Opportunities for pesticide reduction in the Dominican Republic

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A Report by
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SUMMARY
Pesticide impacts on the marine environment in the Dominican Republic, although suspected by many, are difficult to prove scientifically. It is likely that the present cultivation of rice around the perimeter of Samana Bay results in run-off of pesticides into unique coastal marine ecosystems. The high cost of pesticide use in rice along with the development of Integrated Pest Management techniques for rice in other countries offers a unique opportunity to develop non-chemical agriculture in the country's number one pesticide-consuming crop. Dominican organizations who can contribute significantly to this project have been identified.

INTRODUCTION
The general idea that pesticide reduction is an important component in the protection of marine and coastal ecosystems is well-founded. Interviewed local ecologists and environmentalists were supportive of the idea, and many had previously tried to address this problem. Likewise, AID (1991) mentions the need to reduce the impact of pesticides on coastal ecosystems, proposing to develop riparian habitats designed to trap toxics, Integrated Pest Management, and the rational use of pesticides. The importance of investigating the role of pesticides in marine pollution was emphasized in a report by Rosado (1993) and in freshwater pollution by Natale (1992). Addressing agricultural issues for the preservation of marine and coastal environments has been an approach lacking in the past. For example, AID (1990) notes that there has been a failure by most conservation agencies to acknowledge a link between the health of coral reefs and land-based pollution. Thus, by sponsoring this project, WWF is adopting a pioneering strategy and addressing a neglected problem.

PESTICIDE USE
Although misuse and abuse of pesticides is characteristic in Latin America and the Caribbean, the Dominican Republic has a leading position in this respect. It is one of the few countries who, due to intolerable levels of pesticides, has ever had a set of crops (Chinese vegetables) completely banned from importation into the United States. It offers one of the rare instances where the pesticide treadmill effect has led to the elimination of major crops from their main production area (melon and tomato in Azua Valley) (Augusto Villar, pers. com.). And, as a last example, it is a country in which an executive government agency (the ministry of agriculture) approved a secret and illegal resolution amending a presidential decree for the purpose of

allowing the importation and sales of paraquat, a dangerous herbicide (Comision Nacional para el Medio Ambiente, 1991; Thomen, 1994).

From 1974 to 1984, the Dominican Republic registered one of highest increases in pesticide use of the Wider Caribbean Region (UNEP, 1994). This trend is continuing and pesticide imports increased by a factor of six between 1986 and 1990, equivalent to US$ 24.8 million in 1990 (AID, 1992).

Today, with decreases in sugarcane acreage and in the use of inputs for that crop, rice has emerged as the single crop consuming the largest share of pesticides in the country (Rafael Urbaez, pers. com.). Other pesticide-intensive crops are vegetables such as cabbage, sweet pepper, eggplant, onion, garlic and tomato. Crops grown in plantation such as pineapple, citrus, and banana are also heavy pesticide consumers. On the other hand, traditional root crops such as cassava, "yautia", and others are often grown without pesticides (Quisqueya Perez, pers. com.). Plantain and banana, grown on small fields, vary widely in their pesticide consumption (personal observation).

Field trips and interviews indicate that in the Dominican Republic, as in most developing countries, indiscriminate and unsafe pesticide use is the norm. Decisions to apply pesticides are based on calendar spraying or on the simple presence of a pest in the field. Protective gear during application of pesticides is usually absent. Children are often seen applying pesticides, as adults, now cognizant of the hazards of pesticides, are becoming more reluctant to accept this kind of work. There were reports of washing application equipment in irrigation canals and rivers and of using pesticide bottles as food containers. Widespread lack of sound criteria for control measures and hazardous handling of pesticides and equipment throughout the Dominican Republic are also reported by the Freistadt et al. (1979), Departamento de Sanidad Vegetal (1989), Segarra-Carmona (1992), and in a study of the Constanza area (Reyes, 1989).

Pesticides are also used in non-agricultural contexts. Tourist hotels, often located next to valuable coastal ecosystems, consume large quantities of pesticides to control nuisance pests (Rafael Urbaez, pers. com.). Golf courses receive weekly pesticide applications to control pests of turf (Francisco Geraldez, pers. com). Periodical use of pesticides for catching fish in rivers is reported by fishermen (interviews). In addition, pesticides are often used in suicide attempts (Rafael Urbaez, pers. com.).

PESTICIDE IMPACTS

a. Impact on public health.

In a study comparing all rural activities in the Dominican Republic (AID, 1991), pollutants from agriculture ranked as highly important in their socioeconomic impact (i.e., public health), and as a problem highly likely to increase in severity. It is difficult to assess the impact of pesticides on public health. Long term (chronic) effects of pesticides produce symptoms identical to those of other diseases, thus chronic intoxications are not diagnosed as such. Short-term (acute) intoxications are not always diagnosed correctly as many doctors are still not trained in agro-medicine (Ruben Marte, pers. com.). Even when acute intoxications are correctly diagnosed, it is difficult to collect this data, as rural hospitals have a poor record-keeping system (pers. observ.).

Frequent acute intoxications are suspected (Finkelman, 1989; AID, 1992b), but as hospitals do not report cases to any central agency, no numbers are available. The unavailability of health statistics for the poor in rural areas of the Dominican Republic was also observed in a World Bank study (1993).

In the absence of solid data, one must rely on anecdotal evidence. Interviews with farmers show that acute poisonings from pesticides is something familiar to them, with many farmers knowing of people dying from accidental poisoning. One doctor from Hospital de Seguro Social in San Pedro de Macoris said there were 138 acute poisonings diagnosed in that hospital in three years (1986 to 1988), with 6 deaths, most cases resulting from accidental exposure to pesticides in sugarcane. Some data from Constanza showing widespread exposure of the local population to organophosphate was found (see Constanza case study below). Dr. Ruben Marte, a doctor in charge of training in agro-medicine, suspects an even more serious situation in neighboring Jarabacoa Municipality where pesticide use in greenhouses is very intensive.

No reports of pesticide intoxications from eating contaminated food were found. However, there is a common suspicion that pesticides are present in food at intolerable levels (Rosario Blanco, pers. com.). A 1987 unpublished study found widespread pesticide residues in produce from Constanza (see Constanza case study below). Many interviewed people, including some from the Departamento de Sanidad Vegetal (Agricultural Ministry) said they avoid eating cabbage, a usual vegetable in a typical Dominican meal, from fear of pesticide poisoning. Unacceptable levels of pesticides were found in exports to the United States of Chinese vegetables and meats, and led to the rejection of 101 shipments in 1987 and 1988 (AID, 1991). In 1989, US rejections of Dominican produce represented losses equaling US$16-20 million (AID, 1991). Today, as a result of these rejections, Chinese vegetables are no longer produced and a pre-inspection system helps to insure, in export crops, that pest management methods are sound, and that the produce does not contain above-tolerance levels of insects or insect parts (Jerry Dupuy, pers. com.). However, pre-inspection does not include any analyses of produce for pesticide residues. Produce for domestic use does not benefit from the pre-inspection program and is suspected to contain hazardous levels of pesticide residues (World Bank, 1993). There are rumors that shipments of pesticide-contaminated produce are rejected in Puerto Rico and subsequently returned to the Dominican Republic to be sold domestically (Faruk Miguel, pers. com.). It is also known that rigorous pesticide analyses of produce revealed such high pesticide levels that results were kept secret (Thomen, pers. com.).

b. Impact on natural resources.

Pesticide use, by eliminating natural enemies of pests, inducing resistance of pests to pesticides, and changing the soil micro-fauna, affects the long-term viability of agriculture. Insect natural enemies in fields in Constanza, Azua, and Samana Bay were notably absent and pest resistance to pesticides is a phenomenon well known to many farmers. The Departamento de Sanidad Vegetal (1989) reports resistance of the diamondback moth to carbamates and pyrethroids, resistance of three sugarcane pests to chlorinated hydrocarbons, resistance of a peanut pest to Parathion, and others. Thus, disastrous crop losses caused by the whitefly *Bemisia tabaci* and the thrips *Thrips palmi* were brought about by indiscriminate pesticide use (Abraham Abud, pers. com.). At present, despite intensive pesticide use and continuous cropping, pest management in

rice is not at a crisis stage, however, farmers report constantly increasing difficulty in controlling weeds and insects.

Pesticides affect all living organisms. Birds, for example, once diverse and abundant, have disappeared from Constanza. Some (Thomen, pers. com.) feel that, due to pesticides, birds are fleeing the countryside and finding refuge in cities, creating an artificially high bird diversity in cities. On several occasions, farmers mentioned birds as targets of pesticide applications. Insects, except those resistant to pesticides (i.e. whiteflies), were notably absent from farmers' plots in Azua, Constanza, and Samana Bay and apiculturists have difficulty keeping their bees alive.

With intensive pesticide applications near waterways, or within aquatic systems in the case of irrigated rice, with the washing of spray equipment, and the occasional dumping of pesticides in rivers, the potential for contamination of surface freshwater is high. Freshwater can also be contaminated by the leaching of pesticides through soil down to the water table. Upon suspicion of contamination of ground water in Constanza, the Instituto Dominicano de Recursos Hidraulico (INDRHI) in collaboration with the German aid agency GTZ submitted a proposal for pesticide analysis of this water. Similarly, Universidad Nacional Pedro Henriquez Ureña submitted a proposal for pesticide analysis of water in Samana Bay. The World Bank (1993) also reports the suspicion of pesticides as serious water pollutants. However, pesticide analyses of water have not been conducted and no data is available.

As waterways ultimately lead to the ocean, the potential for contamination of the marine environment is consequently high. Investigations of the Taura syndrome in Ecuador (Benbrook, 1994) offer evidence of the harm pesticide use upstream can cause to coastal ecosystems. These investigations revealed that pesticide run-off from banana plantations into coastal commercial shrimp ponds were killing off shrimp larvae in numbers threatening the future of shrimp production. A few studies in the Caribbean point to the seriousness of the problem. Results from a study conducted in St. Lucia on pesticide contamination of coastal waters were "so shocking that the report was never released" AID (1990). Another study in Barbados by the Bellairs Research Institute found pesticide residues in sediments, seagrass and sea urchin eggs. One of the pesticides found was chlordane, a pesticide which had been banned from Barbados 10 years prior to this study (AID, 1990). The United Nations Environmental Program (1994) states that the impact of pesticides on marine ecosystems in the Wider Caribbean Region is "reasonably evident", with significant quantities of pesticides reaching coastal and marine environments, but acknowledges the absence of data on water quality and pollution loads from non-point sources of pollution.

Mangroves, corral reefs, and seagrass beds are the three most precious coastal ecosystems. Mangroves are important in supporting the coastal food chain, stabilizing the shore line, and enhancing water quality. Corral reefs are the basis for marine fisheries and are considered one of the most diverse ecosystems. Seagrass beds provide food and refuge for numerous marine organisms. All three systems are intimately linked and inter-dependent through the flow of nutrients and organisms. For example, 68% of reef fish and many shrimp, crab, and oyster species spend their juvenile stages in mangroves (AID, 1990).

Fishermen interviewed in Sanchez, La Jagua, and Sabana de la Mar (Samana Bay) and in the Puerto Viejo vicinity (Azua province) consistently reported significant reductions in fish, shrimp, lobster, and mollusk populations from both marine and aquatic systems. These fishermen identify the main cause as destructive fishing practices of non-artesanal fishermen. Although overfishing is often blamed for reef degradation, one expert believes that, in the Caribbean in general, tourism and agriculture are the main culprits (AID, 1990). Coral reefs and seagrass beds are considered particularly sensitive to pollution from toxics (AID, 1991). AID (1991) identifies agrochemicals as seriously affecting fisheries. However, it is acknowledged that, in general, very little is known about the impact of pesticides on coastal ecosystems (AID, 1990). The absence of data on the impact of pesticides on coastal environments does not preclude environmental protection measures. For example, 18 Mediterranean countries, in the absence of environmental impact data, agreed to phase out organophosphates to protect the Mediterranean marine ecosystems. These countries, invoking the precautionary principle, signed this agreement based solely on a suspicion of probable impacts of pesticide on their marine ecosystems (Jewell, 1992).

OPPORTUNITIES FOR REDUCTION

At the legislation level, prospects for bringing about actual reductions in pesticide use are low. The case of the 1991 decree banning twenty hazardous pesticides (of which the dirty dozen) illustrates this point. Immediately following the signature of this presidential decree drafted by the Comision Nacional para el Medio Ambiente, pesticide companies obtained from the ministry of agriculture an illegal and never-to-be-seen resolution allowing the importation of one of the banned pesticides (paraquat) under restricted use. Also, as retaliation, the Comision Nacional para el Medio Ambiente was made to leave its offices, and stands today as a presidential advisory body without a locale (A. Thomen, pers. com.). Today, paraquat is the most easily available pesticide (pers. observ.). However, when there is a will on the part of powerful interests, surprisingly expedient results can be obtained from prohibitions. The case of the prohibition of whitefly host plants in Azua illustrates this point. Faced with disastrous tomato harvests due to whitefly outbreaks, the Consejo Regional MIP Sur-Suroeste, a body dominated by agroindustries, decided in 1993 to ban the production of whitefly host crops during certain periods of the year. A few months after the ruling, the ministry of agriculture sent 10 tractors and teams of "chapeadores" working 22 days forcing poor farmers to comply with the ban by destroying their now illegal crops. Ironically, these measures didn't stop the whitefly, and the following harvest was an even worse disaster. Recently, as a measure against this same pest, cotton cultivation has been banned throughout the country year-round, and partial prohibitions of many other crops have been issued (Listin Diario, no. 27750).

An obvious lack of agricultural extension makes farmers very receptive to any kind of technical support. Interviewed farmers consistently complained of the lack of extension available to them. In many situations, a ministry of agriculture extension agent does exist but either doesn't have the resources or the motivation to go to the field. In the Bajo Yuna region (Samana Bay), the only available external source of technical information to farmers was from the Banco Agricola loan officer. The general lack of technical support to farmers in the Dominican Republic is confirmed in a study by Doorman (1991).

The prospects of reduced costs of production makes farmers particularly interested in the development of non-chemical methods of pest control. When the possibility of growing crops with fewer chemical inputs was suggested to farmers, they became very enthusiastic and made us promise to return to visit them. Their main motivation is the lowering of production costs. As pest populations become resistant and soils impoverished, the quantities of increasingly costly agrochemicals applied increase. This increase in production cost comes at a time of scarce credit availability, forcing many farmers to turn to low-investment/low return crops (AID 1992). A seductive alternative to farmers is to continue growing the same higher-value crop using fewer inputs. Since farmers are not overly concerned about the health and environmental hazards of pesticides, they are equally interested in reducing pesticide use as in reducing chemical fertilizer use. Thus, a demand for the development of low external input agriculture exists.

The practice of expensive and non-sustainable agricultural methods is partly a consequence of the lack of knowledge of farmers. Interviewed farmers did not have a good ecological or general knowledge of their pests, often naming and describing the pests with difficulty. One rice farmer, for example, cited spiders as a target pest. Knowledge of non-chemical agriculture is practically absent. Farmers generally don't know about natural enemies or natural fertilizers. In one poor farming community in Azua province, farmers had never heard of the use of animal manure as fertilizer, and despite the presence of swine, grow their crops without any inputs. Exposing farmers to non-chemical agricultural techniques would at least provide them with alternatives they can choose to adopt. Since irrigated rice is the number crop in pesticide use, is yet untouched by IPM programs, and has an intimate relationship with water, it is an obvious candidate for this project.

For rice growers, the main source of credit is from the state-run Banco Agricola. The use of agrochemicals is in-built within the credit system. For example, the loan officer is also a de-facto agricultural extension agent who follows a strict pest control recipe and visits loan recipients regularly (sometimes daily) to insure that the farmer is following the recommendations. Buying inputs through Banco Agricola is expensive. Agrochemicals bought with the bank's purchase authorization cost 4-30% more than their regular cash price (interviews with farmers). Six-month loans are handed out at a 24% annual interest rate, with 1% added for technical services, and farmers without collateral must take a loan insurance of 7.9% of the loan (loan officer interview). In the case of rice, loans are typically US $1,500 per hectare (loan officer interview) (small landholdings are 2 to 4 hectares). Rice processing plants are another main source of credit. Loans are given out at very high interest rates and are paid in rice. Some growers' associations also provide credit, these loans are for the purchase of inputs from the association which functions as a collectively-owned agrochemical business. Individuals also lend money at excessively high interest rates to farmers who do not have access to the above sources (interviews with farmers).

Growing rice, conventionally and even, but to a lesser extent, with low external inputs, requires a large investment. As with technical agricultural information, farmers are faced with a lack of alternative financing. This suggest the possibility of creating a low-interest "pesticide-free" credit system which would provide independence from the Banco Agricola system to farmers wishing to convert to low-input agriculture.

AZUA VALLEY, SURROUNDING HILLS AND PUERTO VIEJO

Interviews were conducted with the local IPM project head, 2 Habitat members, 1 agroindustrial representative, 7 groups of farmers, 2 federations of farmer associations, 2 agrochemical store managers, 2 groups of fishermen, and 1 hospital doctor.

Agriculture in Azua Valley has been in crisis for several years and some irrigated land has been abandoned (AID, 1992). The economically most important crops in Azua Valley were hosts to the whitefly *Bemisia tabaci* and are now largely prohibited from planting; these are: melon and watermelon, sweet peppers, eggplant, tobacco, and red bean. Industrial tomato, the backbone of the economy of Azua valley, suffered bad crops since 1989, with the last one yielding near-zero production due to a whitefly/virosis attack. Industrial tomato will not be planted in the 1994-95 season. Melon has almost disappeared due to the whitefly. Chinese vegetables disappeared earlier due to *Thrips palmi*. Other crops of importance are: corn, sorghum, Musaceae (plantain, banana, and "rulo"), and guandul (pigeon pea).

Pesticide use.

Azua Valley is well known in the country as a center of heavy pesticide use (AID, 1991). The crops with the heaviest pesticide use are hosts to the whitefly and *Thrips palmi*. Many of the staple crops (cassava, corn, guandul) are grown with little or no pesticides. In the case of industrial tomato, local agroindustries control most aspects of production including pest control. According to two agrochemical store managers, agroindustries have not followed the pest management recommendations for tomato developed by the local JAD/IPM project. The following is a description of the usual pest control methods in the most pesticide-intensive crops.

Industrial tomato (direct seeded). Endosulfan (Thiodan), Thiveiclon hydrogenox (Evisect), or methomyl (Lannate) are applied every 8 days in the 105-day cycle against the whitefly. Endosulfan (Thiodan) is applied against *Spodoptera* larvae with a lower frequency. The soil is treated once with carbofuran (Furadan) or fenaminophos (Nemacur). Weeds are controlled by applying fluazifop-p-butyl (Fusillade) twice per cycle. The fungicides mancozeb (Dithane-M45), maneb (Ridomil), and propineb (Antracol) are applied every 8 days against *Alternaria* and early and late blight.

Eggplant and sweet pepper. Endosulfan (Thiodan) or thiveiclon hydrogenox (Evisect) are applied every 15-20 days against the whitefly. Herbicides are not used. The fungicides mancozeb (Dithane-M45) or maneb (Ridomil and Daconil) are applied every 15 days (more frequently for eggplant) against diseases.

Melon & watermelon. Endosulfan (Thiodan) is applied every 8 days against the whitefly. Methomyl (Lannate) and monocrotophos (Azodrin) are applied against two lepidopteran pests ("perro oja" and "gusano cololler a"). Weeds are controlled by applying fluazifop-p-butyl (Fusillade). Fungicides, such as maneb (Ridomil) are applied 8 times in the 80-day cycle.

Musaceae (Banana & plantain). The soil is treated with carbofuran (Furadan) against the banana weevil and nematodes every 7 months. Herbicides such as paraquat (Paradox) or glyphosate (Round-up) are applied every 1-2 months to save manual labor.

Marine Resources
The Bahia de Ocoa is lined with small mangrove stands, large seagrass beds and corral reefs are found throughout the bay. A barrier reef off of Puerto Viejo was studied in much detail in 1978 (CIBIMA 1993). The bay is within the Bani-Barahona section of high fishing potential (AID 1991). Populations of shrimp, lobster, and conch occur. There is a high-tech Taiwanese-Dominican shrimp farming in Puerto Viejo.

Pesticide impacts.
a. impact on public health.
A doctor in Azua's main hospital, not able to provide figures, said most intoxication cases are accidental poisonings in short-cycle crops such as tomato, melon, sweet pepper, carrot, and cabbage. The doctor believes the numbers of poisonings are decreasing thanks to "safe pesticide use" education campaigns. It is also probable that poisonings are decreasing due to the disappearance of the most pesticide-intensive crops. Interviewed farmers said they knew of many acute intoxication cases and many deaths. No protective gear during application is worn.

According to the head of a farmer federation, agroindustries apply pesticides with no consideration for local inhabitants, and cited as an example Barcelo's fields located between 2 large communities, La Clavelina and Palmare, and where a river (rio Jura) passes. He says that when Barcelo is applying pesticides, these communities are exposed, and domestic animals get sick after drinking from that river.

b. impact on natural resources.
Interviewed farmers said they had seen fish kills caused by pesticides. Fishermen at Playa Caney (East of Puerto Viejo) told of reduced fish and lobster catches. Fishermen in Puerto Viejo described drastic changes in fish, crustacean (crabs are gone) and mollusk (gone) populations. They believe these changes started in 1979 with the development of a gas storage plant. Habitat believes two local rivers, Rio Jura and Rio Rosario are contaminated with agrochemicals. Near their estuary, these rivers, save for an abundant reed species, appeared noticeably devoid of aquatic life.

Opportunities for reduction
For whitefly host crops, the pesticide treadmill has run its course, leading to the elimination of those crops from the valley. Since these were the crops with the heaviest pesticide use, the opportunity to reduce pesticide use has basically vanished. Those remaining industries may substitute tomato with other crops and resume heavy pesticide use. Unfortunately, this substitute crop has not been identified yet.

If a strategy of prevention of future pesticide use is followed, there exists the opportunity to work with marginal farmers who are currently not using agrochemicals. Increasing the productivity and profits of these farmers' field could be achieved through the adoption of higher-value crops

and organic agricultural techniques. With the help of Habitat, contact has already been made with two marginal communities where this kind of work could be pursued.

An IPM program for industrial tomato was developed in close collaboration with the local agroindustries who have had total control of pest management in tomato since 1985. These agroindustries have been the recipients of training in safe pesticide use and IPM, while farmers were not included in these programs. Now, as agroindustries go bankrupt or transfer their operations out of Azua, most pesticide use goes back into the hands of uninformed farmers, and the years of efforts by the IPM group are wasted. This illustrates the need to work in close collaboration with farmers.

CONSTANZA VALLEY

Interviewed a member of Corporacion Verde, local IPM project head, 5 farmers, 1 hospital doctor.

The main crops in Constanza are cabbage, potato, & beans.

Pesticide use.

Constanza has been and continues to be notorious for its heavy pesticide use (AID, 1991). Increasing pest numbers, pesticide application doses and frequencies (AID 1992) illustrate an obvious pesticide treadmill phenomenon.

Cabbage. The main pest in cabbage is the diamond-back moth (*Plutella xyllostela*). Conventional pest control is by calendar spraying from once to twice weekly with metamidophos (Monitor), chlorpyrifos (Lorsban), diazinon, Thiveiclon hydrogenox (Evisect), and others. In its three-month cycle, cabbage is treated 12-13 times. In one valley, a perfected IPM program is in use using pheromone traps, Bt, and Jupiter (an insect growth regulator).

Potato. The main insect pest is *Phtorymea*. A control method using a baculovirus of that pest is being developed. There are frequent fungicide applications against the disease *Phytophthora*.

Pesticide impacts.

a. impact on public health.

According to Galvan (1991) citing medical sources, dozens of deaths occur each year due to pesticides. The director of Constanza hospital estimated an average of 3.5 acute intoxications per month in his hospital during months of pesticide use. A study in 1992 (Aponte Romero et al.) showed 15% of the general population (from a sample of 352 individuals) and 40% of pesticide applicators showed evidence of abnormally low cholinesterase activity due to exposure to organophosphate pesticides. The study also reports contamination by pesticides of air, water, soil and food. An unpublished study (Marte, pers. com.) in 1987 in which various produce were sampled at harvest from 300 fields showed 99% of the produce contained intolerable levels of pesticide residues. The head of Departamento de Sanidad Vegetal claims big improvement in application techniques, no more children applicators, no recent clinical intoxications, thanks to the CIBA-GEIGY safe use of pesticides program. This was disclaimed by other interviewees,

personal observations, and an unpublished study by the hospital director showing no changes in the number of intoxication cases in the last few years.

b. impact on natural resources. Many of the country's main rivers have their source here (Yaque del Norte, Yaque del Sur, Yuna, and Nizao rivers). Therefore, water contamination in this zone could have consequences in many distant parts of the country, including coastal areas.

According to Jesus del Carmen Galvan (1991), a local environmentalist, the Constanza area, with its very high biodiversity and endemism rate, was known in the 19th century as "the garden of Hispaniola". Deforestation starting in 1930 has been the major cause of environmental degradation, resulting in decreased river flows, decreased rainfall, and increased average temperatures. After deforestation, pesticide use starting in the 1970s is considered the second most important cause of environmental degradation. During my visit there, a probably pesticide-induced outbreak of the greenhouse whitefly (*Trialeurodes vaporarium*, yet another whitefly species) was so bad that it made standing outdoors within the town unpleasant. Although no scientific evidence is available, the present near-total absence of birds, fish, freshwater crustaceans, and insects (except resistant insects) is attributed to pesticides by local inhabitants. A study showed that, due to the particular topography of Constanza, a pesticide cloud forms atop the valley which, when it rains, causes a pesticide-laced rain to fall.

Opportunities for reduction

A viable IPM program for cabbage (see above) yielding better control of the diamondback moth at one fourth the cost of conventional control has been developed. However, due to lack of resources, this program cannot be extended beyond one pilot area where well-to-do farmers predominate. This illustrates the necessity for good extension and a good definition of the target beneficiaries.

MONTE CRISTI
Interviewed members of Centro de Investigaciones de Biologia Marina, Sixto Inchaustegui, and 2 rice growers in Mao province (upstream, mid-way between Monte Cristi and Santiago).

Monte Cristi is surrounded by salt marshes and no crops are grown there. The country's largest river, the Yaque del Norte has its estuary at Monte Cristi. This river and its associated canals provide irrigation and drainage to a large area, the Cibao Valley, the country's most productive agricultural area.

Pesticide use.
Pesticide use in rice in the Cibao Valley appears similar to that in the Samana Bay area. Mites are reported as an additional pest in that area. Carbofuran (Furadan) is commonly used against nematodes. Pesticides were stored inside the home.

Information on pesticide use in other crops in the Cibao Valley was not collected.

Natural Resources
The Parque Nacional Monte Cristi houses the most biologically diverse mangrove in the country. Some of the most pristine corral reefs are within the boundaries of the park in Bahia Icaquito. A survey of the reef fish by an aquarium fish enterprise reported that area as being one of the best sites in the world for commercializing tropical aquarium fish. It is considered as a fishery of high potential. There are nesting sites for endangered turtle species. The only recent reports of sightings of the very rare manatee are from that area.

Pesticide impacts.
One farmer had a condition on his feet diagnosed as lack of blood circulation which could be due to repeated exposure to paraquat. Interviewed farmers knew of one accidental death due to pesticides one month prior to our visit, and said they knew of numerous accidental poisonings.

According to Garcia (1991), in the third stretch of the Rio Yaque del Norte, downstream from Santiago, with its extensive irrigation network through an area of high pesticide use, exists the possibility of pollution of agricultural source. This study reports the presence of crops with symptoms of "complete burn" attributed to chemicals in the irrigation water. This water, of foamy appearance was also used for domestic and recreational purposes. The author concludes that pesticides analyses of water from this river segment should be undertaken. According to Gladis Rosado, who recently conducted a study of the pollution of water resources in the country, the water from the Rio Yaque del Norte near its estuary is obviously contaminated, appearing thick, foamy, and turbid. Since there is relatively little industry and a light population along the watershed downstream from Santiago, she suspects fertilizers and pesticides as the main contaminants.

Opportunities for reduction
According to an AID study (1991), using criteria of ecological importance, urgency of environmental problem, and practicality of setting up a project, Monte Cristi was given priority as a candidate site for an environmental coastal pilot project. According to Gladis Rosado, who

directed a countrywide survey of the land-based sources of marine contamination, Monte Cristi should be given priority because there is an obvious and large agriculture related pollution problem there with a relative absence of other sources of pollution. However, this area is more remote, and has few NGOs present.

RIO LIMPIO (BORDURE AREA)

Interviews with members of Centro Regional de Estudios de Alternativas Rurales, members of Grupo Antroposofico de Rio Limpio, and 1 representative of Instituto Agrario Dominicano.

In Rio Limpio, there is sedentary farming in the Valley and slash-and-burn agriculture on the slopes. Farmers have little access to credit or irrigation but many are successful enough to own one or more horses. Crops are grown without any inputs (organics or synthetic) and pest problems were reported as negligible. Weed-tolerant tall-stature "traditional" rice varieties are grown in both rain-fed and irrigated fields.

SAMANA BAY AREA

Interviews with CEBSE members, 5 fishermen in Sanchez, 4 fishermen in Sabana de la Mar, 3 fishermen in La Jagua, 4 agrochemical store managers, approximately 25 rice growers or rice growers associations (10 growers' associations contacted), 1 rice grower's widow, 1 Banco Agricola loan officer, 1 loan insurance agent, 2 community leaders.

Pesticide use.

On the peninsula proper, most farmers don't use pesticides (Omar Ramirez, pers. com.). In the Bajo Yuna area (near the Rio Yuna estuary), medium-sized farmers grow irrigated rice with heavy pesticide use (pers. observ.). On the southern coast of Samana Bay (between Sabana de la Mar and Miches) there are many small land-reform landholdings where rice is the main crop. Rice growers used to rely mostly on organophosphates and carbamates against insects, applying them on fields treated with herbicides. This mix induced phytotoxicity resulting in burn and prompted farmers to turn to pyrethroids (Porfirio Alvarez, pers. com.). Pesticide use in the Bajo Yuna and the southern coast appears surprisingly standardized with little variation in the pest management "recipe" followed (pers. observ.). Monocrotophos for use on rice in Samana region has been voluntarily retired by CIBA-GEIGY, because they don't want to carry responsibility of hazards and because overuse and misuse there was prevalent (Rosario Blanco, pers. com.). There are aerial applications of pesticides in Samana. Following is a description of the pest management methods encountered:

Insecticide. Carbofuran (Furadan) is commonly applied to soil once before planting against the rice water weevil (*Lissorhoptrus oryzophilus*). Deltamethrin (Decis) and monocrotophos (Nuvacron, Azodrin) were the most commonly used insecticides against a rice hopper (*Sogatodes orizicola*: Delphacidae), fly leafminer (*Higrelia*), a stink bug (*Oebalus ypsolongriseus* and *Nezara* spp.) and a lepidopteran larva (*Spodoptera* sp.). Against each insect species, these could be applied from one to three times in the three month rice cycle. Total

number of applications in a rice cycle is from six to nine. Other insecticides less frequently encountered were lambda cyhalothrin (Karate) and metamidophos (Monitor).

Herbicide. There is a very heavy and ubiquitous herbicide use in rice fields. Herbicides are applied 3 times in the cycle. Typically, paraquat (Gramasan, Gramoxon, Paradox) is applied before soil preparation, followed by two applications of Propanil (Stam). Glyphosate (Round-up) is applied on bunds. Other herbicides encountered in rice were 2,4-D, Fenoxyprop-ethyl (Furore), and diclorofenil propional (Propadox), and MCPA.

Fungicide. Fungicides were encountered only in the Bajo Yuna area. There, two to three applications of Mancozeb (Dithane) or Maneb (Manzate) were common.

Raticide. There were reports of poisoning rats with "wafarina" and also with monocrotophos (Azodrin)-laced bait.

Avicide. There were reports of poisoning migratory ducks ("pato Florida") with the insecticide monocrotophos (Nuvacron). Native birds feeding on rice grain near harvest are also targets of pesticide applications.

Natural Resources

Samana Bay has the largest mangrove extensions in the country with all four major mangrove tree species occurring (*Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemosa*, and *Conocarpus erectus*) (AID 1991). The single largest mangrove stand (7,783 ha) is at the mouth of the Rio Yuna (AID 1991). In the southeastern portion of the Bay, there are corral reefs adjacent to sand banks and reefs at depths of 10-11 meters that are considered ecologically unique (CIBIMA 1993). There are important seagrass beds mostly on the northern coast of the Bay. Studies report 78 sedentary and 32 migratory bird species and many bat species. Samana Bay is considered the most important nursery of marine organisms of the Caribbean (AID 1991). It is also one of the few zones with lobster (*Panulirus argus*) populations. The Bahia de San Lorenzo and Bahia de la Gina are considered important feeding grounds for several endangered turtle species (AID 1991). There are unconfirmed reports of manatee sightings (Gladis Rosado, pers. com.). Samana bay is an important reproduction site for the humpback whale *Megaptera novaeangliae*. The Bay's biological richness is the basis for substantial income generation. It is one of the principal fishing zones of the country (858 square km of continental platform), and the most important shrimp (*Penaeus schmitti*) fishery in the country (Cesar Mateo, pers. Com.). The peninsula benefits from a substantial ecotourism which promises to increase in the near future (Omar Ramirez, pers. Com.).

Pesticide impacts.

a. impact on public health.

Two of the farmers interviewed had been sick in the past as a result of applying pesticide. A third farmer had a skin condition on his feet and chins that we suspected were from herbicide (paraquat) exposure. We met a young mother whose husband died three months prior to our visit from exposure to an herbicide. She also knew someone who had died 1 year before of accidental pesticide poisoning and reports that many farmers have pesticide-induced skin conditions which force them to wear loose clothing. Farmers reported numerous poisonings, some leading to death. They also observed farmers washing pesticide application equipment in canals or in the Yuna river which also provides drinking water when rain water is scarce. Using pesticide containers for as drinking cups was reported. Pesticide were usually stored inside the house to prevent losing these expensive products by theft. One large bag labeled "extremely hazardous" was stored on top of a rice bag. Ducks deliberately killed with insecticide-laced bait were subsequently eaten.

b. impact on natural resources.

About 10 years ago, Venessia Alvarez of CIBIMA, recalls seeing in San Lorenzo Bay (at the boundary of the parque Los Haitises) dying mangrove trees along a canal whose water was from drainage of the rice fields. Venessia Alvarez also remembered a report of fish kills in the Rio Yuna estuary, presumed to be caused by pesticides from the Japanese rice development project AGLIPO. In Sanchez (at the bottom of the peninsula), fish are no longer commercially caught and large fish are no longer seen. Shrimp populations have decreased dramatically, fishermen report decreases in shrimp catches from an average of 30 to 4.5 pounds per day. According to most fishermen the primary cause is the use of a "chinchoro" (gill net) by larger fishermen starting in 1987. However, without prompting, one fisherman mentioned pesticides from rice as a prime cause of declines in catches. He reported regularly seeing large river fish species

("Robalo") agonizing at the Yuna estuary. The fishermen from Sanchez recalled an incident in 1977 when a pesticide bottle was accidentally dumped in the Bay and a large fish and shrimp kill was observed. Fishermen from Sabana de la Mar (on the southern coast) reported decreases in shrimp catches from 15 to 3 pounds per day. They identified increased sedimentation, Spanish fishermen's drag nets, and pesticide run-off from rice fields as causes of the decrease. They learned about pesticide run-off from rice field from a large shrimp kill which occurred in 1984 after an unusually abundant rain. They mentioned the possible contamination of two local rivers (Rio Yabon and Rio Janigua). Fishermen in La Jagua (8 km from Rio Yuna estuary) said fishermen could no longer make a living from river fishing due to decreases in catches and fish size. An AID study (1991) acknowledges the possibility of agrochemical runoff affecting marine ecosystems, noting its probable occurrence in Samana bay. The recent switch from organophosphates and carbamates to pyrethroids may worsen the impact on marine resources as these are even more toxic to fish.

TAMAYO

Interviews with 2 members of Centro de Investigacion y de Apoyo Cultural, 1 grape grower, and 1 agronomist.

Plantain is the main crop in the Tamayo area. Other crops in are coconut, sweet pepper, eggplant, rice, cassava, sweet potato, red bean, and guandul. Ninety percent of the plantain growers are too poor to use pesticides and don't have access to credit. The remaining ten percent use Carbofuran (Furadan) or Isasophos (Miral) once before planting against the banana weevil and nematodes, and an herbicide such as paraquat (Gramoxon), MSMA (Daconate), or oxyfluorfen (Goal) every 3-4 months.

In nearby Neiba where table grapes is the major crop, pesticide use is more prevalent. Maneb (Ridomil or Daconil) or propineb (Antracol) both fungicides, and metamidophos (Tamaron or MTD), an insecticide, are commonly used every two weeks during production. One grape grower regularly used an avicide against the "ruisenol". He and his daughter were eating grapes which had been treated with maneb the previous day. Tamayo is located on the Rio Yaque del Sur, but the potential for pollution of that river from pesticide use in Tamayo is low since pesticide use there is low, and an overriding problem for that river and its estuary arises from a drastic reduction in its flow due to deviation of much of its water into irrigation canals.

METHODOLOGY EMPLOYED IN INTERVIEWING FARMERS AND FISHERMEN

Interviewees were not selected following any systematic scheme. The spontaneous selection of interviewees depended upon their previous contact with accompanying institutions, their presence in the field at the time of our passing, and their willingness to be interviewed.

Interviews were not conducted following any systematic scheme. Interviews took place in farmer's fields, houses, by the roadside, in associations' locales. Interviews were both with individuals and groups. Information was recorded on paper.

An effort was made to abide by the following principles:
-to interview people from various social strata,
-to never suggest any answers,

-to identify our motivations only at the end of the interview so as not to influence responses.
-to check the veracity of responses by going to the farmer's field or by cross-checking with other farmers.

SOME BACKGROUND INFORMATION RELEVANT TO RICE PRODUCTION

Over the last ten years, an average of 107,091 hectares (ha) of rice were harvested nationally (documents from Depto. de Fomento Arrocero). In 1993, 53% of the area harvested was financed by Banco Agricola In 1993, national average yield was 3.7 tons/ha. (S.E.A. 1994). (S.E.A. 1994). About 40% of rice land is IAD land reform projects (Wilfredo Lozano, pers. com.). 39 kg of rice were consumed per person in 1993 (S.E.A. 1994). In 1992, rice was the number one crop in value. Rice is number one in surface area harvested. The cost of production of rice varies between 1,230 and 1,969 USD/ha. (from various interviews). Total production is irregular, and some years the Dominican Republic imports rice, while there were two years in which rice was actually exported. However, a rumor states that the previous information is government-controlled, and that actually the country imports rice every year.

The following is some information from Lockward & Pozo (1994). It is information for Samana Province which covers most of the Bajo Yuna area in addition to large areas not within the Bajo Yuna. In the absence of more area-specific data, this data gives an approximation of socio-economic conditions in the Bajo Yuna. Infant mortality (under 5 years of age) is 53.3 %. Illiteracy rate is 30%. Main activities are agriculture and fishing. Land tenure is unequally distributed with 19% of landowners holding 98% of the land. In the Bajo Yuna, most farmers are IAD land reform recipients holding 3 hectares (pers. observ.).

STRATEGY AND RECOMMENDATIONS FOR CHANGING PEST MANAGEMENT METHODS

see Project Outline.

RELEVANT ORGANIZATIONS AND THEIR CURRENT OR POTENTIAL ROLE
CEBSE has already provided much help, expressed interest in the project, and agreed to serve as the Dominican coordinator of the project. Other organizations are also described below.

Institutions of community development relevance

The **Centro de Investigaciones y Apoyo Cultural** (CIAC) is an NGO concerned about occupational health and sustainable community development. Their area of activity is in the city of Tamayo.
Contact: Faruk Miguel, tel: (809) 685-4171, FAX: (809) 682-9927.

The **Centro para el Ecodesarollo de la Bahia de Samana y su Entorno** (CEBSE) is providing information and support to Samana Bay communities to encourage sustainable economic activities in the Samana peninsula. CEBSE has been actively involved in the exploratory phase of this project, and is interested in playing a future role in the project.
Contact: Omar Ramirez, tel: (809) 532-4220, FAX: (809) 532-0921.

Corporacion Verde is an environmentalist NGO whose main activities are in Constanza. It has provided help and may be useful in advocacy of non-chemical agriculture.
Contact: Jose Galvan, tel: (809) 539-3359, FAX: (809) 539-2410.

The **Federacion de Campesino Independiente Mama Tingo** is a federation of small farmer's association in Azua province. They collaborate with Habitat on community issues. They are involved in political activities requesting land and infrastructure for the communities they represent.
Contact: Luis Cabrera, contact Habitat.

The **Federacion Provincial de Organizaciones Campesinas Azuanas** (FEPROCA) is a well-funded federation of farmers' associations in Azua province. They have community development projects, a lending cooperative, and take part in negotiations on local agricultural policies providing a counterweight to the powerful agroindustries in Azua.
Contact: Manuel "Frank" Tejeda, tel: (809) 521-3255, FAX: (809) 521-2058.

The **Friedrich Naumann Foundation** assisted a group of sugarcane producers (Procesadora de Cana Organica Cruz Verde) in forming an organic sugar enterprise.
Contact: Guillermina Reynoso, tel: (809) 682-5434, FAX: (809) 685-4376. also **Contact**: Arsenio Soriano (Cruz Verde agronomist), tel (809) 593-8085.

The **Grupo Ambiental Habitat** is helping poor communities to organize themselves in the pursuit of sustainable economic activities. It has also been advocating against pesticides for many years. Their area of activity is in the Southeastern part of the country with a focus in Azua province.
Contact: Rafael Urbaez, tel: (809) 682-9709, FAX: (809) 682-9709.

Some **Peace Corps** volunteers are promoting botanical insecticides and have close contacts with the communities they are based in. However, they are usually stationed in the remote villages where synthetic pesticide use is light.

Rice growers' associations. Most interviewed rice farmers belonged to an association. In some cases, these function as a credit union, as a shareholder organization for an agrochemical business, or for no distinct purpose. These organizations, if interested in the project, could become important collaborators through which farmers become empowered.
Contact: Most associations don't have telephone, contact can be made through Omar Ramirez (CEBSE). Federacion Agraria de Limon del Yuna, Fali does have a radio/telephone: Amalio Mejia, tel: (809) 573-0513 request unidad 292.

Institutions of scientific relevance
The **Caribbean Natural Resources Institute** (CANARI) supports sustainable development and have one scientist (Allen Smith) with expertise in marine pollution.
Contact: Yves Renard, tel: (809) 454-6878, FAX: (809) 454-5188.

The **Centro de Agricultura Sostenible y Tecnologia Apropiada** (CASTA) in Villa Alta Gracia can be useful as a source of knowledge and know-how of non-chemical agriculture. CASTA is the creation of an evangelical university and has the reputation of having poor linkages to the local communities. Contact by telephone only has been made.
Contact: Epifanio Gonzalez, tel: (809) 562-3428.

The **Centro de Investigacion Arrocera** (CEDIA) in Juma is a branch of the Secretaria de Estado de Agricultura. It is the country's center for rice research. This center can help in experimenting with alternatives.
Contact: Vinicio Castillo, tel: (809) 525-2894.

The **Centro de Ingenieria y Manejo Ambiental de Bahias y Costas** (CIMAB) is a Cuban institute with equipment and experience in pesticide analysis of water. Analyses can be done in Cuba by sending samples or a Cuban chemist can come to the Dominican Republic to train Dominican chemists.
Contact: Manuel Alepuz, tel: (537) 62-4387, FAX: (537) 33-8250.

The **Centro de Investigaciones de Biologia Marina** (CIBIMA) (within Universidad Autonoma de Santo Domingo) has the country's experts in marine biology.
Contact: Venessia Alvarez, tel: (809) 532-4220, FAX: (809) 689-4080.

The **Centro Regional de Estudios de Alternativas Rurales** (CREAR) is a school for sustainable agriculture. The focus of CREAR has been on soil conservation and improvement, organic agriculture using polycultures and rotations. CREAR is located in a remote village near the Haitian bordure. CREAR can be useful as a source of knowledge and know-how of non-chemical agriculture. CREAR has a well-defined philosophy involving harmony between humans and nature which might be alien to mainstream farmers.
Contact: Juan Lora, tel: (809) 579-4351, FAX: (809) 579-4351.

The **Departamento de Quimica** of the Universidad Nacional Pedro Henriquez Urena has the basic equipment for analysis of pesticides. They have in the past submitted a proposal to do analyses of water and sediments from Samana Bay. However, they do not have any personel experienced in such analyses. They agreed to provide me with an estimate for the cost of analyzing water for specific pesticides, but appeared unable to do this.
Contact: Luciano Sbriz, tel: (809) 549-7409, FAX: (809) 687-7598.

World Vision's **Escuela Campesina de Agricultura Sostenible** (ECAS) in Neiba is another center which could serve as a source of information on alternative methods. In contrast to CREAR and CASTA, ECAS has the reputation of having strong links with local farmers. No contact has yet been made with this school.

The **Grupo Antroposofico** de Rio Limpio promotes an integrated community development program of which sustainable agriculture is an important component. This group is located in the same remote village as CREAR. It proposes agricultural methods that are more apropriate to resourceless farmers than CREAR's methods. Starting next season they will gain some experience with rice growing. In contrast to CREAR, their rhetoric is pragmatic and non-mystical.
Contact: Guarionex Almonte, FAX: (809) 579-8481.

Instituto Agrario Dominicano (IAD) is a governemtal organization implementing the agrarian reform. In addition to administering the lands under its jurisdiction, it is responsible for providing infrastructural and technical support to growers. IAD has an agreement with CREAR in which IAD provides land in exchange for training of farmers in alternative agriculture. There are IAD stations throughout the countryside including one in Sabana de la Mar (Samana Bay) which has an experimental plot and might be convinced to provide land for experimentation.
Contact: Juan Fernandez, tel: (809) 530-5591.

Instituto Nacional de Recursos Hidraulicos (INDRHI) in collaboration with GTZ, undertook a project to assess the impact of agriculture on underground water in Constanza. They are now attempting to develop their analytical capacity to enable them to do their own pesticides analyses of water. However, it may be years before they receive the equipment and training. INDRHI can serve to provide basic information on water resources.
Contact: Agustina Garcia, tel: (809) 530-5591.

The **Instituto Politecnico "Loyola"** is teaching and developing techniques in non-chemical agriculture. They recently made an agreement with the Laboratorio de Control Biologico to study nematodes parasitic on the rice water weevil (an important rice pest). It may be a useful source of information on alternative agricultural techniques.
Contact: Francisco Taveras, tel: (809) 528-4786.

The **Instituto de Quimica** (within Universidad Autonoma de Santo Domingo) has brand new gas chromatography equipment necessary for pesticides analyses. However they do not have any personnel experienced in such analyses.

Contact: Conrado DePratt, tel: (809) 533-2966

The university **Instituto Tecnologico de Santo Domingo** (INTEC) offers a post-graduate program in environmental science. Students in this program might be available to help in conducting a scientific environmental impact study.
Contact: Jose Contreras, tel: (809) 567-9271, FAX: (809) 566-3200.

The **Junta Agroempresarial Dominicana** (JAD) is an organization supported by the country's agroindustries, Secretaria de Estado de Agricultura and USAID. It provides technological support to farmers. It directs Integrated Pest Management projects in Constanza, Azua, La Vega, Santiago, and Hato Mayor in cabbage, potato, industrial tomato, tobacco, and citrus. It has developed viable IPM methods in at least industrial tomato and cabbage, however the small resources allocated to the IPM projects appear to prevent large-scale adoption of their techniques. JAD currently has no links to rice production but expressed interest in developing activities in rice-growing areas. JAD has qualified personnel in all agronomic areas and can provide useful technical information.
Contact: Abraham Abud, tel: (809) 563-6178, FAX: (809) 687-563-6181.

The **Laboratorio de Control Biologico** (within Universidad Autonoma de Santo Domingo) is developing the production and use of beneficials against agricultural pests. They proposed to work with nematodes and fungi against the rice water weevil.
Contact: Quisqueya Perez, tel: (809) 537-9665.

The **Laboratorio de Control Biologico** (Ministerio de Agricultura, Provincia de Matanza, Cuba) has experience in the production and use of various pathogens against rice pests, not yet contacted.
Contact: info can be obtained through Francisco Taveras Taveras who has had previous contact with them (tel: (809) 528-4786).

Institutions of relevance to credit and policy issues

Banco Agricola is a public institution providing credit to farmers. In recent years, credit availability has been decreasing, forcing farmers to grow short-cycle crops requiring low investment. Banco Agricola loans appear to be strongly linked to pesticide use. It is well-known that high-ranking individuals within Banco Agricola have interests in the sales of pesticides, for this reason, the prospects of changing the bank's policies are not promising.
Contact: Francisco D'Oleo, tel: (809) 535-8088.

The **Comision Nacional para el Medio Ambiente** is an advisory body influencing environmental legislation. The Comision is responsible for the drafting and approval of the 1991 decree banning the dirty dozen.
Contact: Antonio Thomen, tel: (809) 682-3770, FAX, (809) 530-6553.

Departamento de Sanidad Vegetal (within Secretaria de Estado de Agricultura) is responsible for the registration of, overseeing imports (at ports of entry), commerce, and use of

agrochemicals. Due to its lack of resources (AID 1992) which this institution acknowledges (Departamento de Sanidad Vegetal 1989), or due to conflicts of interest (Thomen, pers. com.), this institution shares much of the responsibility in creating the current abuse of pesticides in the country.
Contact: Rosario Blanco, tel: (809) 532-7941.

The **US Agency for International Development** (AID), through ENTRENA funds numerous development programs in the Dominican Republic, including funding agricultural credit programs implemented by Banco Agricola. One of the stated strategic objectives of AID is "sustained, environmentally-sound economic growth with equity". Thus, if made aware of the non-sustainable impact of their agricultural credit programs, AID might be induced to pressure for the elimination of links between Banco Agricola loans and pesticide use.
Contact: Bolivar Pou, tel: (809) 221-1100.

Like AID The **World Bank** has funded specific agricultural credit programs implemented by Banco Agricola.

Prospective funding institutions

The **Fundacion de Desarollo Agropecuario** has helped to fund programs to reduce pesticide use. It has been responsible for the introduction of beneficials against the whitefly. It is currently sponsoring JAD's IPM programs.

The **Deutsche Gesellshaft fur Technische Zusammenarbeit** (GTZ) (German aid agency) has had a long-standing involvement in programs reducing pesticide use. They have helped in the adoption of neem as a botanical insecticide. They funded a project to assess the impact of agriculture on underground water in Constanza.

Fondo Ecumenico de Prestamos de la Republica Dominicana gives out low-interest loans for community projects.
Contact: Flady Cordero, tel: (809) 688-6514, FAX: (809) 682-3246.

The Inter-American Foundation (FIA), supports community development projects. FIA's representative in the DR expressed much interest in the creation of a revolving fund to finance alternative rice production.
Contact: Telesforo Gonzalez, tel: (809) 541-9607, FAX: (809) 541-9750.

The **US Agency for International Development** (AID). (see above).

Winrock International Institute for Agricultural Development has an environment and sustainable development program in the Dominican Republic. It currently has no activities involving pesticide use, and expressed an interest in a pesticide reduction project.
Contact: Daniele Perrot-Maitre, tel: (809) 687-5878, FAX: (809) 687-5766.

Agrochemical companies

Associacion de Fabricantes y Importadores de Productos Agroquimicos (AFIPA) is a powerful alliance of importers of agrochemicals. AFIPA was instrumental in pressuring SEA to allow paraquat importation.

Ciba-Geigy, a major pesticide exporter to the Dominican Republic. It is funding a program in Constanza teaching applicators and school children "safe pesticide use".
Contact: Modesto Reyes, tel: (809) 539-3266, FAX: (809) 539-2410.

Hoechst, exporter of several major agrochemicals used in rice. Run experiments testing their products at CEDIA in Juma-Bonao.

Imperial Chemical Industries (ICI), a major pesticide exporter to the Dominican Republic, was responsible for making possible the importation of paraquat in defiance of the 1991 decree banning the dirty dozen. ICI is funding a program in agro-medicine. This program provides medical training and antidotes in the care of pesticide-intoxicated patients.

FERSAN and **FERQUIDO** are the country's largest agrochemical suppliers. They are known to resort to all means to safeguard their market.

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