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ENVIRONMENTAL ASSESSMENT

Environmental Assessment and Analysis of
Pesticide Use in Agricultural Research Project

(AID Project Number 532-0128)

Prepared for: USAID/Jamaica

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LIST OF ACRONYMS AND ABBREVIATIONS

AID	Agency for International Development
AID/LAC	AID Bureau for Latin America and the Caribbean
CARDI	Caribbean Agricultural Research and Development Institute
EA	Environmental Assessment
EPA	Environmental Protection Agency
IPM	Integrated Pest Management
JAMA	Jamaica Agromedical Association
LD50	Lethal Dose, Expressed in Milligrams of Pesticide per Kilogram of Body Weight, Required to Kill 50% of the Pest Population
LOP	Life of Project
MOA	Ministry of Agriculture
MOH	Ministry of Health
PID	Project Identification Paper
PPM	Parts per Million
RPAR	Rebuttable Presumption Against Registration
WHO/FAO	World Health Organization/Food and Agricultural Organization

BACKGROUND AND RATIONALE (from PID 532-0128)

Agriculture, employing ca. 40% of the populus, has historically played a major role in the Jamaican economy. Traditionally, the major portion of agriculture in Jamaica has been focused on export crops such as sugar, coffee, bananas, cocoa, pimento and ginger. In recent years, even sugar and bananas (major export crops) have declined. More recently, non-traditional export crops (including yams, vegetables, plantains, citrus and mangoes) have increased in importance.

A primary concern of USAID/Jamaica's Agricultural Research Project is to promote diversified cropping systems which will contribute to foreign exchange earnings and savings. Accomplishment of this objective entails (1) private sector investment in non-traditional export crops, (2) improvement in agricultural production technologies, and (3) development of a coordinated research and extension plan among the various Jamaican agencies (public and private) now conducting agricultural research and extension activities.

The Agricultural Research Project will utilize an, as yet unspecified, Research Advisory Council to identify priority crops and problems needful of solution. Via special grants and/or formal contracts (to public and/or private individuals, organizations, national and international institutions, private farmers, commodity boards, etc.,) specific adaptive/applied agricultural research will be conducted. Thus, it is difficult to identify all target crops initially. Scientific personnel exchanges, short term training and minor rehabilitation of existing facilities will also be a part of this project.

On-farm testing of production/protection technologies is considered a vital ingredient in this project. Immediate beneficiaries would be participating farmers and, via the "multiplier effect", other farmers who learn basically from their farmer peers. Women farmers (comprising ca. 24% of all Jamaican farmers and controlling ca. 12% of all cultivated acreage) are to play a strong role in this project. They perform most weeding, share in harvesting and play the central role in marketing of local crops. Thus, women are to be of major concern in the project's on-farm research and evaluation.

Among the pest management tactics commonly used are pesticides. To evaluate the potential environmental impact pesticides used under the Agricultural Research Project may have, an Environmental Assessment (EA) was conducted. What follows is the results of this EA.

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To meet its objectives, the Agricultural Research Project will require some pesticides for use in research plots, farmer demonstrations, and training. This project may propose operational pest control programs within which pesticides play a major or minor role. It is AID policy to try and use only pesticides that the U.S. EPA has registered for "general use" without restriction. In the U.S., pesticides in the general use category can be purchased and used without special permits. By contrast, "restricted" pesticides present high risks to humans or the environment.

A. Project Background:

Project Location	:	Jamaica
Name of AID Project	:	Agricultural Research Project
Number of AID Project	:	532-0128
Project Implementor	:	USAID/Jamaica
Life of Project	:	7 years (FY 1986-93)
Funding	:	\$7,600,000
IEE Prepared by	:	James J. Talbot, Regional Environmental Management Specialist/Caribbean
PID Approved by	:	William R. Joslin, Director USAID/Jamaica 6/13/86

B. ENVIRONMENTAL ASSESSMENT

Prior to disbursement of AID funds into the Agricultural Research Project, an Environmental Assessment (EA) for pesticides which may be used in the project was required.

The EA has been prepared in accordance with AID's Environmental Procedures (22 CFR Part 216) of Regulation 16 of the Code of Federal Regulations. It describes the pesticides and handling methods and sets forth procedures to minimize the adverse effects, as specified under Pesticide Procedures, Paragraph 216.3 (b) (1) (i) of Regulation 16.

In the EA, the term "pest" includes any group of organisms - insects, bacteria, viruses, weeds, nematodes, snails, slugs, birds, rodents, or others - that adversely affect the production, preservation, or use of agricultural plants (including seed and planting stock) or harvested products. "Pesticide" is any chemical preparation used to kill, repel, mitigate, destroy, or stop the action of pest populations and includes the following: (1) insecticides (to control insects), (2) acaricides (to control mites), (3) herbicides (to control weeds), (4) fungicides (to control fungi, molds, etc.), (5) nematicides (to control nematodes - small roundworms), and (6) rodenticides (to control rodents).

1. EPA Registration Status of the Proposed Pesticides

In the USA, pesticides are registered by the Environmental Protection Agency. The EPA registers a pesticide product in one of two categories: "restricted use" or "general use". A restricted use pesticide is available for purchase and use only by pesticide applicators who are certified by law. It presents a very high toxicity and/or environmental hazard. A general use pesticide, by contrast, is available for purchase and use by the general public. It is not AID policy to provide highly toxic pesticides to small farmers.

The Pesticide Advisory Council (Ministry of Health) is aware of dimethoate, paraquat and metaldehyde hazards and has classified them "restricted" pesticides. Such a pesticide is available only to certified users. The Agricultural Research Project does not plan to distribute these three or any other pesticide to farmers. Use of dimethoate would be for small-scale experimentation, training, demonstrating safe use to farmers, or small-scale control programs carried out by project staff. Metaldehyde can be used with the restriction that the label must bear the words "this pesticide may be fatal to children and dogs or other pets if eaten. Keep children and pets out of treated area". For all cases, protective clothing will be worn.

Paraquat presently is used widely in Jamaica, and there is no known substitute per se. A partially effective alternative is the herbicide glyphosate (ROUNDUP). Use of glyphosate would greatly reduce the hazards (see Table 2 for comparison in toxicity of paraquat and glyphosate). Research in Cook Islands (South Pacific) has shown that, when mixed with the common fertilizer urea, glyphosate is effective at reduced rates and therefore less costly. This AID Project affords an opportunity to test this approach in Jamaica and to seek other cost effective alternatives, both chemical and nonchemical, to paraquat and other pesticides that present high risks.

This project will sponsor an effective training component on pesticide safety and will provide protective equipment and clothing to project staff. In addition, the project will provide considerable technical assistance in pesticide management to seek safe, cost effective pesticide application techniques.

Not all the pesticides in Table 1 have been registered by EPA for use in the U.S. (noted as "not cleared" under EPA registration category). However, the FAO and WHO of the United Nations have recommended "residue tolerances" for some of these materials. A residue tolerance is the amount (expressed in parts per million) of pesticide that may legally and safely remain in or on any raw farm products at the time these products are sold for consumption by humans or livestock. Another aspect of this project will be to provide assistance in seeking pesticides for use on export crops that meet EPA or FAO/WHO criteria.

One of the pesticides in Table 1 has been issued (or has ingredients that have been issued) a so-called "Rebuttable Presumption Against Registration" (RPAR) by EPA:

*captan (CAPTAN).

The RPAR process is designed to gather information and stimulate public debate about a pesticide being scrutinized because of adverse effects on human health or environment. If at the end of this process the risks are found to outweigh the benefits, the pesticide may be cancelled (banned) or greatly restricted in the U.S. Section 5 discusses why an RPAR has been issued for captan (CAPTAN).

2. The Basic for Selection of the Proposed Pesticides

After discussions with USAID/Jamaica staff, Janice Reid and Joe Suah (CARDI), Florence King and David Ellis (Plant Protection, MOA), Patience Dennis and Lester Woolery (Ministry of Health), Stewart Hansen (Geddes Grant, Ltd.), the list in Table 1 was compiled. The pesticides are presently registered for use in Jamaica, are locally available and are effective. Table 1A shows pesticides currently available for purchase in Jamaica, but which are considered to be too toxic for use in this project or which have been cancelled/suspended by EPA.

3. Extent to which the Proposed Pesticide Use is Part of an Integrated Pest Management Programs

Reliance on pesticides alone is expensive and rarely gives lasting control. Pests often become physiologically, or behaviorally resistant to pesticides used extensively. Such resistant pest strains offer serious consequences to both farmer and the general public. Resistance is most likely to occur in areas where sole reliance is placed on pesticides and the use is heavy.

Experience worldwide has shown that the best way to avoid pest resistance and also to increase and sustain agricultural production is to employ a variety of control tactics, including biological (predator, parasite and pathogen natural enemies of pests), genetic physical and legislative. This multi-tactic, balanced approach is termed integrated pest management (IPM).

Under IPM, crops are regularly monitored (called "scouting") for presence of pests, natural enemies and other factors which may influence a decision concerning a control measure. Pesticides are applied only if pest populations have exceeded unacceptable density levels and there is reasonable assurance that pesticide use will be profitable and non-disturbing to the environment.

Common Name and (Brand Name)	Action	EPA Registration Category	Tomato	Potato	Egg Plant	Sweet Potato	Yam	Cassava	Pigeon Pea	Cow Pea	Red Kidney Bean	Lima Bean	Crucifers	Cereals	Lettuce	Carrots	Calaloo	Beans	Turnip	Okra
Trichlorfon (DIPHTHREX)	Insecticide	General												X				X*		
Warfarin (WARFARIN)	Rodenticide	Not Cleared																		
Zineb (ZINEB)	Fungicide	General																		

*Residue tolerances have not been established by EPA or recommended by FAO/WHO.

¹Granular formulations of Carbofuran are not restricted, but all concentrate suspensions and wettable powders 40% and greater are. FURADAN 10% granules are proposed here.

²KELTHANE has recently been the subject of EPA cancellation actions. Prior to actual use by the project, the current status of this pesticide should be established.

³Use approved subject to adherence to U.S. labelling provisions.

TABLE 1A

Restricted and/or U.S. Prohibited Pesticides
Currently Used in Jamaica

Paraquat (GRAMOXONE), a herbicide
Fenamiphos (NEMACUR), a nematicide
Monocrotophos (AZODRIN), an insecticide
Carbofuran (FURADAN), an insecticide 1/
Metaldehyde (METALDEHYDE), a molluscicide
Dinocap (KARATHANE), a fungicide, acaricide 2/
Dibromochloropropane (DBCP), a soil fumigant 2/
Methomyl (LANNATE), an insecticide
Mevinphos (PHOSDRIN), an insecticide
Monocrotophos (AZODRIN), an insecticide
Oxamyl (VYDATE), an insecticide, nematicide
Coumatetrolyl (RACUMIN), a rodenticide 3/

1/ only liquid formulations are restricted

2/ This product is no longer permitted for use in U.S. due to
adverse health effects.

3/ Warfarin is an effective substitute and has full EPA clearances.

The IPM concept is currently playing a strong role in Jamaican agriculture. Multi-tactic approaches can now be found; however, much improvement can be made in monitoring programs and use of economic injury levels and thresholds. This AID project may support some research, training and technical assistance to advance IPM concepts and techniques in Jamaica. However, development and implementation of IPM will be a long term undertaking. During the 7 year duration of this project, one should see movement toward IPM where pesticides are truly used only on an "as needed" basis.

It is AID policy to stress JPM and make every effort to minimize the use of pesticides. Past experience in AID projects show that this can only be accomplished by budgetary "set-asides" so that within the term of the project there is assurance that needed testing and technical assistance will be accomplished. Short term technical assistance from plant protection specialists in the U.S. in a collaborative effort with local plant protection scientists is considered to be a key part of this process. Only in this way can there be assurances of completion of successful field trial and studies.

These pest management activities should focus, at a minimum, on the following:

- a) identification of the nature and magnitude of existing pest management problems
- b) assistance in the design and identification of a testing/evaluation program an appropriate pesticide use and efficiency
- c) design of a system of pesticide field trials and evaluation which will include some form of crop insurance for participating farmers
- d) identification, training and use of appropriate personnel to monitor and evaluate field testing programs
- e) sensitization of farmers as to advantages of an integrated pest management program

These field testing programs should include one or more, as appropriate, studies related to:

- a) use of parasites, predators and biolorational pesticides as alternate pest control agents
- b) investigations related to crop loss assessment and establishment of "protocol" treatment threshold recommendations

- c) use of crop varieties which show acceptable levels of resistance to local pests
- d) maximized use of mechanical cultural control based on availability of labor inputs, and/or
- e) evaluation of the status of pesticide resistance

A minimal budget addressing the above pest management needs is presented below. This budget should be clearly segregated in the overall project paper budget.

Technical Assistance (from U.S.)

3 person months/year over
5 year period @ \$250.00 per day.....\$112,500

Travel/per diem for above.....\$65,000

Technical Assistance (Jamaican)

To conduct field plot studies
6 person months/year over/5 year period
@ \$12,500/yr.....\$62,500

In Country Travel\$10,000

Research Technicians
2 persons/year/over 5 yrs.\$80,000

Vehicle\$10,000

Transportation Expenses (e.g., gasoline).....\$5,000

General Supplies @ 2,500/yr.....\$12,500

Pest Application Equipment @ 1,500/yr.....\$7,500

Test Plot Rental @ 1,500/yr.....\$7,500

4. The Proposed Methods of Application, including
Availability of Appropriate Application and Safety
Equipment

If pesticides are used, the project would utilize both gasoline-powered and hydraulic backpack sprayers. Foliar applications would be made primarily with these sprayers, however in some cases, mist blowers would be used. Granular pesticides would be incorporated in the soil, and rat baits would be selectively placed in known rat habitats.

The project will provide and enforce the use of all appropriate protective devices and clothing-face masks, gloves, boots, and coveralls - for project personnel who apply pesticides. Agreement must be reached with all project contractees or grantees that the highest safety standards are upheld, and costs for protective devices and clothing must be a part of contract/grant budgets let by this project if pesticide use is proposed. It is the Project Manager's responsibility to see that pesticides are transported, stored, mixed, applied, and disposed of properly as specified on the pesticide's label.

The project manager will see to it that the project follows the principles of safe pesticide management as outlined in "The World Bank Guidelines for Selection and Use of Pesticides". From time to time the Regional Bureau Environmental Officer will provide to the mission current AID/W interpretations of these guidelines.

Based on appropriate label statements on the pesticide pack, he will enforce all recommendations, rates and frequency of application, time of application, and the number of days before harvest the pesticide may be applied. Failure to meet label standards will be grounds for the project manager's cancellation of specific grants or contracts let by this project.

Pesticides should be stored in their original containers in a facility specifically designated for that purpose. The facility should be locked with keys assigned only to authorized personnel. A sign reading "DANGER: PESTICIDE STORAGE AREA" should be posted. Pesticides should never be stored near food, animal feed, animals or drinking water. The storage place should be in an area protected from tropical storms and fire hazards.

Empty containers should never be reused - there is no practical method for removing all of the toxic residues

Liquid containers should be treated as follows: empty the container's content into the spray tank, drain in a verticle position for 30 seconds. Refill the container 1/4 full, rinse and pour into the tank, drain. Repeat rinsing and draining three times. Use the rinse water in the sprayer. Punch several large holes in the container's bottom. Bury the container in a designated land disposal site on high ground away from water.

Containers and small quantities of leftover pesticides should be buried in pits in the soil about 1/2 meter deep. Bottoms and sides of the pits should be lined with lime, carbon, charcoal, or organic matter such as leaves, straw or other plant debris. Any of these materials is a good absorbent and facilitates breakdown of the chemical. The pits should be refilled and mounded above ground level with the soil. Empty paper containers and bags also should be buried in similar burial pits. The project will initiate an intensive training program in pesticide safety and management for project personnel and collaborators.

5. Acute and Long Term Chronic Hazards, either Human or Environmental, Associated with the use of Pesticides and Measures Available to Mitigate the Hazards

All pesticides are potentially hazardous to humans and the environment and should be treated with caution regardless of their relative toxicity. The potential health hazard depends on the toxicity and the amounts swallowed, absorbed or inhaled. The relative toxicity of a pesticide can be found by examing its LD₅₀ value which is the amount of the chemical necessary to kill 50% of the test animal population (usually laboratory rats). It is expressed in the weight of pesticide per unit weight of body (mg/kg) when swallowed (oral toxicity), absorbed through the skin (dermal toxicity) or inhaled. The latter value, inhalation toxicity, is usually expressed in parts per million per unit volume of air.

Pesticides with the lowest LD₅₀ valves are potentially the most toxic to humans. Ingestion of just a few drops to a teaspoon of a pesticide with an oral LD₅₀ value of less than 50 might be sufficient to kill an adult person. An adult would probably have to consume 16 tablespoon or 1/2 kilogram or more of a pesticide with an oral LD₅₀ of 5,000 before dying. However, the pesticide's formulation, percentage active ingredient, and other factors determine its actual hazard level. Rodenticides (rat poisons), for example, have low oral toxicity values but would be considered only moderately hazardous to humans because their pellet formulations contain only about 2% active ingredients.

Acute oral and dermal LD₅₀ values of the proposed pesticides are shown in Table 3. Acute toxicity results from a severe case of poisoning due to a single dose of exposure to the pesticide.

Table 3 shows EPA's "signal word" for each proposed pesticide. These words have been assigned by levels of toxicity and appear on the labels of EPA registered pesticides. Table 3 gives criteria for signal word designation. Pesticides assigned the signal word "DANGER" are highly toxic compounds and are not recommended by EPA for general use. Materials showing the words "WARNING" or "POISON" also present a high potential hazard to the user.

As noted in section 1, EPA has issued a RPAR against one of the proposed pesticides. Captan has been accused of causing tumors and toxic effects on the liver and kidney. The RPAR process is a continuing activity, and the EPA will not take final action on a RPAR pesticide until the process is completed. Ultimately, the only valid source for information concerning legal use of EPA registered pesticides is the pesticide labels. The label should always be followed carefully, as this best assures minimum hazard to users.

The proposed pesticides are generally non-persistent and, if used in accordance with their labels, should present no unusual hazards to the natural environment (see Section 7). The project will share with the Pesticide Advisory Commission (Ministry of Health) information concerning toxicity of pesticides and procedures for mitigating hazards.

In those cases where pesticides will be used on crops where no U.S. or international tolerances have been established residue sampling will be undertaken according to established FAO/WHO Codex procedures and arrangements for analysis and submission of data to the FAO Joint Meeting on Pesticide will be made. ST/AGR/AP can provide assistance with sampling protocols, needed steps to obtain FAO/WHO review, and arrange for needed collaboration with pesticide manufacturers. Ultimately, this process should lead to the establishment of Jamaican tolerances. Such procedures will be imperative for export crops destined for foreign markets.

6. The Effectiveness of the Requested Pesticides for the Proposed Uses

The pesticides listed earlier have been evaluated under a variety of conditions including those of the Caribbean region and found to be effective for the purposes intended in the project. However, cost effectiveness of these various materials has not been rigorously tested. One of the objectives of this project will be to conduct cost/benefit analyses of all inputs. This

could likely take the form of a specific grant or contract let under the umbrella project. These studies will be done in concern with Integrated Pest Management Activities as described in Section 3, above.

TABLE 3
Toxicity of Pesticides Available in Jamaica

Common Name and (Brand Name)	Acute LD ₅₀		EPA Signal Word <u>1/</u>
	Oral	Dermal	
Benomyl (BENLATE)	>10,000	>10,000	CAUTION
Bti (DIPEL)	-	-	CAUTION
Captan (CAPTAN)	9,000	-	CAUTION
Carbaryl (SEVIN)	850	-	CAUTION
Captafol (DIFOLATAN)	5,000-6,200	-	WARNING
Carbofuran (FURADAN)	11	10,200	WARNING/DANGER <u>2/</u>
Copper hydroxide (KOCIDE)	1,000	-	CAUTION
Copper oxychloride (CUPRAVIT)	1,000	-	-
Coumatetralyl (RACUMIN)	-	-	-
Daconate (DCPA)	10,000	>10,000	CAUTION
Deltamethrin (DECIS)	128 >5,000	>2,000	-
Demeron Methyl (METASYSTOX)	170-300	260-410	WARNING
Diazinon (BASUDIN)	300-400	3,600	CAUTION
Dibromochloropropane (NEMAGON)	170-300	260-410	WARNING <u>3/</u>
Dicofol (KELTHANE)	684-809	2,100	CAUTION
Dimethoate (ROGOR)	215	>1,000	WARNING
Fenthion (FENTHION)	255-298	1,680-2,830	-
Fluazifop-butyl (FUSILADE)	1,490-3,328	>2,420	CAUTION/WARNING
Glyphosate (ROUNDUP)	4,300-4,900	-	CAUTION
Malathion (MALATHION)	1,000-1,375	4,100	CAUTION
Maneb (MANZATE)	7,990	-	CAUTION
Metalaxyl (RIDOMIL)	669	>3,100	WARNING
Methomyl (LANNATE)	17-24	5,880	DANGER
Mevinphos (PHOSDRIN)	4.15	57	DANGER
Monocrotophos (AZODRIN)	8-23	354	DANGER
Oxamly (VYDATE)	37	2,960	DANGER
Metaldehyde (METALDEHYDE)	250-1,000	630	CAUTION/WARNING
Paraquat (GRAMOXONE)	150	-	DANGER
Propineb (ANTRACOL)	5,000	>5,000	-
Spreader-Streker (TRITON)	-	-	WARNING/CAUTION
Thiram (THIRAM)	780	-	CAUTION
Trichlorfon (DIPTEREX)	150-400	>500	WARNING
Warfarin (WARFARIN)	3	-	WARNING/CAUTION
Zineb (ZINEB)	5,200	>2,500	-

1/ See TABLE 3 for explanation. More than one signal word indicates a difference in formulation (dry vs. liquid) or percentage active ingredient.

2/ WARNING = granules
DANGER = liquid

3/ All uses cancelled by EPA

TABLE 4
Toxicity Categories of Proposed Pesticides by
Hazard Indicator

Hazard Indicators	I ^{1/}	II	III	IV
Oral LD ₅₀	50 mg/kg or less	50-500 mg/kg	500-5,000 mg/kg	> 5,000 mg/kg
Inhalation LD ₅₀	.2 mg/liter or less	.2-2 mg/liter	2.0-20 mg/liter	> 20 mg/liter
Dermal LD ₅₀	200 mg/kg or less	200-2,000 mg/kg	2,000-20,000 mg/kg	> 20,000 mg/kg
Eye Effects	Corrosive; corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours
EPA Signal Word	"DANGER"	"WARNING"	"CAUTION"	"CAUTION"

^{1/} The word "POISON" and also a picture of skull and crossbones appear on the labels of EPA registered in Category I.

7. Effect of the Proposed Pesticides on the Target and Non-Target Ecosystems

The pesticides are generally non-persistent and, if used correctly and according to their labels, should present no unusual hazards to the target or natural ecosystem. Applying higher dosages, shrinking intervals between applications, spraying during windy conditions, storing or disposing carelessly or rinsing equipment and/or containers in rivers would have harmful effects.

Most suggested insecticides are toxic to some of the natural enemies and bees, especially if applied at high rates. Thus, populations of natural enemies and bees residing in treated experimental, demonstration or control plots would likely decrease. Further, the threat of buildup of genetically resistant strains of insect pests, plant diseases, weeds, nematodes and rats always exists.

Some of these problems are unavoidable when pesticides are used. Minimal adverse effects result only when pesticides are used in combination with other control tactics in an IPM program and when users are educated to the hazards and proper use of the materials. In cases where pest control is necessary, the project will emphasize IPM and pesticide management and, through special training on these subjects, foster a more rational use of the materials.

8. Conditions under which the Pesticides are to be used Including Climate, Flora, Fauna, Geography, Hydrology and Soil

Jamaica lies ca. 500 miles southeast of the USA and ca. 90 miles south of Cuba. It is the third largest island in the Caribbean. Jamaica is composed of ca. 10,991 sq. km (4,244 sq. miles) and possess a population of approximately 2 million people. With Cuba, Hispaniola (Haiti and the Dominican Republic) and Puerto Rico, Jamaica forms a group known as the Greater Antilles.

Mountains cover ca. 80% of Jamaica's surface, with the highest being the Blue Mountains (7,402 ft.). Climate is humid and tropical (21-27°C) rainfall is seasonal (April-June, September-November) and ranges from 50-150 inches/year depending upon location (77 inches/year average). Coastal regions offer sandy beaches and several natural inlets.

Rich soil (70+ soil types) and abundant rainfall make Jamaica well suited for agriculture, and agriculture employs ca. 40% of the Jamaican populus. Farmers generally have small holdings and limited capital. More than 80% of the land in Jamaica can be classified as "hillside agriculture", and there are ca. 120,000 hillside Jamaican farmers. The typical farm and rural family is composed of 4.2 persons; thus, ca. $\frac{1}{3}$ of the island's population depends directly on the small farm sector. Typical crop mixtures are bananas, scattered fruit trees, assorted vegetables, and a subsistence root crop (e.g., yam). Most holdings include some fallow land and livestock.

9. Availability and Effectiveness of other Pesticides or Nonchemical Control Methods

Proposed pesticides, as well as others, are available through commercial outlets in Jamaica.

Crop rotation, use of clean (pest free) planting material, destruction of diseased crop plants, crop residue destruction, biological control and a host of other cultural practices reduce pest severity. This project will develop and encourage use of these kinds of nonchemical control methods in its programs.

For example, if a cabbage project is funded, presence of the diamond-back moth, Plutella xylostella (L) will most likely be a problem. Successes of the Commonwealth Institute of Biological Control (CIBC, Trinidad) with releasing the parasite, Apanteles plutella, against diamond-back moth should be noted. This project should establish a strong relationship with CIBC and attempt to exploit biological control successes.

Further, demonstration and experimental plots under the guise of this project should be comprised of a variety of alternative, legitimate control tactics aimed at evaluation of cost/benefit of what will emerge as "options" for ultimate farmer user groups. This is a prime methodology for educating farmers to concepts of multiple and alternative tactics.

10. Jamaica's Ability to Regulate or Control the Distribution, Storage, Use and Disposal of the Requested Pesticides

The Pesticide Control Act of 1975 provides for the control of the importation, sale, storage and use of pesticides in Jamaica. Since 1975, responsibility for this control has fluctuated between the Ministry of Agriculture and the Ministry of Health. In 1986, the Pesticide Advisory Commission (a.k.a. the Woolery Commission from its chairman, Lester Woolery) proposed to Parliament that

pesticide regulation be housed in the Ministry of Health and that a Poisonous Information center be established to collect and distribute information on toxic compounds and prevention/antidotes. A government chemist, Ms. Patience Dennis, is in place. Like many other situations, there is a discrepancy between power and enforcement, and, from all appearances, enforcement is not currently strong.

This project affords an opportunity to stimulate more active participation of the Pesticides Advisory Commission and to allow the Ministries of Agriculture, Health and Industry and Commerce (which certifies PCO's) to begin to work in concert.

11. The Provisions made for Training of Users and Applicators of Pesticides

Training in IPM and pesticide management for project personnel and relevant collaborations will be emphasized. A special training course, and necessary follow-up, will be funded in this project. Training is detailed in a separate report.

12. The Provisions made for Monitoring the Use and Effectiveness of the Pesticides

The project manager, in concert with the Pesticides Advisory Commission, will monitor use of pesticides in the project and insure that they are being handled correctly and safely.

Where not already known, pesticide residue analyses will be facilitated and actively promoted by the project manager. Conducting residue analyses may be made a part of the stipulations of any contract or grant let by this project. Such analyses may best be approached by working in concert with CARDI, the Ministry of Agriculture's Plant Protection Division and the Pesticides Advisory Commission. Focus should be made, at least initially, on project experimental or demonstration plots. This will be a vital responsibility not only for the food used for local consumption but also any that may enter export channels.

The primary location for principal contract experimental and demonstration plots will most likely be the Rodles Experiment Station. These plots will be utilized, where applicable, in the "hands-on" portion of the training course sponsored by this project.

C. Requests for Additional Pesticides and/or Information

If project personnel determine a need for pesticides not in Table 1 or if they need additional information about the pesticides or EA procedures, they should notify USAID/Jamaica. This AID office can contact AID's Bureau of Science and Technology, Office of Agriculture (Attention: C. W. Collier) for any needed assistance. Before any actual demonstrations to/with farmers of pesticides not in Table 1, specific labels and compounds must be reviewed by the Bureau Environmental Officer. This, most likely, will involve AID's American Association for the Advancement of Science (AAAS) Fellows conducting such reviews.

D. Contributors

The EA was prepared by Carl S. Barfield, Professor of Entomology, University of Florida, as a Consultant to the Consortium For International Crop Protection, College Park, Maryland. The following persons in Jamaica were consulted for information used in preparing the EA:

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