.), corn (Zea mays), beans (Phaseolus spp.), potato (Solanum tuberosum) and cabbage, broccoli, cauliflower and brussel sprouts (Cruciferae).

Natural vegetation includes oak (Quercus spp.), generally associated pine (Pinus spp.), spruce (Abies spp.), alders (Alnus spp.) and cypress (Cupressus spp.).

The region is inhabited by a variety of ethnic groups of Mayan descent. Several different languages are spoken and native clothing is common. The predominant ethnic groups are Quiché, Cackchiquel, Tzutuhil and Mam. To the north of Huehuetenango and Quiché live Kanhobal, Ixil, Popoti and Chuj indians (ICATA/AID 1984).

In recent years, an increased entrepreneurial commercial spirit has begun to develop among the Indian populations, especially in the larger towns. This offers an apparent contrast with the more traditional farming Indians. Changes in communications and family structure have turned these Indians into merchants and entrepreneurs more competitive than their "ladino" counterparts (ICATA/AID 1984). Again, these changes may reflect an increasing struggle for subsistence as populations grow and land pressures increase.

Highland Agriculture Development and Small Farmer Diversification project activities in this region have been extensively discussed in a companion document (CICP/ECOTECNIA 1988) and are not discussed here.

The Agribusiness Development project has had little activity in this region to date. BANDESA has granted credit to an apple cooperative (Los Manzaneros) in the department of El Quiché (Juan M. Paz, BANDESA, personal communication 1988). However, the potential for granting production (including pesticide) credits is large in this region.

The Commercial Land Markets II project, through FUNDACEN, is working in intensive agriculture crops in this region. A group at Choaquiej, San Andrés Semetabaj, Sololá is receiving technical and financial assistance. A private exporting firm (ALCOSA) is assisting them in pesticide procurement and use. Other FUNDACEN projects in the region include Sucum (in the same municipality)

and Maria Linda, in San Jose Xacayá, Sololá.

Based on FUNDACEN's perceptions of user benefits, this activity is likely to be continued and expanded in the future.

The Cooperative Strengthening project, in its initial stages (institutional development and training), has been concentrated in this region and future plans are to have a strong influence in agriculture through the credit component. Agricultural cooperative federations affiliated to the project in this region include FECOAR and FEDECOAG. Other federations include ARTEXCO (folk crafts), FENACOAC (savings and loans) and FEDECOM (consumer goods). Of those mentioned, FECOAR will be the first to receive short-term credit (for production) and long-term credit (for investments). The purpose of these credits with be to improve traditional crops, such as corn, beans, and wheat, in the region (D. Fledderjohn, personal communication 1988).

In addition, this project plans to establish 80 demonstration plots of corn in 1989, to show the use of fertilizers and genetic improvement. Its purpose is to promote the use of new fertilizer formulas and new seeds that will be sold by the federations.

The Agricultural Production and Marketing Services project has not worked in this region yet. It plans to extend production credits, technical assistance and training through AIFLD/CUSG. Production credits will emphasize agricultural diversification.

B. Regions II and VIII

These adjacent regions are discussed together because of their ecological, geological, hydric, agricultural and cultural similarities.

They comprise the departments of Alta Verapaz, the Purulhá municipality of Baja Verapaz, the Uspantán municipality of El Quiché and the northern part of Lake Izabal in the department of Izabal. Total area for these regions is 16,063 km2 and its total population is 698,165 inhabitants (APROFAM 1988).

Both regions are located just north of central Guatemala, region VIII bordering the Petén department.

Predominant cultures in these regions are Keckchi, and to lesser extents Pocomchi, Uspanteco and Ixil (ICATA/AID 1984).

Roads are poor, especially in region VIII, the area known as the Franja Transversal del Norte. Two roads, primarily serving oil fields are its only access. The regions are perceived as having a high economic development potential because of possible

oil deposits. Currently, subsistence agriculture prevails among small and medium size farmers (ICATA/AID 1984).

Percentage rural population is high in these regions (84% compared with 61% national average). Public services are scarce in spite of high population densities (ICATA/AID 1984).

Predominant ecological zones include:

- Very humid sub-tropical forest (hot)
- Very humid sub-tropical forest (temperate)
- Very humid tropical forest
- Rain sub-tropical forest
- Humid sub-tropical forest
- Rain mountainous low forest

Climate is very variable. In most of the regions, annual rainfall is high and between 2,000 to 3,000 mm, with some areas receiving as much as 5,000 mm. Rainy seasons last from 9 to 11 months per year (De la Cruz 1982).

Temperatures ranges between 16 to 27 C, region VIII having the higher temperatures.

Main crops in these regions include coffee, cardamon (Elletaria cardamomum) and cacao (Theobroma cacao L.). Annual crops encounter problems due to high rainfall and little soil depth. Most farmers produce corn and beans and the potential for agricultural diversification is considered limited (De la Cruz 1982).

Natural vegetation includes "ramón blanco" (Brosimun alicastrum), "Manchiche" (Lonchocarpus sp.), "palo sangre" (Virola sp.), "Guarumo" (Cecropia sp.), Petén pine (Pinus caribaea), "sad" pine (Pinus pseudostrobus), "aguacatillo" (Persea donnel smithii), sweet gum (Liquidambar styraciflua), magnolia (Magnolia guatemalensis), giant begonia (Gunnera sp.) and others.

These regions have a high forestry potential and some extensive cattle production potential. Ecosystems are fragile because of the thinness of soils and high rainfall.

The Commercial Land Markets II project supports coffee farms in Tucurú and Cahabón, Alta Verapaz.

The Cooperative Strengthening project is working in this region through FEDECOVERA. Based on estimates from project personnel, 2 out of 3 beneficiaries of this federation (28 cooperatives and 6,000 affiliates) are located in the Polochic valley and principally dedicated to coffee cultivation. This target group has received training in institutional development

and may potentially be agricultural beneficiaries through the credit component.

C. Region IV

It borders region VI to the east, Mexico to the north-west, regions I and V to the north and the Pacific ocean to the south. Comprises the departments of Escuintla, Suchitepequez, Retalhuleu and lower portions of Quetzaltenango and San Marcos. Covering 11,375 km , it is inhabited by 1,481,513 people (APROFAM 1988) and it is the third largest in size but the most important economically, because of traditional agriculture activities, including coffee, sugarcane, cattle and cotton.

An outstanding feature of this region is the number of rivers that traverse it. It is estimated that nearly 23 billion cubic meters of water flow from the highlands down to the Pacific ocean through this region. The largest underground water reservoirs are located here.

Its geological origins are quaternary flood plains and volcanic formations in intermontane valleys. Acquifers are formed in pyroplastic quaternary deposits near the surface. Some studies have obtained yields from 13 to 76 m3 of water per second (ICATA/AID 1984).

Its topography is considered the most uniform of the entire country. Good soils and rainfall patterns, access to ports and markets and good roads contribute to this region's agricultural importance.

While there are areas where the Tzutuhil language is spoken, most Indian populations found in this region are migrant workers from the highlands.

Predominant ecological zones include:

- Very humid sub-tropical forest (hot)
- Humid sub-tropical forest (hot)
- Dry sub-tropical forest.

Higher areas get as much as between 2,100 to 4,300 mm of rainfall per year, distributed in 7 - 10 months. The lower areas get between 500 to 2,000 mm per year, in 5 to 6 months. Temperatures range from 19 to 27 C, and are particularly high in areas centrally located with respect to the coastline and the piedmont. Elevations range between 0 to 1,600 meters above sea level.

Main crops include cotton (Gossypium hirsutum), sugarcane (Saccharum officinarum), plaintain and banana (Musa spp.),

coffee, rubber (Hevea brassilensis), cacao (Theobroma cacao), corn, beans, rice, sorghum (Sorghum vulgare) and sesame (Sesamum indicum).

Natural vegetation includes "corozo" (Scheelea preussii), cabbage tree (Andira inermis), "volador" (Terminalia oblonga), "kola" (Sterculia apetala), blackberry (Chlorophora tinctoria), laurel (Cordia alliodora), red mangrove (Rhizophora mangle), "ceibillo" (Ceiba aescutifolia) and others.

The Commercial Land Markets II project supported a coffee farm (it burned down in 1987 and it has no beneficiaries at the present time) and another with pineapple in Guanagazapa, Escuintla and three more in San Vicente Pacaya (Escuintla), Santa Barbara and San Juan Bautista (Suchitepéquez); the last has not been distributed to beneficiaries yet.

The Agricultural Production and Marketing Services project intends to work in this region, mainly in sesame production. High number of agricultural worker unions are located in this region.

The Cooperative Strengthening project has a relatively low potential for activities in agriculture in this region, even though 8 cooperatives are affiliated to FENACOAC (4 - Esquintla, 1 - Mazatenango, 2 - San Marcos, 1 - Coatepeque) and they are oriented towards savings and loans and to the consumer.

D. Region V

This region consists of the central portion of Guatemala, which includes the departments of Guatemala, Baja Verapaz, Chimaltenango, El Progreso and Sacatepéquez. Altitude ranges between 250 meters above sea level in El Progreso to 2,300 meters above sea level in Chimaltenango. Its total area is 9,616 km , with a 1988 population of 2,538,000 (including Guatemala City) (APROFAM 1988).

The predominant life zones in this region are:

- Humid sub-tropical forest (temperate);
- Humid mountainous low forest;
- Dry sub-tropical forest.

Annual rainfall, concentrated in the second half of the year, is 500 - 1,600 mm and temperatures range between 19 to 26 C.

Crops of this region include: corn, beans, cabbage, broccoli, cauliflower, brussel sprouts, tomato (Lycopersicum sculentum), pepper (Capsicum spp.) and other products of

intensive agriculture. Also common are fruit trees, such as peach, apple and avocado. Large areas of forest potential land use exist in this region.

Representative species of the region are: leucanena (Leucaena guatemalensis), oak, pine and cow tongue (Curatella americana). Its soils have good physical and chemical qualities and through irrigation could develop their full agronomic potential.

HAD activities in this region have been covered in a companion document (CICP/ECOTECNIA 1988).

The Agribusiness Development project includes two of its main beneficiaries in this region, the Cuatro Pinos and Magdalena cooperatives. Both export non-traditional vegetables and have received credits for plant equipment and vehicles. Export agriculture potential is high in the region and likely the Agribusiness Development project will continue to support its development.

The Commercial Land Markets II project has had some activity in this region. Some preliminary land-purchase activities have started in the Chimaltenango area. The idea is to develop small farmer horticulture. One of these farms has already started operations at Parramos, in the department of Chimaltenango.

After Region I, this would be the next region with the strongest influence by the Cooperative Strengthening project. The two principle federations working in this region are FECOAR and FENACOAC. Both have been involved in the project through institutional development and training (financial stability), and of these FECOAR will begin using credit for agriculture in 1989.

Cooperatives affiliated with federations supported by the Cooperative Strengthening project grant production credits for small farmer horticulture in the Chimaltenango area as well, although the money being used comes from other sources.

E. Region VI

It is located in the Southern and South-Eastern portion of Guatemala. It covers 8,237 km and had 760,855 inhabitants in 1988 (APROFAM 1988). The terrain consists of flatlands, rolling hills to slightly irregular terrain in parts of Jalapa and Jutiapa. Soil quality varies. Good quality soils are found in the flatlands and very poor soils on the hillsides. Potential land uses for some of these soils are forest management and wildlife conservation.

The main life zones in this region are:

- Sub-tropical dry forest;
- Humid sub-tropical forest (temperate).

Temperatures range between 18 and 26 C. Annual rainfall is between 500 and 1,350 mm. and concentrated in the second half of the year. Altitudes range between 200 and 1,750 meters above sea level.

The most important crops are: corn, black beans, rice (Oryza sativa), tomato, tobacco (Nicotiniana tabacum), watermelon (Citrullus vulgare), melons (Cucumis melo), onion (Allium cepa), and pastures.

The principal species of this region are: leucanena (Leucaena guatemalensis), pitch pine (Pinus oocarpa) and oak.

The HAD project has been working in all departments of the regions. The greatest activity has taken place in Jutiapa and in the higher elevations of Santa Rosa.

HAD project activities in this region are described in a companion document (CICP/ECOTECNIA 1988). The SFD project has had no activities in this region.

The Commercial Land Markets II project has had relatively little activity in this region. Some land acquisitions have been negotiated and concluded but no reselling to small farmers has taken place yet.

The Cooperative Strengthening project potential for activity in this region is relatively low. Cooperatives affiliated with FECOAR are located in Jutiapa and in Monjas. The rest of the region does not have agricultural cooperative activity. There are 3 affiliates of FENACOAC in this region, 1 in San Pedro Pinula (Jalapa), 1 in San Rafael Las Flores and 1 in Nueva Santa Rosa (both in Santa Rosa). Regional activity of this project would be directed at traditional crops, such as corn, beans and rice, with short- and long-term credit mainly for FECOAR affiliates.

The Agricultural Production and Marketing Services project intends to promote productivity and production increases in traditional crops in most of this region through appropriate technology development and credit. Climate and soil are limiting factors to crop diversification in this region. The project plans to further investigate diversification options and improve marketing mechanisms through small agrarian labor unions.

The Agribusiness Development project has acquired increased

importance in the region, with the extension of credit to tobacco growers (Juan M. Paz, BANDESA, personal communication 1988). Pesticide and application costs as a percentage of total costs in tobacco growing are 25% in this region (BANDESA 1988).

F. Region VII

It is located in the eastern and north-eastern sections of Guatemala and includes 3 departments of which two are affected by HAD-I (Rolando Sánchez, DIGESA, personal communication 1988). The affected area covers 5,066 km in 2 departments, Zacapa and Chiquimula, and has a population of 390,000 inhabitants (APROFAM 1988). Altitudes range between 150 and 1,350 meters above sea level; temperatures between 19 and 28 C; annual rainfall between 400 and 1,350 mm, distributed in the months of May through November.

The life zones in this regions are:

- Dry sub-tropical forest;
- Humid sub-tropical forest (temperate);
- Thorny sub-tropical brush.

High levels of evapo-transpiration and insolation characterize this region. Soils are moderately deep in the flatlands and poor, shallow and rocky in the higher regions.

Crops commonly found in the lower elevations are tomato, tobacco, okra (Hibiscus esculentus), Cucurbitaceae, pepper and other Solanaceae. In the higher elevations, beans, corn and other less intensive crops are found.

The natural vegetation consists of royal palm in the lower elevations, tuno (Camaerocerius sp., Cephalocerius sp., Nopalea sp.), gum trees (Acacia spp.), "upay" (Cordia alba), "pitaya" (Pereskia spp.), leucaena and in the higher elevations, pitch pine and oak.

HAD activities in this region are described in a companion document (CICP/ECOTECNIA 1988).

The SFD project has not operated in this region.

The Commercial Land Markets II project has one coffee farm at El Mirador, Usumatlán, Zacapa.

This region has the lowest potential for Cooperative Strengthening project activities, in reference to agricultural activities. No plans exist to provide credit or promotion activities in this region since most of the cooperatives are affiliated "in name only" to FENACOAC. In addition, FENACOAC is

not an immediate beneficiary of the credit component.

The Agribusiness Development project has not worked in the region yet, but may in the future, as potential credit beneficiaries are expanded to include tobacco growers.

The Agricultural Production and Marketing Services does not include this region in its target areas.

III. INSTITUTIONAL RELATIONSHIPS, ROLES AND RESPONSIBILITIES

This Chapter identifies the governmental, non governmental, international and private entities that are involved or likely to be involved in the implementation of the four ORD projects.

They are:

A. Ministry of Agriculture
   1. DIGESA
   2. ICTA
   3. BANDESA
   4. CONACOMIP
   5. Major Institutional Weaknesses

B. Ministry of Health and IGSS
   1. Ministry of Health
   2. IGSS

C. Ministry of Labor

D. Interministerial Groups
   1. Interministerial Commission on the Safe Management of Pesticides
   2. National Environmental Commission

E. NGO's/PVO's
   1. CARE
   2. Penny Foundation-FUNDACEN
   3. AIFLD/CUSG
   4. AGMIP

F. Universities
   1. University of San Carlos
   2. Del Valle University

G. Regional and Other Resource Institutions
   1. IICA
   2. ICAITI
   3. CATIE/MIP
   4. OIRSA

H. Private Sector
   1. Cooperatives
   2. GREPAGRO

A full description of these organizations and institutions is presented in Appendix 12. Their current roles, relationships and responsibilities as well as their potential roles in implementing recommendations stemming from this Environmental Assessment are highlighted in that appendix.

IV. LEGAL MANDATES

Existing and proposed Guatemalan laws were analyzed in reference to the environment, pesticides, natural heritage, water and forest resources in relation to the ORD projects.

A. National Environmental Law

Ever. though the Guatemalan Law for the Protection and Improvement of the Environment requires an environmental impact evaluation of projects or works, there is no regulation that stipulates the requirements and scope this study must have. Article 8 of the Law for the Protection and Improvement of the Environment states "For all projects, works, industry or any other activity that by its characteristics can cause deterioration of the natural renewable or nonrenewable resources, or the environment, or introduce harmful or noticeable modifications to the countryside and the cultural resources of the natural national heritage, before development is carried out an environmental impact evaluation must be done by experts in the field and approved by the Environmental Commission."

Since the principal objectives of the six projects is to develop and increase the production of the small farmer in rural areas, through crop diversification, agribusiness development, cooperative strengthening, promotion of new production systems, land and agricultural marketing, no major conflicts were found between the implementation plans for the six projects and the existing and proposed laws of Guatemala. Revision of the HAD Amendment, mid-term evaluations and the project papers of the other five projects showed that their basic focus is adequately within the context for, or does not conflict with, watershed management and resource conservation. The Environmental Law's, Article 12 paragraph b) objective refers to "the protection, conservation and improvement of the country's natural resources, as well as the prevention of the deterioration, misuse or destruction of the [same] ..."

B. Proposed Water Law

Even though legislation exists that includes articles or regulations for water, such as the Environmental Law and the Political Constitution of Guatemala (Articles 127 and 128), they are either very general or overly specific.

This should change if the proposed General Water Law becomes effective. The purpose of this law is to fill the gap caused by the lack of central regulation to "regulate the dominion, exploitation, use, enjoyment and conservation of the waters and the other public domain water resources; the construction, modification and demolition of public works that affect them to guarantee the satisfaction of social needs, at the same time regulate the tenure of the domain, use and conservation of the waters, works and other private domain water resources." (Article 1)

All the waters in the country are considered public property in the Constitution which took effect January 14, 1986. Private water rights acquired before this date remain as such but, the title of water rights must be entered in the register administered by the Application Authority (Articles 16 and 18).

If this water law is passed, the Application Authority, in charge of the execution of this law and its regulations, will be the only entity that can grant water rights for any use. Rights for agricultural use will be granted if the land can be conveniently drained, the soil is apt for the proposed crop and there is the quantity, quality and availabilty of water. In addition the Authority will have to be notified when the right granted can be used to irrigate a larger area than that which was approved originally or if not all of the right granted is used. This law also establishes the priorities for use of water in Article 31: "a) Energy; b) Domestic and population requirements; c) Agriculture, forestry, fishery and aquaculture; d) Industrial; e) Mining; f) Recreational; g) Other uses." The General Water Law does not specify any priority between agricultural, forestry, fishery or aquaculture uses. But, in relation to state agricultural and forestry programs Article 72 states that these activities will be subject to special regulations based on the objectives of the sector benefitted/affected and the National Water Plan.

Concerning water contamination, the Law (Article 99) "prohibits dumping or introducing to any body of water, riverbed that may or may not convey clean or sewer or waste waters, any solid, liquid or gaseous residues that could contaminate the waters, deteriorate works or other water resources detrimental to public health, subsequent uses, natural resources and the environment." Also, Article 100 stipulates that persons or entities that cause deterioration in the quality of water should take the necessary steps to diminish the contamination or improve the quality of these waters at their own expense.

C. Existing and Proposed Forestry Laws

Existing legislation on forestation/reforestation is included from the Constitution and the Forestry Law (Decree No. 118-84). DIGEBOS (formerly INAFOR) is the administrator of this law "whose objective is to protect, conserve, promote and propitiate the exploitation of the forest resources. Accordingly, it will be governed by it [the law] and its Regulation, the forests, conservation areas, extracts and forest products, the lands covered by forests and those that qualify as dedicated to forestry, notwithstanding it's legal ownership" (Article 1). Clearing forests for agricultural uses requires previous authorization from DIGEBOS and forestation of an area equal to that transformed. If there is not enough area available to forest, Q2.00 per square meter (U.S. $0.74) will be paid to the Private Forestry Fund for the area transformed. Article 18 stipulates that the State must previously acquire private property affected by the establishment of conservation areas before these are carried out.

A new proposed Forestry Law would replace the existing law if approved by the Congress of Guatemala. "...Its essential and primary objective is to monitor the protection, conservation, exploitation, industrialization, management and promotion of the country's forest resources in conformance with the principles of sustained rational use of the renewable natural resources." This new law would require the committment of all persons or entities that exploit forest resources, nonrenewable natural resources, water resources and/or works that use this resource and develop agricultural areas. Forestation should begin no later than one year after forest resource exploitation, a water resource use, or shifting land use for agricultural purposes is begun. In this last case, the alternative is to pay 20, 3 or 2 % for annual crops, permanent non-tree crops, and permanent tree crops, respectively, "of the cost of forestation and maintenance for four years determined on the basis of the surface transformed and the costs of forestation published annually" (Article 33). In areas converted to agricultural use without forest coverage, the new law would require that certain required practices be instituted for soil conservation. The main difference between this law and the existing law, is that the existing does not include the requirement of forestation when exploiting water resources.

D. Natural Heritage Law

The six ORD projects under evaluation are located throughout most of Guatemala. Steps should be taken to insure that during implemention the projects have a minimum environmental impact,

protect the wild flora and fauna and the natural resources, such as biotic communities, water sources, watersheds and agricultural soils.

Another proposed law that could affect the ORD projects is the Natural Heritage Law of Guatemala. This law, in addition to "insuring the maintenance of the essential ecological processes and the vital natural systems for the development of Guatemala" and "achieving conservation of the genetic diversity of the wild flora and fauna of the country;" will expand and increase the protected areas for the conservation of the wild flora and fauna and their habitats. With the possible expansion of these protected areas, which include national and regional parks ("biotopos"), biological reserves, forest reserves, resource reserves, private natural reserves and others, it is possible that some work areas of the ORD projects will fall within the protected areas. In this case, even if it is private property, these lands will have to be managed and maintained in accordance with the norms and regulations of the National Heritage Law, and if not, the State has the right to acquire them. Specifically, in Article 27 it states that "public or private enterprises that actually have or that will develop activities or installations ...., fishing or forestry, agricultural or experimental, within the perimeter of the protected areas, must sign a contract in which the conditions and norms will be established, determined by an environmental impact study, under which the mentioned companies will operate, provided that its activity is compatible with the area it is related to."

E. Pesticide Legislation

Finally, the major emphasis of this project is to evaluate the environmental impact of pesticides in ORD projects.

These six projects promote the development of the small farmers by providing credit for traditional crops, such as corn and wheat and the agricultural diversification that includes non-traditional crops such as snow peas, broccoli, brussel sprouts, strawberry and others. In addition to the common use of pesticides for traditional crops, introduction of non-traditional crops results in an increased use of chemical pesticides to combat pests and diseases. The Plant Health Law, Article 3 states that the farmers have the obligation to "exterminate and combat existing pests and diseases and stop their diffusion outside the country." Also the Law concerning the Importation, Creation, Storage, Transportation, Sale and Use of Pesticides (Decree No. 43-74) stipulates it is the Ministry of Agriculture's "obligation to introduce predators or natural enemies to combat pests, such as: beneficial insects, bacteria, fungus, etc., whose importance leaves it free of any burden.

Likewise, support and promote all private and government activities dedicated to the reproduction or artificial breeding of predators, with the aim of combating agricultural pests." (Article 5 paragraph c)

Pesticides are included as part of the complete package in these projects to diversify and increase agricultural production. The "Regulation on the Importation, Creation, Storage, Transportation, Sale and Use of Pesticides" regulates all pesticide activities in Guatemala. Pesticides include insecticides, fungicides, herbicides, nematocides, acaricides, plant regulators and other similar products. In addition to the requirement that all importation, creation, storage, transportation, sale and use of pesticides must be authorized by the Ministry of Agriculture and Public Health, Article 6 requires that pesticides be previously registered in the Ministry of Agriculture. Before registration the Regulation on Research and Evaluation of Agricultural Chemicals (Article 1) states that ICTA is responsible for "the execution or supervision of field research and evaluation of agricultural chemicals ..." The objective of these activities is "to determine the level of effectiveness and dosage of the agricultural chemicals for field applications, in conformance with the commercial use recommended by the manufacturer." (Article 3)

Regarding hygiene and personal safety Article 21 paragraph 2 of the pesticide regulation states that persons or entities that are involved in any of these activities should "provide the workers with the required personal protection equipment ..." This includes a hat, mask, overall, gloves and boots. Article 24 paragraph d) states that all persons in contact with pesticides should "have proof that training was received on the use and dangers, given by the General Administration for Agricultural Services, Ministry of Agriculture and Social Prevention and the Guatemalan Institute for Social Security; as well as knowledge of personal hygiene measures, prevention and first aid in the use of pesticides." As a prevention measure Article 36 states that workers in contact with pesticides should get periodic medical examinations, specifically to check cholinesterase levels from the effects of organophosphates. These examinations are to be done by the Guatemalan Institute for Social Security. Article 23 paragraph 5 stipulates that the area where pesticides are being applied should be "removed 100 meters from lakes, lagoons, fountainheads, rivers, brooks or streams that are for public or general use ... with the purpose of protecting humans, aquatic species and cattle..."

Revision of the existing laws regulating fumigation demonstrated that no laws exist governing ground spraying activities. Existing laws only cover aerial spraying.

In summary, 1) the six projects of the ORD fall within the existing legislation relating to the management of natural resources; 2) once approved the proposed water law would introduce important modifications to the execution of ORD projects including: a) the requirement to obtain prior approval before execution of any projects exploiting water resources and b) requiring persons or entities causing contamination of water resources to reduce contamination or improve the quality of these resources at their own expense; 3) pesticide users may not be complying with the pesticide regulation in regards to protective equipment, medical examinations and the distance between the pesticide application area and water sources for public use.

The following is a list of the laws reviewed:

Law/Regulation	Date/Status
Regulation on the Importation, Creation, Storage, Transportation, Sale and Use of Pesticides	19 April 1974
Law concerning the Importation, Creation, Storage, Transportation, Sale, and Use of Pesticides (Decree No. 43-74)	30 May 1974
Law for the Protection and Improvement of the Environment	5 December 1986
Forestry Law (Decree No. 118-84)	20 December 1984
Vegetable Sanitation Law (Decree No. 446)	25 October 1955
Institutional Regulation - Research and Evaluation of Agricultural Chemicals	12 November 1986
Political Constitution of the Republic of Guatemala	31 May 1985
Decree No. 375 (Aerial Fumigation)	2 September 1975
Water Law (Proposed)	Under revision by the National Environmental Commission
Forestry Law (Proposed)	Law temporarily withdrawn from revision process in June 1988

Natural Heritage Law of Guatemala (Proposed)	Law temporarily withdrawn from revision process in June 1988

V. CROP PROTECTION - PEST AND PESTICIDE MANAGEMENT

A. Special Considerations of Pesticides

This section summarizes specific problems of pesticide use in Guatemala, as they relate to all ORD projects under evaluation. The analysis applies to the Small Farmer Diversification, Highlands Agriculture Development, Agribusiness Development, Commercial Land Markets II, Cooperative Strengthening and Agricultural Production and Marketing Services projects.

The objective of the analysis was to identify and describe significant environmental effects of pesticide use supported by actual or potential actions of ORD projects. Part 216 of the Code of Federal Regulations (22), especially 216.3(b) **Pesticide Procedures** was the guiding frame of reference for the analysis.

Several analytical tools were used to develop the data on which the evaluation was based. They were:

1. A general survey of 469 farmers, including 351 ORD project beneficiaries and 118 controls; the questionnaire used in this survey is presented as Appendix 1.

2. Collection of various available statistics on human pesticide poisonings, production costs and pesticide imports.

3. Collection and laboratory analysis of environmental samples to detect presence of pesticide residues.

4. An epidemiological survey of 145 farmers in intensive and non intensive crops; questionnaire used is presented as Appendix 2.

5. An in-depth agroecological/economic survey of 14 farmers to detect specific pest and pesticide problems; questionnaire used is presented as Appendix 3.

6. An experiment of pesticide effects on non target organisms as Appendix 4.

7. A workshop to identify pesticide problems and solutions at the farmer's level.

Data were analyzed using standard personal computers and software such as DBase, Lotus and SPSS. Methodology and results are discussed in Section C, points 1 - 4 below. A summary of significant effects is presented here.

Under Regulation 16, a proposed action has a significant effect on the environment if it does significant harm to the environment [216.1(c)(11)].

Table 1 presents specific effects of pesticide use in Guatemala as they relate to ORD programs. Two categories are employed: Category A, Significant Environmental Effects or Insufficient Evidence to Dismiss Significance; and, Category B, No Effect or Negligible Effect. These categories serve to identify all potential environmental effects and separate those for which mitigative measures are designed.

Evidence on these effects is presented in Section C below.

Table 1. Specific Problems of Pesticide Use in Guatemala as they relate to ORD Projects

		CATEGORY A: Significant environmental effects or insufficient evidence to dismiss significance.	CATEGORY B: No effects or negligible effect.
1.	Human intoxication acute	*	
2.	Human intoxication chronic	*	
3.	Destruction of non target agricultural beneficials	*	
4.	Destruction of domestic animals/livestock		*
5.	Destruction of bees		*
6.	Destruction of fish and shellfish	*	
7.	Effects on other crops		*
8.	Potential pesticide residue in export crops/rejections	*	
9.	Crops of residue analysis in export crops	*	
10.	Potential pesticide residues in crops for local consumption	*	
11.	Cost of residue analysis for local produce	*	
12.	Increased production costs	*	

(Table 1. continued)

	CATEGORY A: Significant environmental effects or insufficient evidence to dismiss significance.	CATEGORY B: No effects or negligible effect.
13. Increased foreign currency demands	*	
14. Soil contamination	*	
15. Water contamination	*	
16. Increased cost of control	*	
17. Increased resistance of pests	*	
18. Increased pest outbreaks	*	

B. Component of Larger USAID/Guatemala Effort

This section describes crop protection and pesticide use in the context of the overall USAID/Guatemala mission strategy. It summarizes what may cause environmental effects in ORD projects and what USAID/Guatemala can do about it. Actual causes and effects are discussed under C below.

The CICP/ECOTECNIA EA team identified two major causes of potential pesticide effects in ORD projects. They are:

1. Inadequate crop protection technology; and,

2. Insufficient knowledge and/or resources to identify, prevent and solve human health pesticide problems.

1. Inadequate Crop Protection Technology

Crop protection technology in intensive export crops was found to rely for the most part on a nonecological and unsafe use of chemical pesticides. Pesticide selection, method of application and dosage were seldom influenced by the need to protect beneficial organisms and ecological factors affecting pest population development were not knowingly taken into account. Economic thresholds for pests were rarely used. As pesticides became ineffective, and sometimes even when they were effective, higher dosages, more poisonous materials and mixtures were used. (See Section C below).

2. Insufficient Knowledge and/or Resources to Identify, Prevent and Solve Human Health Pesticide Problems

While awareness of pesticide dangers varies and has variable effects on behavior, protective equipment is seldom available and/or used and health clinics are only visited approximately one out of four times of actual need to get pesticide intoxication treatment. About a third of surveyed farmers reported receiving no warnings on pesticide dangers and another third were reportedly told to just be careful. Some farmers reported that they simply were not afraid of pesticide poisoning.

The vast majority of farmers never used protective equipment while applying pesticides; that which was used, such as hats and boots, was standard peasant apparel. At a workshop on pesticide exposure and dangers various reasons were given for not using the equipment, ranging from that of being uncomfortable to inablity to finance. Only one in every 4 intoxication instances was

reported to either Public Health or Social Security clinics while use of home remedies was quite common.

Insufficient knowledge and/or resources to identify, prevent and solve problems of pesticide contamination of the environment in general was also apparent but the CICP/ECOTECNIA EA team did not find this to be a source of significant environmental harm. However, this factor will also be addressed when identifying mitigative measures.

Three alternative courses of action or strategy components, available to USAID/Guatemala in order to comply with 22 CFR Part 216.3(b) and mitigate significant environmental effects stemming from pesticide use in agricultural activities supported directly or indirectly by ORD projects, were identified:

i) NO ACTION

Do not support procurement and or use of pesticides directly or indirectly. This would imply ceasing most ORD agricultural activities in Guatemala. Enforcing compliance, especially in cases of indirect support, would be nearly impossible. Farmers who get support in other aspects would free some of their own resources for the procurement of pesticides.

ii) UMBRELLA PEST/PESTICIDE MANAGEMENT PROJECT FOR ALL ORD PROJECTS

Design and implement a pest/pesticide management project to provide this component to all USAID/G projects that support procurement and/or use of pesticides.

iii) INDEPENDENT ACTIONS UNDER EACH PROJECT'S RESPONSIBILITY

A pest/pesticide management component is designed, funded and implemented for each ORD project directly or indirectly supporting the procurement and/or use of chemical pesticides.

To avoid duplication of efforts and maximize effectiveness of resource use, and following directives contained in the SOW for this EA, an umbrella pest/pesticide management project is further developed as the prefered alternative. This would imply i) starting some specific actions under HAD-II while project documents are prepared, approved and signed and ii) phasing the pest/pesticide component of HAD-II into the larger ORD project.

The objectives of this pest/pesticide management project would be a) to implement IPM first in HAD-II and then in other ORD projects gradually to the maximum extent feasible, given present knowledge, resource and time constraints; b) to implement an agromedical approach to pesticide use in HAD-II and ORD projects; and, c) to set up an environmental protection and

monitoring system, including wildlife and rare/protected areas.

The strategy should encompass both HAD-II and other ORD projects. Maximum advantage would be obtained from the HAD-II organizational set up and resources without incurring any organizational, institutional or legal problems. For example, the pest/pesticide management specialist under HAD-II can act as an advisor in the development of the PID and PP for the umbrella project; results and experiences from HAD-II could improve the design of the larger project.

As the umbrella project got under way, the pest/pesticide management component of HAD-II would be phased into it. HAD-II could act as a "pilot" for the ORD P/PM project. While project preparation takes place, available mitigative measures can be implemented in other ORD projects, tailoring them to current project P/PM status and resource availability.

C. Affected Area

Environmental issues have already been discussed under A above, while geography and climate were dealt with in Chapter II. This section describes the affected area from the standpoint of tropical forests/protected areas and rare/endangered species.

1. Tropical Forests and Protected Areas

Three categories of protected areas fall in the area of operation of ORD projects. These are: I) Protected areas that are managed; II) Protected areas that are not managed; and, III) Proposed protected areas. These areas are presented in Appendix 10, Tables 1-3. Figure 2 shows the location of the existing protected areas.

The degree of management varies even in those areas considered under management. For instance, management is considered adequate in the Biotopo Universitario para la Conservación del Quetzal.

Tropical forests and unique habitats include the cloud forests of Alta Verapaz, lake Atitlán's watershed, the María Tecún heights, the Cuchumatanes, the Pasión and Chixoy rivers and the Pacific coast mangrove forests.

Appendix 10, Table 4 presents a list of rare and endangered species compiled from all available sources.

2. Current Pesticide Use

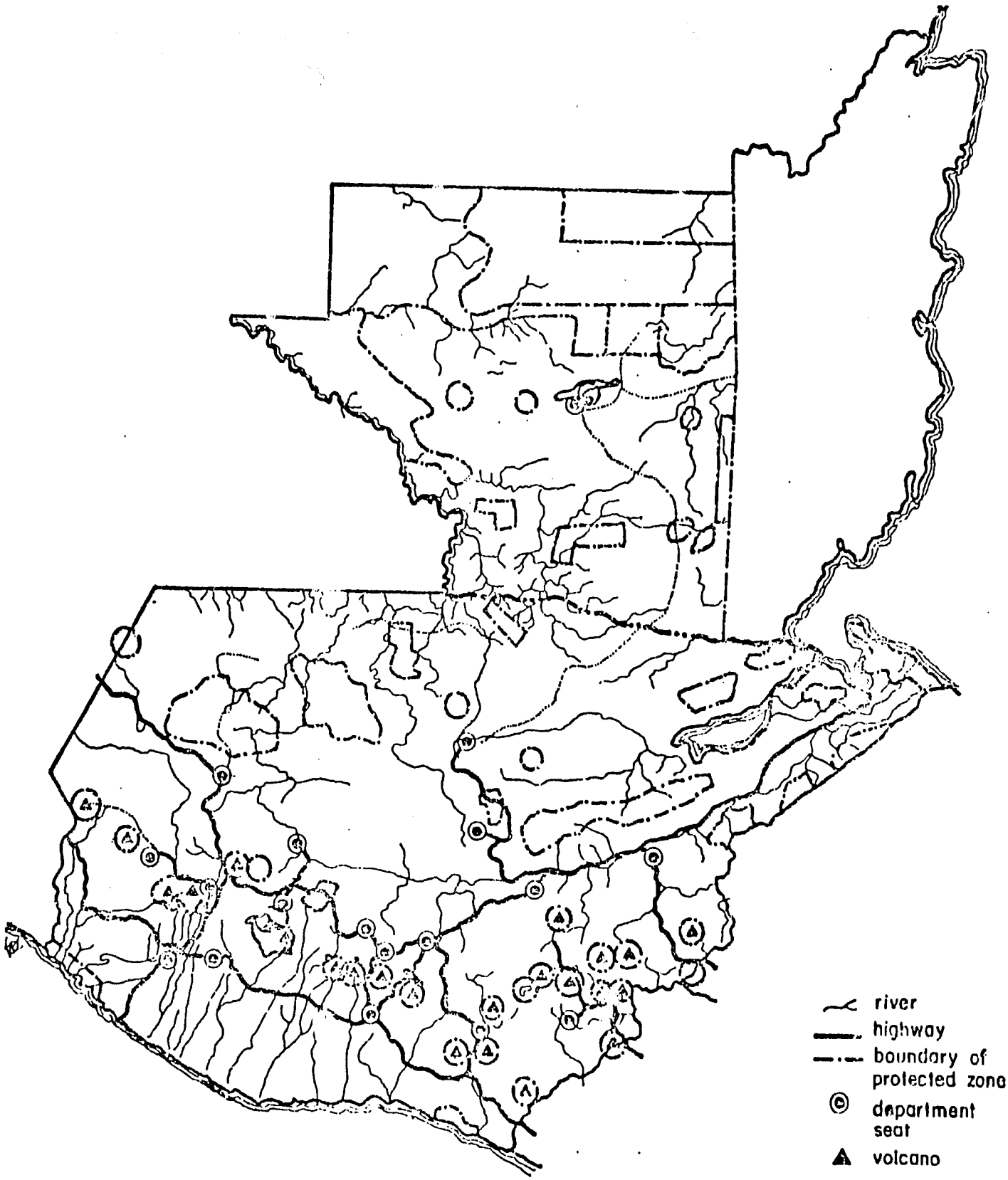

FIGURE 2
PROTECTED ZONES IN ORD PROJECT AREA

In order to determine types of crops financed through USAID projects, cropping practices, types of pests and trends in pesticide use, the CICP/ECOTECNIA EA team conducted a survey of 469 farmers in the regions under study. This survey included 351 farmers who were beneficiaries of ORD projects and 118 control farmers in the highland and coastal regions. See Appendix 6 for methodological details.

All current ORD projects were included in the survey. This includes the Highlands Agriculture Development, Small Farmer Diversification, Agribusiness Development, Cooperative Strengthening, Commercial Land Markets II and Agricultural Production and Marketing Services projects. The 46 coastal farmers were located in 8 micro-farm settlements established by INTA, out of a total of 64 spread along the coast from Escuintla to the Mexican border. These were included foreseeing future ORD activities in the area, either through HAD or through other projects.

a) Types of Crops

Analysis of the data reveals the crops being financed by USAID/G (See Appendix 7, Table 1).

b) Cropping practices

Field surveys were conducted to determine the types of crops being grown in the various regions, when they were being grown, the main pests involved and trends in pesticide use. The trend toward diversification, producing a greater variety of high value crops for export, has created problems of a different kind and magnitude than were observed with traditional cropping practices, particularly with insects and diseases.

Several cropping practices emerged as important from the crop protection standpoint. They are: i) Year-round or nearly year-round cultivation; ii) Different plant/harvesting times for the same and different crops in neighboring fields; and, iii) Inconsistent practices for disposal of crop residues.

Field observations and inspection of survey results showed that farmers try to keep their fields planted most of the year. Depending on the availability of water, dry season crops are more or less intensive, sometimes relying on the moisture left in soils after the rains have stopped. Weather patterns allow for some cover on fields in most of the places most of the year.

As a result, there are hosts for both pests and beneficials most of the year. With improper management, this could lead to severe outbreaks of certain polyphagous pests, since they are provided with a continuous host. The combination of a continuous

host sequence and intensive pesticide use could result in severe pesticide-related problems, for example, accelerated rate of resistance development, secondary pest outbreaks and other environmental and human health effects.

This is compounded by an irregular planting/harvesting pattern. Although planting of most crops is concentrated in some months, variations were observed as shown in Table 2.

Table 2. Number of months in which sampled farmers reported that they planted selected ORD financed crops, 1987.

CROP	MOST IMPORTANT MONTH	OTHER MONTHS REPORTED (NUMBER) 1
1. Apple	June	3
2. Bean	May	9
3. Beet	October	7
4. Broccoli	May	7
5. Brussel sprouts	May	3
6. Cabbage	October	8
7. Cauliflower	January	
	June	
	October	5
8. Carrot	January	7
9. Corn	May	8
10. Fava bean	May	4
11. Garlic	October	4
12. Onion	March	11
13. Pea	May	4
14. Potato	April	11
15. Snow pea	May	7
16. Tomato	October	7
17. Wheat	June	4

Source: CICP/ECOTECNIA EA team farmer survey

Survey results showed that only 31% of the farmers destroyed crop residues. This means that crop residues are largely left on or in the ground until they rot or until fields are planted again.

c) Types of Pest by Crop

1) This is the number of other months mentioned by farmers in which planting of the particular crop took place.

Pests identified during survey, by crop are presented in Appendix 7, Table 2.

d) Pesticides procured through ORD Projects

Insecticides, fungicides and herbicides procured through ORD projects, according to farmers' survey, are presented in Appendix 7, Table 3.

e) MOSCAMED Program Implications and Impacts

The t[illegible]m reviewed the MOSCAMED EA conducted by CICP/IICA in early 1988. Several issues were found to deserve comment.

* Pest control efforts by the MOSCAMED program were found to bear no relation to the amount of economic damage inflicted by the medfly to Guatemalan fruit. Granted that an important objective of the MOSCAMED effort is to deter the insect's northern spread, its control has often been justified in Guatemala with no concrete appreciation of its potential economic damage. This is analogous to the pest control situation observed in most crops surveyed, where pesticides are applied on a calendar basis or as a preventive measure without an objective idea of potential economic damage.

* Malathion impact on non target organisms is discussed below.

Guatemala MOSCAMED applies aerial spray in alternate parallel strips, leaving 50% of the treatment area unsprayed in order to minimize damage to non target species. Other measures to reduce impact on non target species include:

* restricting the malathion bait spray treatments to coffee and fruit plantations;

* handling isolated medfly infestations by ground spraying host plants; and,

* spraying in calm conditions with large droplets to reduce drift.

An Environmental Impact Analysis was made by the CICP/IICA EIA team on the impacts of malathion spraying on naturally occurring non target organisms.

The CICP/IICA EIA-team studies showed that normal helicopter spraying (at rates used by Guatemala MOSCAMED) had no significant effect on non target arthropods (except for parameters included in one period) in a natural montane habitat and coffee plantation. Except in the one case noted, no statistically

significant differences were found in numbers of individuals, species, families or individuals per species or species diversity between sprayed and unsprayed areas in either the montane habitat or the coffee plantations.

Another study by the CICP EIA team on the impact on other invertebrates showed that results with airplane spraying were similar to those obtained from helicopter spraying. When high dosage ground spraying of coffee trees at the farm Las Nubes killed an average of 30.3 species and 62.5 individuals per manta, normal MOSCAMED helicopter spraying never exceeded an average of 11 species and 31 individuals.

In summary, very high dosages of malathion bait spray are harmful to a wide range of non target arthropods. However, CICP EIA team studies showed that normal helicopter spraying (at MOSCAMED program rates) had no significant effects on non target arthropods (except for parameters evaluated during period 3) in a natural montane habitat or coffee plantation.

Data on impacts on other organisms such as microorganisms and wild vertebrates were not obtained. However, it was concluded that impacts on most species of small mammals exposed to dosage rates required for insect control tolerated the insecticide quite well.

3. Impacts

This section discurses the potential environmental impacts of pesticide use in small farmer Guatemalan agriculture. Impacts, already listed in Table 1 above (pg. 39), are discussed below.

a. Non target Organisms

Because pests are almost never isolated and pesticides are seldom 100% specific, most pesticides have an effect on non target organisms. The CICP/ECOTECNIA EA team made an attempt to document these effects in a typical small farmer situation in a highland crop, broccoli. Three 625 m plots planted with broccoli were chosen: one that had been recently transplanted, another in the midst of the vegetative cycle and another ready for harvest. One half of each plot was treated with a mixture of 60 g manzate, 50 cc ambush and 100 cc complesal per 18 liter application pump; the other half was left untreated. Two replicates of the experiment were obtained (See Appendix 4).

1) No significant differences in the biodiversity index were found before and after treatment when the plantation was young (8 days after transplant) and near harvest (60 days after transplant) in

TABLE # 3

RESULTS OF ANALYSIS OF PESTICIDE RESIDUES IN ENVIROMENTAL SAMPLES
OCTUBER 11 - 13 1,988

No	FARM	LOCATION	METAMIDOPHOS			CYPERMETHRINE			PHOSPHORUS PESTICIDES IN GENERAL			Jan/
			WATER (ppb)	SOIL (ppm)	PRODUCT (ppm)	WATER (ppb)	SOIL (ppm)	PRODUCT (ppm)	WATER (ppb)	SOIL (ppm)	PRODUCT (ppm)	RAIN
1	El Termal (1)	Joyabaj	ND	0.03	0.04							15
2	El Termal (2)	"	nd	0.02	4.18							15
3	Choaquiej (1)	San Andres S										12
4	Choaquiej (2)	San Andres s				nd	0.01	0.002				12
5	Choaquiej	San Andres S										12
6	Sta Lucia Utatlan	Solola	nd	0.03	0.01							12
7	Sta Lucia Utatlan	Solola										12
8	Xetzaru Bajo	Patzun										12
9	Xetzaru Bajo	Patzun							nd	nd	traces	9
10	Xetzaru Bajo	Patzun							nd	nd	traces	9
11	Chirijuyu	Tecpan	nd	0.03	0.1	nd	nd	traces				9
12	Chirijuyu	Tecpan	nd	0.03	0.1	nd	traces	0.002				9
13	Chirijuyu	Tecpan	nd	0.03	0.1	nd	traces	0.002				9
14	Chirijuyu	Tecpan				traces	0.01	traces				9

nd = no detection
traces of Cypermethrine in soil= less 0.01 mg/kg (ppm)
traces of Cipermethrine in water= less 0.03 ug/litro (ppb)
traces of Cipermethrine in product= less 0.002 mg/kg (ppm)
traces of Phosphorous pesticide in product= less 0.005 mg/kg

any of the plots.

2) However, significant (= 0.01) differences were found in the biodiversity index before and after treatment when the plant was in the midst of its vegetative cycle (30 days after transplant) and arthropod populations were at their highest.

3) Significant (= 0.01) mortality was also caused in spiders and Collembola both in the mid-season and near-harvest plots.

4) No conclusive results can be obtained by one experiment consisting of one treatment. Multiple applications may have different effects.

5) Plots were small and surrounded by other crops. No attempt was made to monitor migration in and out of experimental plots.

As regards vertebrates and cattle, USAID beneficiary farmers were asked whether they had observed a) bird, b) domestic animal, c) fish and e) other animal mortality from pesticides. Only 1.5% reported bird mortality, 5% reported mortality in domestic animals and none reported noticing fish or other animal mortality during the survey.

Nevertheless, interviews with control farmers in the southern coast did report problems: 17% of those interviewed reported bird mortality after fumigating; 30.4% reported domestic animal mortality (mainly hens and chickens); and, 2% (1 case) reported finding a dead snake in the field.

b. Off-site Effects

Pesticides are washed off to the ground where they stay until carried off by water or until they break down. Water is thus a good monitor of off-site contamination. However, Guatemala gets high levels of rainfall and dilution is high. The CICP/ECOTECNIA EA team collected samples of a product, soil and water in 14 farms throughout the Guatemalan highlands in mid-October 1988.

Water, soil and product samples were analyzed for presence of metamidophos, a phosphate pesticide with a half life of 120 hours at 37 C, in 6 of the samples. Water, soil and product samples were analyzed for presence of cypermethrin, a pyrethroid,

(with no half life information available), in 4 of the samples. A generic phosphate residue analysis was conducted in samples from 2 of the sites.

Water was not found to be contaminated in any of the samples analyzed. Soil samples showed consistent residues of metamidophos. All product samples showed significant residue levels of metamidophos and traces of the other pesticides. Results are presented in Table 3.

c. Pests - Key Problems by Crop

See 2. c) above.

d. Identified Incidence of Resistance

Circumstancial evidence of the development of resistance was obtained through farmer surveys. When asked whether pests were "stronger" every time, 85% of farmers surveyed who answered the question said yes. When asked whether it was necessary to use more pesticides each time, 82% answered yes.

Pesticides mentioned as being less effective include: 1) Metamidophos, 2) Methyl parathion, 3) Aldrin, 4) Methomyl, and 5) Propineb. However, very few farmers specified which pesticides had lost effectiveness.

e. Relation to Other Programs

The following large scale pest control programs were identified:

Human health: malaria, dengue fever, onchocercosis and chagas control programs.

Agriculture: Medfly and screw worm control programs.

Representatives from these programs were interviewed by the CICP/ECOTECNIA EA team. Of these, the only one reporting interference from other pest control programs was the malaria program, but the development of cross resistance was, in this case, attributed to DDT and carbamates (clorphoxin) used in cotton over 10 years ago.

f. Human Health Implications

These ranged from trace contamination of human tissue to fatalities and included chronic health problems associated with prolonged exposure and/or accumulation of pesticides in the human body.

Several lines of study were pursued by the CICP/ECOTECNIA EA

team. They were:

1) Collection of statistics from the Ministry of Public Health clinic system;

2) Analysis of 700 clinical pesticide poisoning records from Public Health clinics;

3) An epidemiological study covering 145 farmers;

4) Analysis of 416 clinical poisoning records from the Social Security Institute clinic system;

5) A survey of 60 farms by an agromedical team;

6) A workshop to discuss pesticide effects in 50 farmers.

Results from these efforts are discussed below.

1) Published pesticide poisoning statistics: Together, the Public Health Ministry and the Guatemalan Social Security Institute reported 1,431 pesticide poisoning cases for 1987 and 1,073 for 1986. The Social Security Institute reported 10 fatalities for 1987 and 7 for 1986, the Public Health system reported 29 for 1987 and 33 for 1986. A summary with the municipalities reporting the highest number of intoxicated individuals (5+) both by Public Health and Social Security is found in Appendix 9, Table 1 and 3, respectively. Figure 3 shows the distribution of reported intoxications and fatalities in the ORD area.

Appendix 9, Tables 2 and 4 presents pesticide poisonings reported at Public Health clinics and by IGSS hospitals, respectively, by muncipality for 1986-87.

Marked with an asterisk in Appendix 9, Tables 2 and 4 are areas considered to be "of intensive, high value cash crop agriculture by small farmers". However, none of these cases is necessarily or even very likely to be related to ORD financed projects. The number of direct ORD beneficiaries under BANDESA's trust fund is 2,431, 1.6% of the total number of farms (150,889) in 1979 with less than 7 hectares (ICATA/AID 1984). Other direct ORD projects, such as Commercial Land Markets II (coffee and pineapple) and Agribusiness Development (strawberry) were using appropriate protection equipment at the time of survey. The latter, at their request, had been advised of the team's visit. Their protection equipment and techniques were the most complete

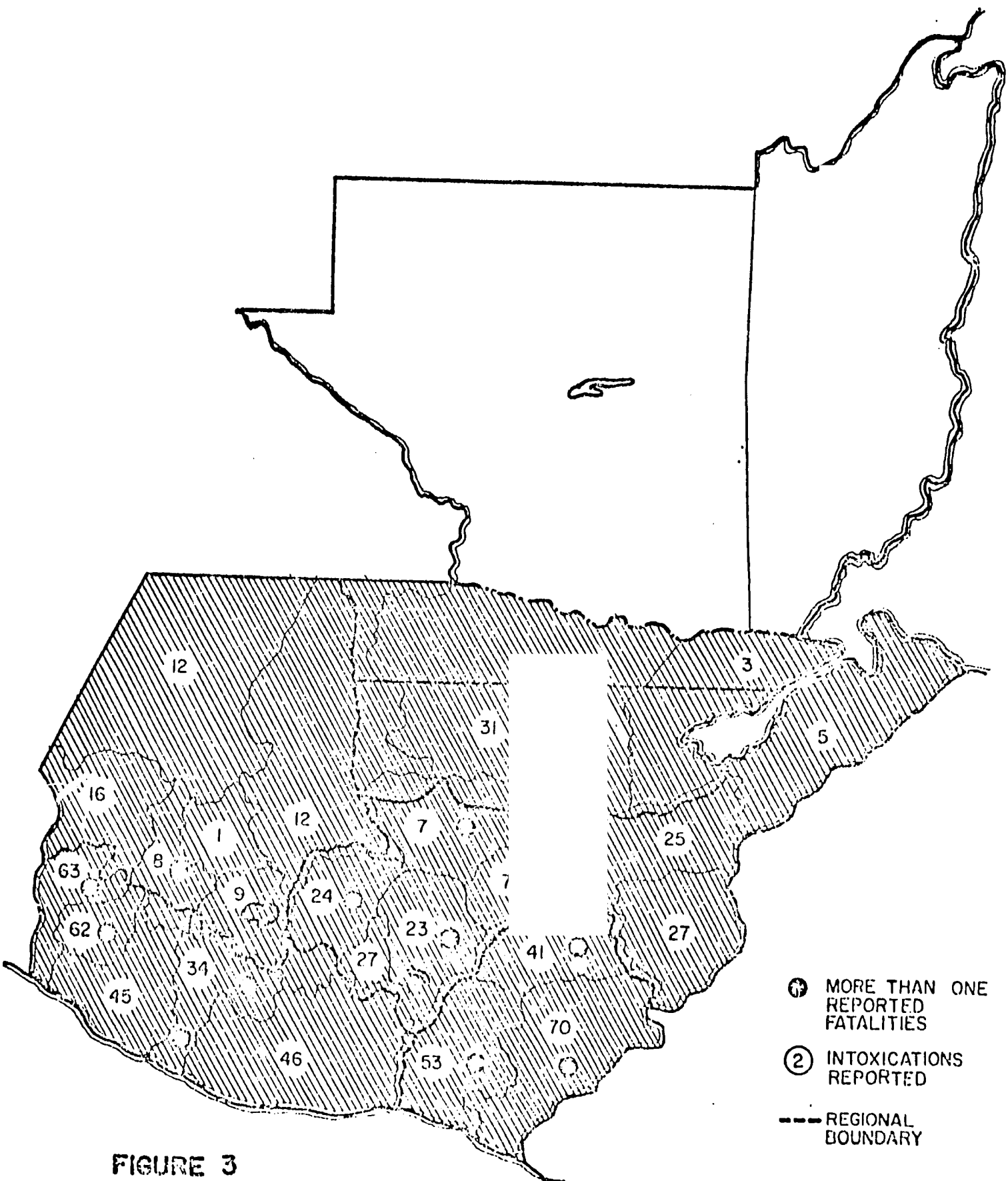

FIGURE 3
INTOXICATION AND FATALITIES REPORTED
MINISTRY OF HEALTH / SOCIAL SECURITY GUATEMALA 1987

of all farms surveyed. In projects such as Cooperative Strengthening, the number of indirect beneficiaries is large.

During the epidemiological survey, it was found that only one of every four poisoning incidents is reported to Public Health or Social Security clinics. In other instances, the persons reportedly took homemade remedies or simply waited for the symptoms to disappear. This suggests that pesticide poisoning statistics could be underestimated by a factor of four

2) Clinical record analysis: 700 clinical records from the Public Health Ministry 1986 and 1987 files were examined in depth to determine poisoning circumstances. Most of the cases occurred in persons between 11 and 40 years of age (561 cases or 80% of total). Of these, 448 were males (64% of sub total) and 113 females (16% of sub total). In the younger age groups (under 5), a total of 40 patients received treatment. In the bracket over 40, 87 cases were regist

In the group over 40, out of 87 total cases 20 (23%) were suicides, 40 (46%) were while working and 27 (31%) were accidents. Of the total 700 cases, 157 (22%) were suicides.

Occupational breakdown is available for all cases. Most were farmers (470 cases or 67%), followed by housewives (96 cases or 14%), students (46 cases or 7%), children less than 5 years (40 cases or 6%) and 37 other cases.

Appendix 9, Table 5 shows breakdown by pesticide.

Fatalities were caused by aluminum phosphide (13 or 24% of all fatalities), paraquat (11 or 20%), metamidophos (5 or 9%), organophosphates in general (4 cases or 7%), aldrin (3 cases or 5%) and unknown (18 or 33%).

3) Epidemiological study: A group of 145 farmers was interviewed to detect habits/symptoms that may be associated with pesticide intoxications. Most (82%) were farmers and (69%) knew how to read. A high (29%) proportion had experienced at least one intoxication with pesticides. The pesticides most frequently reported as causing acute intoxications were metamidophos, methomyl and others. Most (81%) were applying pesticides when they became intoxicated. Of those that went somewhere for treatment, (61%), 53% went to public health clinics. Thus, 32% (0.61 times 0.53) could appear reported in public health records. This is consistent with the results of a separate agromedical survey, that 1 in every 4 cases is reported to public health clinics.

With pesticide applicators, 46% spent more than four hours per day when they applied them, 43% spent more than 6 months per year applying pesticides and 41% had been applying pesticides for

more than ten years.

Farmers were surveyed for the presence or absence of certain symptoms generally associated with (but not necessarily related to) pesticide poisoning (see Appendix 2B for questionnaire used). They were asked for the presence of these symptoms when they were applying and when they were not. Results:

Very significant (= 0.01) differences occurred between those reporting the following symptoms when applying pesticides as opposed to those that reported no such symptoms when not applying pesticides:

a) Dizziness
b) Weakness in legs
c) Lacrimation
d) Sweating
e) Convulsions
f) Loss of sleep
g) Loss of sexual appetite
h) Tachycardia
i) Chest pains
j) Coughing and runny noses
k) Diarrhea
l) Constipation
m) Stomach aches
n) Blood in feces.

Also significant (= 0.05) was cramps.

There is no way of ascertaining whether these symptoms had actually been experienced or whether they were a psychological response to being questioned on the health effects presumably associated with pesticide application.

Most of the respondants (35%) were between 21 and 30 years old. Another important age group was 31-40 (23%), followed by the under-20 group (17%). Thirty four percent of the 107 respondants who answered this question reported to have experienced at least one intoxication instance and 4 reported more than two. Many (30%) complained that pesticides caused headaches, sweating, lacrimation, coughing, runny noses, loss of appetite, nausea, dizziness and nervous disorders.

4) Social Security record analysis: Information was received on 416 intoxications in 13 departments of Guatemala with the higher percentages reported from Escuintla (73 cases - 18%), San Marcos (69 cases - 17%) and Quetzaltenango with (71 cases - 17.3%).

In relationship to age and intoxications, it was found that the 11 to 30 year old age group made up 72.5% of the reported

intoxications. A higher incidence of intoxicated males was found with 384 cases (93%), as opposed to females with 27 cases (7%), resulting in a 14 to 1 ratio.

Review of these records showed that 82% were work related intoxications, 6.5% accidental and 0.24% suicide. However, the incidence of suicide reports may affected by the fact that suicides are not be covered by the Social Security insurance program. Pesticide mixtures caused 8%, gramoxone 7%, and both metamidophos and disyston 14% of the intoxications. Thirty-nine other reported pesticides caused 40% of the intoxications. Non-reported pesticides caused 30% of the intoxications.

Of the 416 records reviewed only 5 fatalities (1.2%) were reported; 40% were caused by gramoxone and 60% by other organophosphates; of the total, 80% were accidental and 10% were work-related intoxications.

5) Agromedical survey: A team composed of an epidemiologist and an agronomist visited 60 farms for the purpose of observing actual pesticide use and application practices. The survey revealed considerable insight as to how the farmers perceived, used and were affected by pesticides. This information was addition to that from the survey and was obtained in conversations wit' the farmers. Symptomatic of the increasing problems of pest control and pesticide use is the common-thread finding that farmers are continually having to use greater quantities of pesticides to do the job. For example, some farmers no longer use Bayer caps (25 cc) as units of measure for pesticide mixtures, instead they use pounds, cups or eights-of-a-liter as units of measure. These anecdotal notes are valuable and are included in Appendix 11.

6) Pesticide workshop: A pesticide use/problems/solutions workshop was organized at Retana, Jutiapa, for the purpose of obtaining complementary information concerning pesticide use, problems and solutions. As a side result, however, a possible methodology for interdisciplinary pesticide workshops using farmer groups was identified. Farmer participation was arranged by DIGESA's regional representative. The team's crop protection specialist, epidemiologist, sociologist and toxicologist participated. The USAID/G environmental officer was also present.

The workshop was divided into three parts. Part I was a general meeting where pesticide awareness was discussed. This included pesticide benefits and costs as part of crop protection schemes, pesticide hazards and intoxications and use of protective equipment and treatment of intoxications.

Part II consisted of dividing the group into 6 working groups, two dealing with protective equipment, two with pesticide

procurement and application, and two with pesticide intoxications. Each group was led by a member of the CICP/ECOTECNIA EA Team.

Part III was again a general meeting, where potential solutions to pest/pesticide problems were discussed.

Several features of the workshop deserve comment.

a) Interdisciplinary approach: the participation of several disciplines allowed farmers to address pesticide issues more realistically. Emphasis was placed on safe and effective use of pesticides without making pesticides "the culprit." Participation of agrochemical companies and GREPAGRO in future workshops can help maintain this component.

b) Group approach: As farmers listened to others discuss problems and solutions, their own problems became more apparent and their possible solutions surfaced. An "aggregate" effect, more effective that individual questioning and consciousness raising, became apparent.

c) Participatory approach: By dividing the group into smaller groups, each farmer had a chance to voice his/her opinion. This "opened" them for the closing general meeting and increased their contribution.

A similar approach can be developed in areas of intensive pesticide use and ORD activity. The interdisciplinary team should include: DIGESA (organizer), DTSV (coordinator), GREPAGRO and/or agrochemical companies (positive aspects of pesticide use), AGMIP (IPM approaches), IGSS and/or public health representatives (pesticide epidemiologist).

Main conclusions from the workshop were:

i) Farmers commented on 46 poisoning cases known to them; 13 persons died.

ii) One out of 26 farmers uses pesticide protective equipment other than a hat and boots.

iii) 29 out of 31 stated that the protective equipment was too expensive.

iv) 9 out of 31 stated that it is too uncomfortable.

v) 9 out of 31 reported "not to be afraid of pesticides".

fields.

vii) 6 out of 24 re-use pesticide containers.

viii) 12 out of 12 fix spray nozzles with their hands and blow into them to unclog them.

ix) 18 out of 36 reports stated that some of the pesticides they buy are re-bottled at the agricultural supply shops.

g. Other Impacts

Other possible pesticide environmental effects, not specifically contemplated in the SOW for this EA, are discussed in this section.

* Fish and shellfish: even small amounts of pyrethroid pesticides can have negative effects on these populations. Circumstantial evidence of fish and shellfish kills was obtained during survey. Although no systematic evidence was collected, the potential importance of this effect cannot be dismissed.

* Potential pesticide residue in export crops leading to rejection of shipments: 22 samples of broccoli, snow pea and cauliflower were analyzed at a private laboratory for presence of pesticides. All samples but one showed traces or low levels of different pesticides (see Table 3, pg. 48. None had levels above established FDA tolerances. This shows that adequate care is being taken by exporters to suspend treatments prior to harvest or to wash product prior to packing. Nevertheless, vigilance is to be maintained if residues are to remain below tolerances, especially as more groups such as new cooperatives and peasant associations enter export markets.

* Potential pesticide residues in crops for local consumption: produce sampled by the team (see Table 3) was found to be contaminated with metamidophos, in one case at a level above FDA tolerance. Since products for the local market are not treated by packers/ wholesalers with the same degree of care as are export products, it is possible that pesticides are reaching the local consumer via contaminated produce and fruit. LUCAM routinely analyzes samples of food for local consumption and this vigilance causes costs to be incurred. LUCAM informed the CICP/ECOTECNIA EA Team that residue levels found were much lower than

suspected. In addition, there was no specific crop or area that could indicate a pattern of residues in food (Marit de Campos, personal communication 1988).

* Increased foreign currency demands: pesticides are imported and add to the already high demand for foreign currency. Appendix 8 shows the imported component for 55 crops.

h. Economic Costs

Economic costs were estimated using two sources. One was BANDESA's records by crop and by region. The other was a specific survey among broccoli producers.

BANDESA has developed production cost estimates for over fifty small farmer crops in Guatemala for the purpose of calculating credit requirements. These figures are updated every year and include indirect costs such as management, land rentals and overall interest on capital.

The CICP/ECOTECNIA EA team, based on BANDESA information, estimated pesticide and application costs for these crops as the amount of these total expenditures per hectare. Crops with less than Q1,000 (U.S. $368) total pesticide expenditures included: peanuts, sorghum, yucca, pineapple, soy beans, lettuce, cucumber, okra, sweet pea, corn, beet, peaches, sugarcane, rice, beans and rubber. Crops whose total pesticide expenditures were between Q1,001 and Q2,000 (U.S. $368 to $735) included: pepper, watermelon, tobacco, papaya, potato, onion, cabbage, apple, carrot, broccoli, garlic and tomato. Crops whose total pesticide cost component was between Q2,001 and Q6,000 (U.S. $735 to $2206) included: coffee, plantain and melon, and one, snow peas, whose total pesticide expenditure was over Q6,000.

Among the hot climate export crops, melon, watermelon and pepper have the highest pesticide component as a percent of total cost while in cooler areas, export crops with a pesticide component of over 20% include snow pea, cauliflower, broccoli and lettuce.

The 9.5% of total cost spent on pesticides for the production of beans, corn, potatoes and cabbage in region V, is markedly lower than the 22.5% spent for snow pea, broccoli, cauliflower and lettuce.

A survey of 12 export broccoli producing farms revealed a pesticide plus application cost component of 35%, when analogous reports at the regional level reported between 16% and 24%. Regional and national averages are influenced by low level users.

4. Awareness and Public Education

The focus of this section is on the behavioral elements which contribute to making current pesticide use unsafe. The section is divided into use categories, which include procurement, application, storage, disposal, and other or miscellaneous. The practices involved in these categories, included in a survey of 469 small farmers as part of the field research for this environmental assessment, are then discussed and analyzed.

a. Procurement

Farmers (421) answered the question of what made them purchase and use pesticides, and 64.6% stated that it was as a preventive measure to prevent attacks of pests, 18.0% used them when they found pests in the fields, 10.2% upon someone's suggestion or recommendation, and 5.9% when they were able to perceive damage done by pests. Pest control based on potential pest damage is the proper approach.

Farmers based their choice of pesticide purchases mostly upon on their own experience (64%), although they also took into account advice from technical personnel from DIGESA (41%) and from family members, friends, and neighbors (40%). The media plays a much less important role with radio being the principal source of influence.

The principal outlets for pesticides for the farmers surveyed, were farm supply stores and cooperatives. Outlets known to the farmers included farm supply stores, cooperatives, and the Casa del Agricultor.

Packaging and labeling have both been identified as potential sources of danger to farmers, since faulty labeling and/or rebottling may mean that the farmer does not know or forgets what the contents are. According to the survey, however, this did not appear to be a serious problem area, since over 95% of the farmers surveyed stated that the pesticide came with the commercial name of the product on the label.

Nevertheless, in a field visit with farmers in the Retana area of Jutiapa, it was found that eight of the 23 pesticides mentioned (35%) were repackaged but with a label from the original maker of the pesticide, while seven (30%) had no label at all. The EA team was told that in the latter case, it is common for the individual farmer to come to the retail outlet with his own bottle--usually an eighth of a liter, for rum--to get it filled with whatever pesticide he wants.

Lack of literacy can make a label meaningless. It was found that about one in every five farmers lacks the functional

literacy necessary to read a pesticide label. Of the 469 farmers surveyed, 384 of the 466 who answered could read labels while the other 82 (17.6%) could not.

The individual farmer cannot be expected to independently acquire any great depth of knowledge about how the pesticides should be used or the dangers some of them represent, and this is particularly true if one in five admits an inability to read. It can be assumed that even those who claim to be able to read do not do so often or well, and if simple, clear, and complete instructions do not come with the pesticide containers, it is incumbent on the pesticide vendor to supply this information to the farmer.

Most vendors, however, do not provide sufficient information on pesticide use and the potential risks entailed in the improper use of the products they sell. Farmers were asked about the explanations given at the time of purchase. They were asked whether the explanation was full and included a warning as to what might happen if they were used incorrectly, whether the explanation simply included a warning to be careful with them, or whether they were told virtually nothing. Approximately one-third reported receiving a complete explanation (34.8%), another third was reportedly told to be careful (31.3%), and another third told nothing (34%).

b. Application

The application of pesticides is in most cases carried out by the farmer himself (79%) according to the survey, although it is clear that the responsibility is sometimes shared with employees (11%) or family members (9%).

The use of protective equipment is crucial in protecting the pesticide user from pesticide poisoning. According to authorities in the field and Guatemalan Social Security regulations, the minimum outfit for all types of pesticide application, regardless of relative danger, should include overalls, a hat or helmet, boots, a special pesticide protection mask, gloves, and protective glasses. A handkerchief is not an adequate replacement for a pesticide mask. An item which can further reduce the risk of poisoning is a special apron.

Farmers were asked whether they used these items every time they applied pesticide, whether they used them sometimes, or whether they never used them.

The notable thing about their responses is that the items used most often are the kinds of things almost every farmer is likely to own anyway: a hat, some boots, and a handkerchief. Conversely, those items never used are items related only to pesticide application and items that represent a considerable

financial investment of money for farmers of scarce resources: overalls, helmet, apron, mask, gloves, and glasses.

In comparison with the rest of the country that has a temperate and cold climate, survey of the pacific coastal plain, with a hot climate, showed that none of the farmers interviewed used masks, gloves, or aprons; only 23% used rubber boots and 4% glasses. This could be the reason that only 10% of the reported intoxications come from the cooler climates and 90% from the warmer climates (southern and eastern parts of the country).

In addition, it should be noted that in the field visit to Retana in Jutiapa, 40 farmers were asked if they had ever used a more or less complete outfit modeled for them, including hat, mask, glasses, gloves, overalls and boots. Only one had ever used the complete outfit, not on his own land but rather as a salaried migrant laborer on a coastal farm.

It is probable that those farmers who use these items are who that own them. The fact that farmers use overalls either always or never would seem to indicate that those who do not use them do not own them either. Those who occasionally use masks, gloves, glasses, aprons, and helmets probably borrow them (overalls, as a clothing item, would be less likely to be lent) rather than own them and just use them occasionally.

This leads to the hypothesis that if all farmers owned a full pesticide application outfit, most would use it nearly all the time. This hypothesis could be tested by providing a pilot group of farmers with complete outfits and then surveying them at a later date.

At Jutiapa, farmers stated that there might well be two types of farmer. The first type included those with sufficient good land to be able to buy the full outfit but who had not done so because they had not realized the seriousness of the risks in not doing so. This group also tends to plant high value vegetables or tobacco and to use pesticides much more heavily.

The second group is made up of farmers with smaller and less fertile plots who simply do not have the financial resources to purchase a full outfit costing about Q.92 (about U.S. $38). This group is more likely to grow subsistence crops like corn and beans and to use far less pesticide.

In Jutiapa, as a result, work should be initiated with the more well-to-do farmers so that they understand the dangers of pesticides and, in turn, purchase protective outfits for themselves and, more importantly, their employees. Furthermore, they need to feel strongly enough about careful use of pesticides to insist that their workers use the outfits they provide them. The less well-off-farmers could probably get by with fewer

outfits, available on loan perhaps from the DIGESA Agricultural Representative.

Routine use of protective equipment was also apparently related to the explanation of cautionary measures provided the farmer by the pesticide vendor. In order to test the effect of these explanations, the question involving what farmers revealed about their actual behavior in applying pesticides was crossed with the question asking what protective equipment the farmers used when they applied pesticides.

Those who stated that they had received a full and careful explanation from the pesticide vendors consistently reported taking more precautions in applying pesticide. In some cases, the difference between those who had received a good explanation and those who had not is significant. The following percentages of respondents reporting on use of various equipment items came from the good-explanation group: overalls when spraying, 55.1%, mask, 59.5%, gloves, 63.2%, and 66.7% always used eyglasses (= 0.01 level). This indicates that explanations may be key in influencing farmer behavior as regards pesticide application and/or that informants were presenting a consistent image.

Finally, with regard to protective equipment, there is little doubt that the outfit is somewhat uncomfortable to use. The heavy overalls are hot in the sun, the rubber gloves make the hands sweat, the glasses tend to fog up, and the mask can make it hard to breathe. Farmers in Jutiapa mentioned the lack of comfort as a reason not to use the protective outfit almost as often as they did the expense and the fact that they simply were not afraid of pesticide poisoning.

Farmers in Jutiapa were asked about prefield preparation of pesticides. The preparation of pesticides for application usually involves mixing solid or liquid concentrates with water. This may be done in a barrel and the mix transferred to the spray tank, or the mixing may be done directly in the tank itself. The mixture may be stirred with a stick, but stirring the mixture with one's hands was not unknown. It may also be strained through a screen or nylon stocking. In any case, few use rubber gloves, and hand contact with the mixture is common. If this occurs, farmers either dry their hands on their clothing or let their hands dry in the air.

Contact with the mixture also occurs when the individual carries the tank on his back, either while loading or through movements such as bending over while spraying. Again, the individual simply lets the mixture dry on his clothes and skin. Other contact comes through leakage in the spray handle, where the applicator may simply grip it tighter with his hand or wrap it with a piece of plastic. If the nozzle becomes stopped up, the farmer may try to unstop it with some object, may blow on it,

or may even blow into it.

Relative to other potentially dangerous behavior during the application of pesticides, most farmers do not smoke, eat, or drink while in the field applying pesticides. The percentage is higher in the southern coastal plain, where 24% of the 46 farmers reported that they drink or eat while applying pesticides.

Complementing pesticide equipment use and other behavior in the field is post-application behavior such as bathing, changing clothes, washing hands and face, and so on, and some farmers at least appear to understand the importance of this behavior. Over half reportedly bathe and change clothes. Over 90% also wash their spraying equipment after a pesticide application.

The role of stressing the dangers of pesticide use and the precautionary measures necessary to avoid intoxication seems again crucial.

With the exception of washing ones hands, where there was little difference between groups, the differences between the behavior after pesticide application between those who had received an ample explanation of the dangers is also striking. Of those who stated that they always took a bath after pesticide use, 51.3% came from the well-informed group. Of those who said they changed their clothes after spraying, 50.0% came from this group, while 46.8% of those who stated they washed their faces after pesticide aplication also came from the group that had received the more complete explanation of the dangers of incorrect pesticide use.

Careful instructions (from vendors, ICI agents and others) may play an important role in improving the safety precautions used by farmers.

c. Storage of Pesticides

As regards pesticide storage, about half the farmers said the kept their pesticides in the house. Most of these specified that they were kept in a secure place, either in the space below the roof, locked up, or at least out of the reach of children and away from food. Another large group of farmers stated that pesticides were kept in a separate room, building, or shed away from the main living area. The principal determining factors storage were to keep pesticides from children and to protect them from being stolen.

d. Disposal of Pesticide Containers

The disposal of pesticide containers is a problem not easy to resolve. Considerable variation is found in disposal of pesticide containers as well as uses given to pesticide

containers that are not disposed of.

The survey showed that 11.5%, or 52 farmers, kept pesticide containers for reuse and of these 35 (8% of total) were for other uses than for more pesticides. There is little doubt that the usefulness evident in the pesticide container, especially for liquids, combined with the lack of resources to acquire one or more commercially made plastic containers for the same purpose, lies behind their reuse. In addition, people are convinced that a good washing with hot or boiling water and soap renders the container safe for any use.

5. Alternatives for Pesticide Use Practices

This section is organized around alternatives regarding the different participants in the procurement-distribution process: the farmer and farm worker, the retailer, the distributor or chemical company, and the public sector agencies who have responsibilities and activities regarding pesticides.

a. The Farmer and Farm Worker

According to CICP/ECOTECNIA EA team observations made during the agromedical survey of 145 farmers and to findings from the pesticide workshop, farmers and farm workers have little awareness of the range of health problems which misuse of pesticides can cause. Both the long and the short term effects of pesticide intoxication are poorly understood.

Farmers did not seem concerned as to whether they purchase pesticides in safe, sealed containers in the sizes they require, accept pesticides in rebottled form, or contribute to the problem by bringing their own containers to be refilled. Storage appears to be less of a problem with farmers who are generally aware of the danger of children accidentally poisoning themselves. Never the less certain pesticides can represent a threat just by being present in the home environment, especially if the container has been opened and the seal broken.

The establishment of a separate facility (room, shed, building) for storing pesticides should be encouraged even though represents a financial burden for many farmers.

The preparation of pesticides for application represents the single most potentially dangerous activities relative to pesticide poisoning. It is at this time that the pesticides are handled in their concentrated form. Those who prepare the mixture need protective outfits (glasses, masks, gloves, clothing) to lessen the risk of accidental splashes or spills, as well as do those who actually apply the pesticides. Farmers must be aware of how defective equipment can represent a risk of contamination; This includes leaky tanks, poorly-fitting handles that leak, clugged nozzles, and so on.

Other behavior related to pesticide use need to be emphasized as well. Cleanliness, from washing hands and face and bathing to changing clothes, must be stressed. Disposal of excess pesticide and empty containers needs to be addressed to lessen the risks of accidental poisoning and harm to the environment. People need to understand post-treatment reentry periods, i.e., the potential danger a sprayed field represents.

b. The Retail Outlet

Retail outlets can protect against pesticide poisoning in several ways. One of these is to provide pesticide products in containers which represent the least possible risk to the farmer and, incidentally, to the retail outlet employee. Retail outlets can make the agrochemical companies aware of the demand for products in certain size containers and request that these sizes be made available. Rebottling of pesticides in containers not offered by the companies should be phased out as the desired sizes become available. Finally, the retail outlets should refuse to provide product to farmers who bring their own, non-standard and unlabeled container to be filled.

Another possible activity is informational. The outlets need to provide clear, detailed information on how the product should be used, and the potential dangers of the product as regards human health and danger to the environment. The outlets should stress the cautionary measures, particularly the use of protective outfits, in the application of these products.

c. The Agrochemical Distributors and/or Makers

The distributors which provide farm products including pesticides to the retail outlets have an important responsibility in providing products to the outlets which represent the least possible risk to the farmer, farm worker, and farm family. To avoid the risks involved in rebottling at the retail outlets and in filling containers brought in by farmers, the companies must provide containers in the sizes desired by the public and insist that the retail outlets do not sell in any other form. To make it possible for the retail outlet personnel to provide the necessary information on the product to the farmer, the companies must provide this information to the retail outlets and to train retail personnel in the presentation of this information.

Agrochemical distributors sometimes sell their products directly to medium or large farmers in larger quantities. The companies in these cases have the responsibility of providing more complete information on the safe use of their product, since they have direct contact with the farmers. They need to provide special information on how to prepare the product in large quantities, how to transfer it to spray tanks with a minimum of risk, and the conditions under which it should be stored.

d. Public Sector

The role of the public sector is varied and involves contact with virtually all players in the safe use of pesticides. The agency most directly involved is DTSV. As was discussed previously, the agency is understaffed and underfunded (Also see

HAD EA, V.C.3.D.) The Institutional Strengthening Plan presented under separate cover addresses these problems from the standpoint of implementing mitigative measures.

e. USAID/Guatemala

Pesticide problems are socially, culturally and economically related to Guatemalan agriculture with or without USAID/G assistance. It is apparent, that USAID beneficiaries are a small percentage of all Guatemala farmers. By law, USAID/G cannot provide direct or indirect assistance for the procurement and/or use of pesticides without implementing measures to mitigate their environmental effects. The role of USAID/G is to implement mitigative measures in such a way as to maximize their demonstrative impact and diffusion potential to non beneficiaries as well as to comply with the laws of the United States.

f. Programming Designs

This section discusses options for making pesticide use and safety information available to Guatemalan small farmers.

1) Direct Contact with Farmers

The EA team made a field visit to farmers at Retana, Jutiapa, which had the objective of collecting further information on actual pesticide use. The visit was arranged by DIGESA, and the participants included both area DIGESA Agricultural Representatives as well as a sample of farmers at Retana. In addition to the 50 farmers there was a group of 10 women, wives of area farmers. Six groups of farmers were organized, along with the group of women, to provide input and discuss pesticide purchase, storage, application, container disposal, and poisonings.

Although the exercise was intended mostly to provide information for the environmental analysis, the CICP/ECOTENCIA EA team came to the realization that the meetings and discussion had the additional effect of raising the consciousness of the farmers and wives who participated in discussions about the dangers of using pesticides incorrectly. It was clear that similar meetings held with better preparation and the objective of having the maximum impact on farmers and their families could contribute strongly toward the rational use of pesticides in the future.

There are a variety of agencies and institutions which can and should participate in such programs in an integrated manner. DIGESA should arrange such meetings as an integral part of its extension program with the Agricultural Representatives. The DTSV is the internal DIGESA department to coordinate and oversee this activity. The Technical Directorate of Health Services of the Ministry of Health can complement this activity with their own

volunteer extension workers, the Health Promoters.

In the private sector this activity should be carried out by both GREPAGRO as the umbrella organization of the agrochemical distributors as well as by the individual companies themselves. Currently GREPAGRO has only a small program in this area at this time but has the ability and willingness to dramatically expand their activities and should be encouraged to do so. The individual agrochemical distributors and producers have also carried out this type of activity, most notably in conjunction with farmers in the FECOAR cooperatives.

Another organization to be included in this activity is the Guatemalan Association for Integrated Pest Management - AGMIP, due to its dedication to integrated pest management. Its participation has the advantage of focusing on the alternatives to pesticide use as an important ecologically and economically sound solution for pest control dilemmas.

The DTSV in DIGESA is the logical organization to coordinate these activities, to channel requests for meetings to the appropriate organization, to recruit technically qualified personnel, to oversee the quality of the presentations, and so on. The Permanent Commission on the Safe Use of Pesticides, on which the DTSV presides and in which the above-mentioned organizations participate, could provide the coordination vehicle.

2) Using the Media: Radio Spots and Programs

The CICP/ECOTECNIA EA survey found that radio was the only medium with any potential impact on rural farmers. Radio has the advantage of portability, which allows the farmer to listen while in the field as well as at home. An additional advantage is that women, who should be targeted equally as much as men, are also part of the regular radio audience.

Research into how to use the radio medium effectively must be carried out before programming begins. Focus groups could be used to critique and improve spots and longer programs as well as to determine what length of program is most effective. Heavy radio listening hours need to be determined for both men and women, and programming for these two audience types arranged accordingly.

Radio programming will be most effective if care is taken in assuring the cultural relevancy of the spots and programs. Voices used in programming for Ladino areas must have believable local accents, while in Indian areas, especially when directed toward women, Indian languages should be used, although not exclusively.

Real events such as actual poisonings should be dramatized in a realistic manner, followed by appropriate information on how to avoid such problems.

3) Demonstration Plots

In spite of the influence of radio, farmers were far more likely to select a pesticide on the basis of word of mouth, either from a DIGESA technician or from family, friends, and neighbors, and their own experience was even more important. Demonstration plots developed to show off the effectiveness of integrated pest management, combined with "events" organized to demonstrate IPM and pesticide safety techniques, plant the idea in the individual farmer's mind that these techniques might work for him too.

Demonstration plots should be established in areas where greatest pesticide use and abuse have been determined. They should be developed in conjunction with the Agricultural Representatives as the logical tie between the program and the community.

4) Videos at the Farm Supply Stores and BANDESA

Video cassette recordings could be used as a means of supplementing the radio messages with visual images. Videos of various lengths, themes, and methods of presentation, could again be developed in the context of focus groups to determine the ideal parameters of the videos. Videos have the advantage that they can visually demonstrate correct behavior with regards to pesticides: how they should and should not be mixed, loaded, applied, and stored. In addition, videos are more vivid than radio, especially if they are complemented by oral instructions (Robert E. Klein, personal communication 1988), according to studies in other rural health attitudinal programs.

Where such videos could be shown will require further research and planning, but there are a few options that seem reasonable to pursue. ICI's, such as BANDESA and FENACOAC, direct beneficiaries, such as FUNDACEN and others, through its rural agencies, could show the film to individuals and groups which solicit loans. This could be done on a regular basis with scheduled showings or on demand if a sizeable group arrives at the ICI's office. Seeing the video at least once might even be made a loan condition, so that it could be assured that everyone with an ORD production credit has been exposed to a film on the safe use of pesticides.

Another logical place to show videos would be at the farm supply stores. Such videos could even be produced by the commercial distributors. In this way, the distributors could

provide the video and necessary equipment to the retail outlets, perhaps on a rotating basis. The distributors products appear in the video, which provides the stimulus for the distributors to participate in the program. The video simply provides a demonstration of how to use the product correctly, mix it safely, store it properly, dispose of the containers, apply it, and utilization of protective equipment.

5) Alternatives for Protective Outfit Use

The lack of use of protective outfits in applying pesticides is one of the most serious problems, and various alternatives need to be tested to make comfortable, affordable, functional protective outfits available to as many farmers as possible and to get the farmers and farm workers to use them. There are three basic obstacles to protective outfit use: lack of comfort of existing outfits, lack of understanding of the need for the outfits, and lack of funds on the part of many farmers to acquire an outfit.

There is little doubt that the outfits presently offered are less than adequate. Effort should be made to develop or introduce glasses that do not fog up, masks that are comfortable and which do not make it difficult to breathe, and lighter weight overalls which protect the worker but which do not become unbearable in hot climates.

As regards the problem of availability of outfits, it is clear that cost represents an obstacle to acquiring outfits for many farmers. The retail cost today for overalls, boots, gloves, mask, and glasses is 0.92 (U.S. $34.07).

To bring the cost of outfits down and to make them available to those who need them, the possibility of a massive purchase may be considered. This might lower the actual cost of the outfits. It is very possible that their use would grow, if additional promotional programs are also implemented.

Another alternative would be to make outfits available at a minimal cost to farmer organizations, such as cooperatives, agrarian unions, and other associations. The number of these outfits could be readily determined by the types of crops grown in the area. Corn and bean farmers use little pesticide, so a cooperative or other group might get by with two or three such outfits available on demand to farmers who need to use them. In vegetable areas the number of such outfits necessary would be greater, but the mechanism of loaning or renting them for a nominal fee would be the same.

6. Training Needs

Two major areas were identified as requiring substantial training efforts. They are: Integrated Pest Management as it relates to crops that use pesticides intensively and Pesticide Agromedicine in general and for high pesticide use crops in particular. In addition, some training in pesticide registration, residue analysis, formulation regulation, monitoring environmental toxicology and safe handling and disposal of pesticides and containers was found to be of use.

IPM training was found to be necessary in four areas: research, demonstration, extension and implementation. Target audiences are USAID/G project officers, ICTA researchers, DIGESA extension directors, DTSV personnel, DIGESA extensionists, para-extensionists (or representantes agropecuarios) and the farmers themselves. (See Training Plan presented under separate cover).

USAID/G officers: one or more ORD officers should receive short term training in IPM demonstration to be able to supervise or assist in the supervision of IPM demonstration efforts. This involves setting up IPM demonstration plots, choosing adequate controls, monitoring plant development, monitoring pest and beneficial populations, collecting other important cost, pesticide use and environmental parameters, refining and sharing the results of demonstration plots. One or more ORD project officers should receive short term training in IPM extension. This involves an acquaintance with IPM components at the farm level: ecological and climatic factors, relations between pests and crop development, names and damage potential of major pests, natural control agents and pesticides and their mode of action.

ICTA: High level technical personnel should get training in several IPM research subjects. Among the most important: biological control, economic threshold design, plant simulation modelling, and IPM in general. At least ten high level technicians should get Ph.D. level training in these subjects and an equal number M.S. level training.

DIGESA: At least five high level technical personnel should get short term training in all aspects of IPM demonstration and extension (see recommendation for USAID/G officers above). As many extensionists as possible should get practical, on-the-job training in the same subjects.

DTSV: All personnel would benefit from access to training in IPM research, demonstration, extension and implementation. The limiting factor here is the number of technicians working for DTSV and their availability for training without further impairing its already insufficient workforce.

Agricultural representatives: Practical on-the-job training on IPM extension and implementation under DIGESA extensionists and HAD/ORD technical personnel.

Farmers: On-the-job training in IPM implementation under agricultural representatives and DIGESA extensionists.

Pesticide Agromedicine was found to be necessary at several levels also. At least one or two USAID/G ORD officers should receive short term training in the principles of pesticide agromedicine. The University of San Carlos School of Medicine should support EPS students in pesticide epidemiology and agromedicine. A pesticide agromedicine course should be offered optionally to students in their last academic years. Rural clinic employees at both the Public Health and Social Security systems should get practical training in pesticide agromedicine. The same courses would be made available to the "promoters of rural health".

DTSV should get additional training for pesticide registration methodology.

Although both ICAITI and LUCAM have adequate pesticide residue analysis laboratories, both need to train additional personnel in this subject. Existing experts would also benefit from "refresher" courses and exposure to up-to-date materials, equipment and procedures.

Universities, particularly Universidad del Valle, are particularly suited to develop training in pesticide toxicology.

Courses should be developed and offered as part of schools of biology or pharmacy in both Del Valle and San Carlos.

The safe handling and disposal issue is an area for training extensionists, agricultural representatives and farmers.

VI. PROGRAM ALTERNATIVES

Although the HAD amendment is part of the overall ORD portfolio and its actions or no-actions are interrelated with those of other projects, this chapter discusses program alternatives for both the HAD amendment and the ORD program.

A. Alternatives for the HAD Amendment

Three project alternatives are discussed: 1. Project "as is"; 2. Project plus a strengthened P/PM component and a strengthened watershed management component; and, 3. No Action.

1. Design of Proposed Project Amendment

The implications for pesticide use and natural resource management are discussed in detail in Chapter VI, Environmental Implications of the HAD Project EA (CICP/ECOTECNIA 1988). A summary of potential benefits and possible adverse impacts is presented here.

a. Potential Benefits

As generally designed, HAD-II would have the following potential benefits:

* Protect watersheds from which irrigation water is obtained, whenever practical;
* Complement soil protection with site specific soil conservation measures;
* Improve soil quality and provide additional soil protection by implementing agroforestry;
* Improve land use by developing forestry when it suits a particular site better than agriculture;
* Increase water availability and timing;
* Increased reforestation;
* Increased agroforestry applications;

b. Possible Adverse Impacts

Without a specific, integrated watershed management approach, effects of the Land and Water Use component on

watershed management would be largely left to chance. The negative effects would include:

* Deforestation in recharge zones, with loss of water yields. This was evident when reviewing existing small irrigation projects built under HAD I without an integrated watershed management approach.

* Soil erosion from irrigation without adequate soil conservation.

Environmental implications of HAD II related to pesticide use, both indirect (from promoting agricultural intensification) and direct (through the production credit program) are:

* Unnecessary and uneconomical destruction of natural enemies of pests;

* Potential for developing increased resistance in pests;

* Higher production costs derived from increasing and inadequate pesticide use;

* Increased risks of human pesticide poisonings;

* Pesticide contamination of non target organisms;

* Increased enviromental contamination;

If pre-clearance facilities include pre-treatment, environmental effects may result from use of chemical pesticides or from radiation. Environmental assessments for these facilities will have to be performed as per Regulation 16, Part 216.3(b)(v).

The HAD credit component by itself would have the following potential effect on forest resources:

* Increased demand for firewood from larger agricultural populations year round.

2. <u>Design Strengthened P/PM Component and Integrated Watershed Mangement Component</u>

The elements of a strengthened P/PM component for HAD-II are combined with the ORD umbrella EA presented below.

3. No Action

Under Alternative 3, the HAD project would essentially cease, since no small irrigation or soil conservation activities could take place and no agriculture using any kind of chemical pesticide could be supported directly or indirectly. All potentially adverse impacts would cease and so would all potential benefits, environmental and economic. However, Guatemalan highland agriculture would probably continue the same trends as identified under the HAD project, and all potentially adverse impacts would probably still accrue without the HAD project. HAD-II has the potential for exerting leadership in the area of natural resource management and sustainable agriculture in Guatemala while pursuing its stated objectives.

B. Alternatives for the Umbrella EA

This section presents the environmental benefits and possible adverse impacts of pesticide procurement through the Office of Rural Development, USAID/G direct and indirect project assistance. Current pesticide procurement/use support is described in Chapter II, Section A. above.

1. Current and Projected Agricultural and Rural Development Program with Pesticide Procurement through the Direct and Indirect Mechanisms Described Above

Assistance for the procurement and/or use of pesticides through ORD projects is of three types: a) Direct credit assistance for crop production, as in the cases of the Commercial Land Markets II project, some instances of the Agribusiness Development project and some potential cases in the Agricultural Production and Marketing Services project; b) Credit through intermediate credit institutions (ICI's), such as the credit component of the Cooperative Strengthening project and the credit component of the Agribusiness Development project; c) Indirect support to organizations that finance or support the procurement and/or use of pesticides, for example, support provided by the Cooperative Strengthening project to its beneficiary federations and support provided by the Agribusiness Development project to companies and cooperatives that in turn finance the procurement and/or use of pesticides.

The way Regulation 16 is written, all USAID projects that assist in the procurement and/or use of pesticides must identify the environmental effects of pesticides being procured and implement mitigative measures unless USAID is a minor donor (less than 25% of total funding being provided and USAID's contribution is less than $1,000,000) plus USAID does not control the planning

or design of the multidonor project. This is not the case in any of the ORD projects.

As stated above, crop protection in small farmer Guatemalan agriculture is characterized by a) lack of an understanding of relationships between pests, beneficials, crops and environmental conditions; b) sole or almost complete reliance on chemical pesticides; c) pesticide application by calendar or when pests appear without due regard for their economic damage potential; d) use of increasingly toxic chemicals and mixtures as resistance develops and pests are harder to control. Pesticide use, in turn, is characterized by a) lack of awareness of pesticide dangers; b) a certain degree of "bravado" concerning pesticide risks even when awareness has developed; c) lack of protective equipment during application; d) lack of training and experience in pesticide application; e) inadequate treatment of pesticide intoxications.

Use of agricultural inputs in general (improved seeds, fertilizer, pesticides, mechanization) goes together with the modernization of agriculture. The higher values paid for export crops and their higher cosmetic quality requirements support and to a degree require increased use of pesticides.

As USAID/G supports agricultural diversification and development in Guatemala, it is inevitable that it will find itself supporting the procurement and/or use of chemical pesticides within an existing context characterized by misuse unless actions are taken to promote rational pesticide use in the projects it supports.

a. Benefits

Aside from the obvious economic benefits of current pest control practices in small farmer Guatemalan agriculture (69% of farmers surveyed stated that they could not go on with their current crops if pesticides were unavailable at the present time), no environmental benefits are perceived from current pesticide use.

b. Possible Adverse Impacts

Possible adverse impacts of current pesticide use in small farmer Guatemalan agriculture include:

* Acute human intoxication
* Chronic human intoxication
* Destruction of non target beneficial organisms in agricultural fields
* Potential destruction of fish and shellfish
* Potential pesticide residue in export crops, with the potential for export rejections

- Potential pesticide residues in crops for domestic consumption
- Cost of residue analysis for local produce and fruit
- Increasing production costs due to the development of resistance
- Increased foreign currency demands
- Soil contamination with pesticides
- Potential water contamination
- Increased resistance of pests
- Increased pest outbreaks.

2. Current USAID/Guatemala - ORD Program plus an Umbrella IPM/Pesticide Management Support Program

a. Information

This pesticide information sub-component involves distribution of pesticide guidelines, development and distribution of a Guatemala-specific pesticide handbook, development and distribution of a video film on pesticide safety and refinement and implementation of periodic pesticide information workshops.

The pesticide guidelines are presented under separate cover.

The pesticide handbook should represent a merger between the pesticide guidelines and an agromedical handbook such as Davies, J.E., et al, or equivalent. It is to be prepared under HAD-II and distributed to Public Health and Social Security clinics and ICI agencies.

The film needs to be Guatemala-specific and produced by a professional film company in cooperation with an appropriate agromedical authority or combination of authorities.

A description of the pesticide workshop is presented above, VI.4.

b. Credit

Credit agreements with ICI's and other cooperating institutions may need to be modified to exclude pesticides other than those approved by USEPA for same or similar uses without restrictions based on user hazards and to include the purchase of protective equipment and the development of IPM and agromedical products, services and technology.

c. Training

Two major areas were identified: integrated pest management and pesticide agromedicine. Specific types of training include:

a) Basic pesticide use and safety (short term)
b) Agromedical workshops
c) Basic IPM
d) On-the-job training for IPM extensionists
e) Specific-subject workshops on IPM
f) Advance degree (M.Sc. and Ph.D. level) training on IPM and agromedicine

The SUMMARY OF MITIGATIVE ACTIONS at the beginning of this EA and the TRAINING PLAN FOR PESTICIDE USE IN ORD PROJECTS presented under separate cover explain the proposed training program more fully.

d. Demonstration

To be started under the direction of the P/PM specialist in 3-5 crops in 10-15 locations, with the assistance of 3-5 IPM agronomists and under the auspices of the DTSV, this program seeks to demonstrate IPM in crops for which enough technology already exists. The crop protection problem must be attacked at its roots. IPM is the alternative to sole reliance on chemical pesticides.

Crops identified by the EA team include broccoli, potato, snow pea and tomato. However, the P/PM specialist must make her/his own decision on what can be successfully demonstrated. The objective is to show that IPM can reduce amounts of pesticide used and pesticide expenses. Demonstration plots can also serve educational purposes in both IPM and agromedicine.

Examples of locations for the 4 crops suggested are: broccoli and snow peas in San Lucas Sacatepéquez, Chimaltenango and Tecpán; potatoes in Chiquirichapa (2), Quetzaltenango, Tecpán and Santa Rosa; tomatoes in La Fragua, Usumatlán, Retana, San Jerónimo and Monjas.

The 3-5 IPM agronomists would each train 2-3 DIGESA extensionists, BANDESA credit officers, EPS students and DTSV personnel, as available and willing, per crop season. Extensionists would be expected to help disseminate IPM approaches, practices and results.

While some crops are at the IPM demonstration stage, others will be at the validation and testing stage. Validation and testing may be supported through ICTA, University of San Carlos, Del Valle University, Landivar University or AGMIP, depending on

degree of interest, availability of resources and promise of results. New crops for validation may include green pepper, apple, melon and watermelon at the present time.

e. Research

IPM and agromedical research is to be supported through the same institutions mentioned under IV above. Crops, techniques, components and methodologies may be investigated until they are ready for validation/demonstration. Again, the emphasis is to retain a degree of flexibility and avoid irreversible commitment of resources to any particular group unless this commitment is tied to the delivery of results.

f. Coordination

The P/PM component is to be coordinated by DTSV with the assistance of the P/PM specialist to be hired under HAD-II. Coordination is to include the Permanent Commission on Safe Use of Pesticides, GREPAGRO, the Ministry of Public Health, the Social Security Institute and other ORD programs that may benefit from the P/PM component. If, for any reason, the P/PM specialist cannot be placed or stationed at DTSV, another coordinating mechanism must be devised. By itself, DTSV does not possess the resources to effectively coordinate the proposed program at the present time; however, it could do it with the proposed support.

Additional institutional strengthening suggestions are presented under separate cover.

g. Monitoring

The strengthened P/PM component should be monitored by an outside group, such as CATIE, with the laboratory support of ICAITI. The following parameters may be included in this monitoring sub-component:

i) Changing Status of Pests.

ii) Poisoning cases in project area.

iii) Pesticide residues in water, soil and products in sample beneficiary farms.

iv) Status of resistance of key pests.

v) Destruction of non targets and beneficial species from pesticide applications.

vi) Permanent inventories of pesticides used and conditions for storage.

vii) Periodic medical checkups with special medical forms to control intoxications.

viii) Records with the amount and frequency of application of pesticides.

The Government of Guatemala should be informed of all pesticide developments in HAD-II, starting with this EA and provide complementary materials as they are prepared under project.

All of the environmental effects of pesticide use could be mitigated if the above program were made into a project component. The CICP/ECOTECNIA EA team aknowledges the fact that by themselves, ORD projects cannot quantitatively affect significantly the Guatemalan environment nor its overall agricultural production; however, they have already started to affect it qualitatively, with small irrigation and soil conservation as well as agricultural diversification, land marketing, cooperative strengthening and agricultural services. It is the opinion of the CICP/ECOTECNIA EA team that this leading role in Guatemalan agriculture can be valuably strengthened with the addition of an integrated P/PM component as outlined above.

3. No Action

This would imply not supporting pesticide procurement and/or use directly or indirectly and it is an alternative that would severely impair ORD's agricultural projects in Guatemala. It would be virtually impossible to guarantee that supporting farmers in non pesticide activities would not free their own or other institutions' resources for procuring pesticides, thereby making USAID an indirect contributor. Under this alternative, all of the environmental effects would cease and so would all pesticide economic benefits. Most importantly, USAID/G would be foregoing the opportunity to exercise leadership in the area of pest/pesticide management in Guatemala.

REFERENCE CITATIONS

Alvarado, Pineta, Edgar; Alvarado, Gonzales, Federico; La Agricultura en Guatemala, Camara del Agro de Guatemala, Asociacion de Amigos del Pais, Guatemala 1981.

Asociacion pro Bienestar de la Familia, APROFAM, La interaccion de los sistemas y el Deterioro Ambiental de Guatemala. Diciembre 1986.

Asociacion Pro Bienestar de la Familia, APROFAM, El Crecimiento de la Poblacio· de Guatemala y sus implicaciones 1987.

Asociacion Pro Bienestar de la Familia, APROFAM, Poblacion y Vivienda. 1983.

Asociacion Pro Bienestar de la Familia, APROFAM, Seguridad Alimetaria (Aspectos Demográficos). Diciembre 1986.

Asociacion Pro Bienestar de la Familia, APROFAM, Ambiente, Recursos Naturales, Desarrollo y Poblacion. Junio 1988.
Banco Nacional de Desarrollo Agricola - BANDESA, costos de produccion para 1987 de las regiones I, II, IV, V, VI, VII.

Banco Nacional de Desarrollo Agricola, BANDESA, departamento de cartera y cobros; List of AID trust fund beneficiaries, 30-05-88.

BANDESA, Production Costs by Region (several publications), 1987
Direccion General de Servicios Agricolas MAGA, informe de todas las actividades ejecutadas, en ejecucion y a nivel de proyecto hasta el primer semestre de 1988. Regiones I, II, IV, V, VI, VII, VIII.

Bottrell, Dale G., Integrated Pest Management, Council on enviromental Quality, December 1979.

Centro Panamericano de Ecologia Humana y Salud, Organizacion Panamericana de la Salud, Organización Mundial de la Salud, Plaguicidas, La Prevencion de Riesgos en su uso, Manual de Adiestramiento. Segunda Edición. Metepec, México 1986.

Centro Panamericano de Ecologia Humana y Salud, Organizacion Panamericana de la Salud, Organización Mundial de la Salud. Prevencion, Diagnostico y tratamiento de Intoxicaciones por Insecticidas, Metepec, Mexico, 1986.

Centro Panamericano de la Salud, Organizacion Mundial de la Salud, Clasificación de Plaguicidas conforme a su peligrosidad, Metepec, Mexico 1986.

Chiri A. A., "Aspectos generales del Manejo Integrado de Plagas",

Presentado al I Congreso de Manejo Integrado de Plagas, Febrero de 1983.

Clark and Schkade, Statistical Methods for Business decisions. South Western Publishing company. Cincinnati Ohio 1969.

Consortium for International Crop Protection, Environmental Impact Analysis of the Guatemala Medfly Program, (College Park, Maryland, 1988)

Davies, J.E., V.H. Freed and Fred W. Whittemore, Enfoque Agromédico sobre Manejo de Plaguicidas-Algunas Consideraciones Ambientales y de la Salud, (OPS/WHO, Washinton, D.C., n.d.)

De La Cruz, S., Jorge René, Clasificación de zonas de Vida de Guatemala a nivel de conocimiento, MAGA, SPA, INAFOR, DIGESA; Guatemala 1985.

Guerra, Borges, Alfredo; Geografia economica de Guatemala, Editorial Universitaria de la USAC, 1976.

HAD I, Mid-Term Evaluation.

Hough, Richard; Kelly John; Miller, Stephen; Derossier, Russell; Man, Fred, L.; Seligson, Mitchel, A; Land and Labor in Guatemala: An Assessment, AID/Washington Development Associates, Guatemala, 1979.

Hoyt, S.C. and E.C. Burts, 1974, Integrated Control of fruit pest. Ann. Rev. Entomology, 19:231-252.

Instituto Interamericano de Cooperacion para la Agricultura, IICA, study HAD II, April 1988.

Informe anual de Labores, IGSS, 1986.

Instituto Geografico Nacional, Diccionario Geografico de Guatemala, Tomos I al III, Guatemala 1983.

Morales, Julio René, Estudio de la Epifitiologia y evaluación de programas de fungicidas para el control de Ascochyta sp. en Arveja China.

SFD, Mid Term Evaluation.

SFD, Final evaluation.

University of California, Division of Agriculture an Natural Resources publication 3305, Integrated Pest Management for Cotton in the Western Region of the United States, 1984.

University of California, State Wide Integrated Pest Management project Division of Agriculture an Natural Resources publication

3307, Integrated Pest Management for Cole Crops and Lettuce, 1985.

Watson, F., Theo; Moore, Leon; War, George, W.; Practical Insect Pests Management. WH Freeman and Company, Sn Francisco, 1975.