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# PESTICIDES AND HEALTH IN THE CENTRAL AMERICAN ISTHMUS

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Pan American Health Organization  
World Health Organization  
Health and Environment Division/HEP



Environmental Program and Health in the Central American Isthmus (MASICA)  
Occupational and Environmental Aspects of Exposure to Pesticides  
in the Central American Isthmus Project (PLAGSALUD)

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Occupational and Environmental Aspects of Exposure to Insecticides  
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# Prologue

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One of the priority areas of the Strategic Plan of the Pan American Health Organization for the period 2003-2007 is the promotion of safe physical environments. One of the most important problems and challenges is the one faced by the countries of the Region with respect to pesticides.

The average use of these substances has been rapidly increasing which, together with the use of other well known dangerous products, has caused serious problems that compromise the sustainability of the agro systems, the biodiversity and the quality of human life.

This document was prepared using the conceptual model of Motor Force, Pressure, State, Exposition, Effects and Action adapted by the World Health Organization from the proposal made by UNDP to supervise the progress towards sustainable development, and it carries out quantitative analysis of the importation, use and consequences that the use of chemical pesticides in the Central American Isthmus represent for health conditions. The document also presents the manner in which the Pan American Health Organization (PAHO) through its Project of Occupational and Environmental Aspects of the Exposure to Pesticides in the Central American Isthmus (PLAGSALUD) has faced this problem during the last few years in this Sub region. We are sure that this type of intervention will serve as a guide for all countries of the Region in their compliance with the purpose of the Technical Cooperation Office to "increase the number of countries with operational regulations for the importation and use of pesticides and to insure permanent supervision of the pollution they cause."

MAURICIO PARDÓN  
*Director,  
Health and Environment Division*





# Pesticides: a serious problem in the Isthmus

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## ➤ BACKGROUND

The agricultural industry is a vital branch of the economy of the seven countries which form the Central American Isthmus. Consequently, the use of synthetically chemical pesticides in support of this industry and of other activities of public health has been of great importance. The Central American countries are among the largest importers of pesticides. It is estimated that in the last decades the per capita consumption has been three or four times higher than in the rest of the world.

The potential for damages to the health and the environment is important; however, even by mid 1990 the true magnitude of these effects was rather unknown. In this context, in August of 1994 emerges the "Project on Occupational and Environmental Aspects of the Exposure to Pesticides in the Central American Isthmus" (PLAGSALUD), formulated within the framework of the Program on Environment and Health in the Central American Isthmus (MASICA), of PAHO/WHO.

Among other achievements, the actions of PLAGSALUD have helped the countries in the Isthmus to collect more reliable and timely information regarding the importation, use and consequences of the handling of synthetically chemical pesticides. The great majority of the information used for this analysis comes from the various activities developed by PLAGSALUD.

## ➤ METHODOLOGY

Using the conceptual model of *Motor Force, Pressure, State, Exposition, Effects and Action* several quantitative analyses were carried out on the importation, use and consequences on the health of individuals from the use of synthetically chemical pesticides in the Central American Isthmus for the period 1992 to 2001.



## ➤ RESULTS

**Importation of Pesticides.** The importation of pesticides in the Central American Isthmus has shown a dramatic tendency towards the increase. Between 1992 and 1994, it almost duplicated, going from 17.964 to 34.529 tons (92,2%). Although in 1998 the upward trend which amounted to 36.224 tons showed a slight decrease, as of 1999 imports continued to increase, reaching almost 46.370 tons in 2001. That is to say, the importation of pesticides in the area almost tripled in 10 years (1992 to 2001). Under these circumstances it is not surprising that the potential to pesticide exposure is considerable. For instance, the importation of pesticides tended to increase during the period 1992 to 2001 in almost all the countries of the region up to 267,0%, as was the case in Guatemala. In Belize they increased by 36,1%, in El Salvador by 55,5%, in Honduras by 323,0% and in Nicaragua by 307,0%. Although between 1992 and 1997 Costa Rica and Panama presented an increase in the importation, starting in 1998 they showed a slight tendency towards the decrease.

**Frequency of intoxications caused by the use of pesticides.** With the information of the seven Central American countries for the period from 1992 to 2001, a total of 43.368 cases of acute intoxications caused by pesticides and 4.323 deaths were associated to such exposures. The rates of incidence expressed per 100.000 habitants showed a general upward pattern for this period, particularly in El Salvador, Nicaragua and Guatemala. Although Costa Rica shows an upward trend, during the last few years the incidence rates have decreased. In the year 2001, with the exception of Belize, all the countries in the region experienced a decrease in the number of intoxications. For the working population, the population at risk was estimated based in the proportion of economically active individuals dedicated to agriculture, assuming that close to 80% of the intoxication cases occur in rural areas. Based on these calculations, Costa Rica, Nicaragua and El Salvador would show the greatest number of acute intoxications for the region in this population.

**Lethality associated with the use of pesticides.** Lethality in the region has increased, going from 4,78% in 1992 to 12,24% in 2001. Countries such as Belize, Costa Rica, El Salvador and Panama, have been able to decrease it, but that trend is not seen in Guatemala, Honduras and Nicaragua. This calls for immediate action to improve the identification and adequate handling of the cases on the part of health institutions.

**Strength of the association of the use of pesticides with health effects.** When modeling indicators of exposure at the regional level, the results indicate that the rate of intoxication incidence by pesticides increases by 9% to 11% per each 100 tons of pesticides imported per hectare of agricultural and non-agricultural land. Instead, there is no clear association between these exposure indicators and lethality associated to pesticides.



## ➤ CONCLUSIONS AND RECOMMENDATIONS

- Importation and use of pesticides increased during the period 1992 to 2001 in the Central American Isthmus region.
- The rates of acute intoxication have a tendency to increase, while the lethality behavior is less consistent among countries.
- Lethality in the region has progressively increased, going from 4,78% in 1992 to 12,24% in 2001. Countries such as Belize, Costa Rica, El Salvador and Panama, have been able to lower it, but that trend is not observed in Guatemala, Honduras and Nicaragua.
- The import trend has always been upwards, that of the intoxications, although it showed increases up to 1997 linked to a larger number of cases reported, is showing a tendency towards stabilization as of that date, although imports are still increasing; lethality and mortality to a certain extent, are on the rise which is a cry of alert towards the need for timely consideration of the diagnosis, improving the clinical handling of the problems and to increase research on the effects of pesticides presently used on the health of the population.
- An important advance is observed in the notification in all countries. The reinforcement of this process must continue.
- It is necessary to strengthen and develop a stronger inter sectorial action aimed at a greater commitment which will involve not only the safe use of pesticides but also the promotion of alternative systems for the handling of pests.



# Achievements and Challenges of the PLAGSALUD Project

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*History, achievements and challenges of the project "Occupational and Environmental Aspects of Exposure to Pesticides in the Central American Isthmus" (PLAGSALUD).*

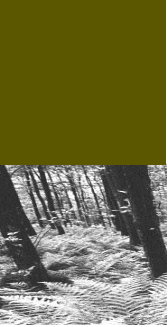
**F**or decades, the sub region has been one of the main consumers of pesticides per capita in the world, which has brought fatal consequences not only for human health but also for the environment.

In view of this situation, the Health and Environment Division of the Pan American Health Organization (PAHO/WHO), formulated the PLAGSALUD Project, in the context of the Environment and Health in the Central American Isthmus Program (MASICA). The direct beneficiaries of this Project are the 18 million inhabitants of the rural area and in particular the four and one half million agricultural workers, who have been financially backed by the Danish Agency for International Development (DANIDA). The first Phase of the PLAGSALUD project was executed in Costa Rica and Nicaragua (1994-1996), and the second Phase (1997-2001) was extended to all countries of the Isthmus. Phase III of the Project will end in the year 2003.

## ► OBJECTIVES

This project gives priority to health and environmental aspects arising from exposure to pesticides. It is hoped that a reduction of illnesses related to pesticides and the development of alternatives will be obtained through:

- The establishment of epidemiological supervision systems and the increase in the diagnostic capacity and response to treatment for intoxications and illnesses caused by pesticides in all seven countries.
- The establishment of local capacity to monitor and respond to problems caused by pesticides, which involve multi sectorial coordination and political reforms, as well as an active and prominent role of the health sector.
- The strengthening of national institutions and the use of networks for the exchange of information and technical cooperation.
- The strengthening of organic agricultural programs and the integrated handling of vectors in agriculture and public health, together with similar programs in the Central American ambit.
- Less unfairness in health in aspects related to pesticides when it refers to gender, childhood and socioeconomic aspects.



## ➤ ACHIEVEMENTS

The Project has shown important achievements in its five areas of work during Phases I and II:

### ◆ **Epidemiological surveillance**

All the countries have included acute intoxications caused by pesticides in diseases of mandatory report within the national surveillance systems.

At the local level, Pesticide Committees have been formed, which have had an outstanding role in the responsibilities of control of the seat. Research on intoxication alerts has permitted the interference of risk factors.

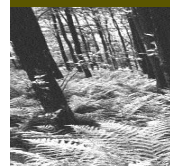
### ◆ **Education**

Each country, taking into account its own cultural characteristics, has produced educational material about pesticides directed to workers exposed, the community in general and students. At the same time, at a sub regional level, material has been prepared for health workers and technicians of various sectors.

The documents have been widely distributed, using it in trainings done at various sectors and levels.

### ◆ **Legislation**

The Project has been backing the improvement of legislation on pesticides in each country and, at the regional level, it has obtained the approval of agreements tending to restrict the use of the more dangerous pesticides and to homologate the forbidden pesticides in the seven countries of the Central American Isthmus.



#### ◆ **Research**

The countries have prepared their “Diagnosis of the Situation” on the subject of pesticides and each of them has developed research on the subjects of special interest, such as under registration of intoxications, attitudes and practices and residues of pesticides in food and others.

#### ◆ **Coordination with other organizations and regional projects**

The PLAGSALUD project has coordinated actions with other agencies, ONG’s and projects that have been working at the Central American level on pesticides and their alternatives, such as CCAD, OIRSA, IICA, CATIE, EPA, Zamorano, Radio Nederland, etc.

#### ◆ **Alliance for Sustainable Development in Central America (ALIDES)**

The Alliance for Sustainable Development was constituted in October of 1994. It is an initiative of policies, programs and actions in the short, medium and long terms, which delineates a change in the schedule of development, our individual and collective attitudes of the local, national and regional policies and actions towards sustainable political, economical, social, cultural and environmental development of societies.

The principles which rule ALIDES are respect for life, the improvement of the quality of human life, respect and good use of the vitality and ethnical diversity of our countries, the achievement of greater degrees of economic integration between the countries of the sub region and of these countries with the rest of the world and the inter agencies responsibility for sustainable development.

Within the environmental specific objectives, the following stand out:

- To reduce the levels of air, water and soil pollution which affect the quality of life.
- To harmonize and modernize environmental parameters, the legislation and the national institutions in charge.
- To promote regional discussion of common policies regarding new products environmentally compatible, green seal and environmental impact studies.

The Central American Council for Sustainable Development is the entity for the promotion of the Alliance, in charge of furthering and negotiating the signature of agreements directed to complementing the sustainable development in Central America.





# The Central American Setting

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## *Framework of environmental health for decision making*

The relationship between human health and the environment is rather complex, much more so if its components are related to subjects of socioeconomic development.

The model *Motor Force, Pressure, State, Effects and Actions* makes the analysis of this complex relationship a bit easier. Said model is the adaptation made by the World Health Organization of the UNDP proposal to monitor the progress towards sustainable development and constitutes an answer to Chapter 40 of Agenda 21 (Information for Decision Making).

The model is a six level framework of cause and effect taken as the basis to analyze situations of environmental health, to help the persons in charge of decision making and policy formulations, as well as to orient the emphasis in health aspects in the sustainable human development. It is used to establish priorities of action in new and traditional environmental problems for human health.

*Motor force* is the first and widest level of the framework, and it refers to general factors which motivate and promote environmental processes, such as population growth and economic development.

The existing motor forces generate movements of exploitation and occupation of the environment which results on pressure over the same, which constitutes the second level of the framework.

The pressures modify the environment situation; for example, the equilibrium between the natural components and the level of polluters in their environment. This modified *state* is the third level of the causal chain.

The different conditions in the environment and the presence of contaminants may turn to be environmental risks for humans if there is an exposure and this becomes the fourth level in the framework.

If there is exposure, it is expected that there is an *effect* over the health, which is the fifth level of the causal chain. The effects on the health demand an action, but the solution of the problem requires actions at all levels of the chain.

The use of this framework to orient actions is useful for the health sector as well as other sectors to accomplish sustainable development. The following schedule shows the relationship and interior dynamics of the model.



**OUTLINE OF THE MOTOR FORCE, PRESSURE, STATE, EXPOSURE, EFFECTS AND ACTIONS MODEL**

<p><b>MOTOR FORCES</b></p> <ul style="list-style-type: none"> <li>◆ Population growth</li> <li>◆ Globalization of the economy</li> <li>◆ Globalized trade of pesticides</li> <li>◆ Economic development</li> <li>◆ Technological development</li> <li>◆ Type of geo climatic area</li> </ul>	←	<p><b>ACTIONS</b></p> <ul style="list-style-type: none"> <li>◆ National policy for sustainable development</li> <li>◆ National policy for population control</li> <li>◆ Health, environment and Agricultural policies</li> </ul>
<p><b>PRESSURE</b></p> <ul style="list-style-type: none"> <li>◆ Demand for food</li> <li>◆ Expansion of areas dedicated to agriculture</li> <li>◆ Agricultural practices with pesticides</li> <li>◆ Advertising/publicity and commercial promotion of pesticides</li> <li>◆ Pesticides residues</li> </ul>	←	<ul style="list-style-type: none"> <li>◆ Use of technology for food production based in sustainable agricultural practices without the use of pesticides</li> <li>◆ Legislation and promotion of advertising ethics</li> <li>◆ Citizen Participation</li> <li>◆ Improvement of sanitary barriers</li> <li>◆ Strengthening of pesticides registration</li> <li>◆ Development of alternatives to the use of pesticides: Integral management of pests (MIP) and Organic agriculture</li> </ul>
<p><b>STATE</b></p> <ul style="list-style-type: none"> <li>◆ Inadequate use of pesticides</li> <li>◆ Environmental pollution: soil, air, water and foodstuff</li> <li>◆ Resistance to pests and other changes in the ecosystem</li> </ul>	←	<ul style="list-style-type: none"> <li>◆ Control of pesticides' residues in foodstuffs and water</li> <li>◆ Improvement of occupational hygiene in the use of pesticides</li> <li>◆ Use of less risky methods</li> <li>◆ Preservation of wild fauna and flora</li> <li>◆ Laboratory strengthening</li> <li>◆ Education of the agronomist in less risky practices</li> </ul>
<p><b>EXPOSURE</b></p> <ul style="list-style-type: none"> <li>◆ Use of pesticides in agriculture</li> <li>◆ Consumption of foodstuffs with pesticides residues pesticides</li> <li>◆ Use of pesticides in campaigns to control vectors of public health</li> <li>◆ Use of pesticides in the home environment to control pests and vectors</li> </ul>	←	<ul style="list-style-type: none"> <li>◆ Biological monitoring</li> <li>◆ Occupational Hygiene</li> <li>◆ Strengthened system of epidemiological surveillance</li> <li>◆ Monitoring of pesticides' residues in foodstuffs and water</li> <li>◆ Education of the population on the use of pesticides</li> <li>◆ Percentage of agricultural companies where MIP and organic agriculture is used.</li> </ul>
<p><b>EFFECTS</b></p> <ul style="list-style-type: none"> <li>◆ Acute intoxication</li> <li>◆ Chronic effects such as: neurological, hepatic, renal, immune systems, endocrine system alterations, cancer, etc.</li> <li>◆ Environmental pollution</li> </ul>	←	<ul style="list-style-type: none"> <li>◆ Epidemiological monitoring of acute intoxications from pesticides</li> <li>◆ Research on chronic effects, especially those that can aggravate the response of the population to prevalent diseases, such as immunological</li> <li>◆ Strengthening the response capacity of the health sector</li> <li>◆ Treatments and clinical follow-up</li> <li>◆ Monitoring, research and control of environmental pollution.</li> </ul>



➤ **MOTOR FORCES**

For the analysis of motor forces the following indicators were considered: population growth, structure by age, national gross product, literacy rate, availability of calories, percentage of the population living under the poverty line, ratio of income, infant mortality, the under registration of mortality and the amount of doctors per person. As much as possible, the information was obtained at the country level.<sup>1</sup>

◆ **Population growth in Central America**

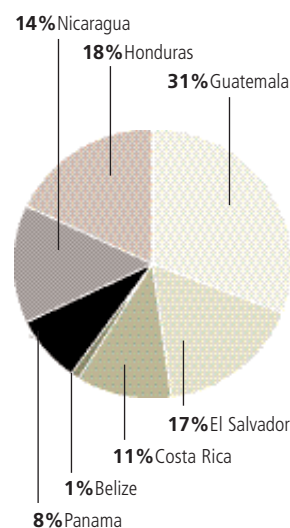
The region, constituted by seven countries, has grown in absolute numbers from around 28 million inhabitants in 1990 to 37,3 million in the year 2001, which represents an average yearly growth of 2,5% for the region.

All the countries of the region show a positive population growth. Although there has been an expansion towards urban growth, the population of the rural sector continues to be important (50%). Taking care of the needs of this population is a priority, because of their characteristics of dispersion, few social services and even less prevention.

Country by country, the one with the least population is Belize with less than 250.000 inhabitants, according to the population estimated for 2001, while Guatemala is the country with the largest population, with a little more than 11 million inhabitants for the same year, followed by Honduras, and El Salvador with a little over 6 million inhabitants each. These three countries together make up for more than two thirds of the total population of the region (See Graphics 1 y 2).

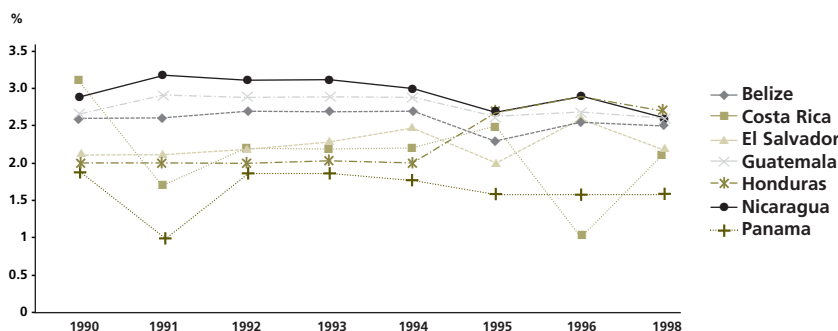
**GRAPHIC 1**

Population distribution by country, 2001



**GRAPHIC 2**

Population growth 1990-1998



<sup>1</sup> The largest part of the following information was obtained from "The State of the Nation in Sustainable Human Development" (United Nations Development Program – UNDP), Ombudsman, National Council of Rectors (CONAR), and the European Union: [www.estadonacion.or.cr](http://www.estadonacion.or.cr). The most updated data available was used.



#### ◆ Population structure

**Belize:** The population pyramid shows a wide base, which means that the population below 15 years represents nearly 40% of the total, while the population over 65 years does not reach 10%.

**Costa Rica:** This country, together with Panama, shows a process of demographic transition closer to that of developed countries. Therefore, it has been classified by CELADE as a country in full transition, with lesser population growth rates. Its pyramid shows a narrower base, since its population under 15 years has been decreasing since 1990 from 36,1% to 34% in 1996 with a percentual increase of the population over 65 years old. Its female population has remained between 50,2% in 1990 and 50,1% in 1997. The rural population has remained around 56% during the nineties.

**El Salvador:** The population of less than 15 years of age, which has represented an important percentage of the total population, has been steadily decreasing from 44,5% in 1990 to 36,8% in 1996. The female population has remained stable at 51%, and its rural population has decreased from 55,6% in 1990 to 47,7% in 1996.

**Guatemala:** Is a country with a demographic structure typical of a developing country. It shows a wide base (less than 15 years) with little variation, from 45,4% in 1990 to 44% in 1996, contrary to most of the countries in the region, and with a narrow vertex, those over 65 years old do not represent more than 10%. The female population has remained at 49,5 % and its rural population shows an interesting proportional growth phenomenon of 58% in 1990 to 61% in 1996.

**Honduras:** Similarly to Guatemala and Nicaragua, it shows a wide base and a very narrow vertex. Those with less than 15 years have decreased slightly from 44,6% in 1990 to 43,4% in 1996. The female population has remained stable at 49,6% throughout the decade. Its rural population has gone from 56,4% in 1990 to 55% in 1996.

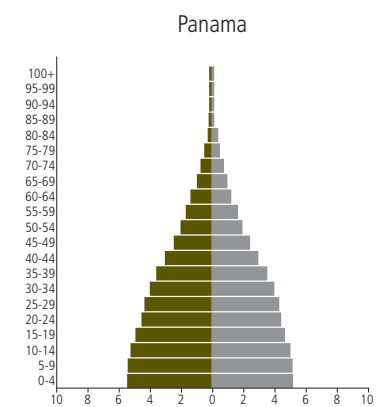
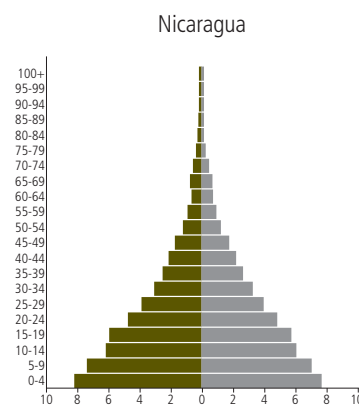
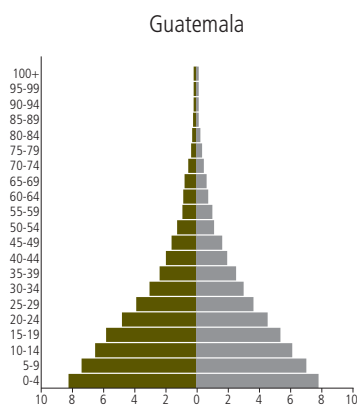
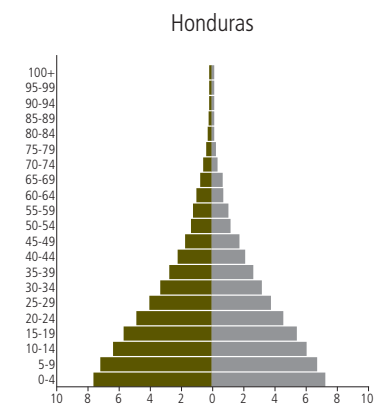
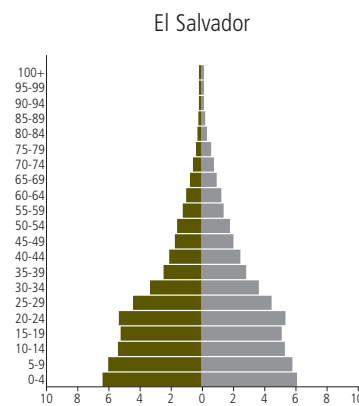
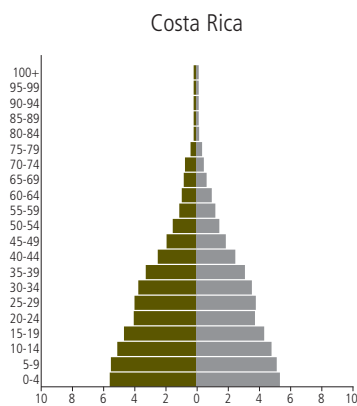
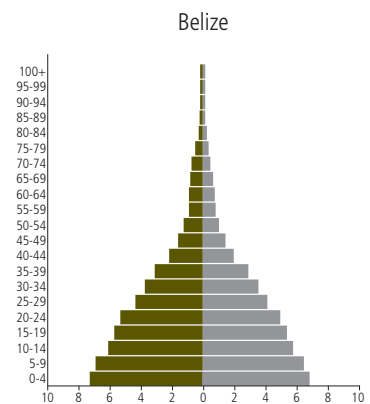
**Nicaragua:** Shows a pattern similar to that of Honduras and Guatemala that have not started the demographic transition. Population of less than 15 years of age has slightly decreased from 45,8% in 1990 to 43,1% in 1996. Female population has fluctuated between 49,9% in 1990 and 50,1% in 1996. The rural population has slightly increased from 40,2% in 1990 to 41,5% in 1996.

**Panamá:** Together with Costa Rica, it shows a pattern more similar to that of developed countries. A base not so wide (less than 15 years of age) represents 32% in 1996 and a widening of the vertex (older than 65 years) represents more than 10% of the total population. The female population has fluctuated between 49,1 and 49,5%. The rural population has diminished from 45,2% in 1990 to 43,7% in 1996.



From these conditions two clearly differentiated patterns are observed. On the one hand Panama and Costa Rica, undergoing demographic processes of full transition, and on the other hand, the rest of the countries of the region considered by the Centro Latinoamericano de Demografía (CELADE) (Latin American Demographic Center) as countries undergoing a moderate transition, considering their high indexes of births, mortality and population growth. One characteristic common to the whole region is that the population between 15 and 44 years old, has remained constant throughout the decade, particularly the rural population which still makes up close to 50% of the total population of the region. This population, which has remained stable for the decade of the 90s, is important, since it constitutes the group potentially exposed to the use of pesticides. It should be mentioned that individuals under 15 years of age and women also constitute populations exposed to the use of pesticides.

**GRAPHIC 3**  
Population pyramids  
of each country in the Isthmus  
El Salvador



■ Male  
■ Female



#### ◆ National Gross Product (NGP)

**Belize:** Its NGP, in current values, increased from US\$ 306.000,0 million in 1989 to US\$ 589.000,0 in 1999. The economy of Belize, made up mostly of agricultural exports, includes sugar cane, citric and bananas.

**Costa Rica:** Its NGP has gone from 522.847,8 million colons in 1990 to 2.214.228,8 in 1997, at current values, making it the first economy of the region. The rural EAP corresponded to 54% in 1996. An interesting data is that the ratio agriculture and livestock production/NGP has shown a slight descent from 16,1 % in 1990 to 15% in 1996. Additionally, the use of the land ratio has been inverted, with a marked descent for internal consumption and an increase in export crops.

**El Salvador:** Its NGP has increased from 36.486,9 million colons in 1990 to 99.699,0 in 1997, in current values. The rural EAP corresponded to 42,5% in 1996. The ratio agriculture and livestock production/NGP has gone down from 17,1% in 1990 to 13,6% in 1996. It has kept a steady ratio between the land planted for internal consumption and that dedicated to export products.

**Guatemala:** Its NGP has increased from 34.316,9 million quetzals in 1990 to 107.915,5 in 1997, at current values. The rural EAP corresponded to 57,4% in 1996. The ratio agriculture and livestock production/NGP has gone down from 28,5% in 1990 to 26,5% in 1996. The land planted for internal consumption has decreased slightly, while the land for export products has increased.

**Honduras:** Its NGP has increased from 12.537,0 million lempira in 1990 to 61.445,0 in 1997, at current values. The rural EAP corresponded to 50,7% in 1996. The ratio agriculture and livestock production/NGP has gone down from 20,0% in 1990 to 19,3% in 1996. An interesting phenomenon is that the land planted for internal consumption as well as that dedicated to export products have increased throughout the decade.

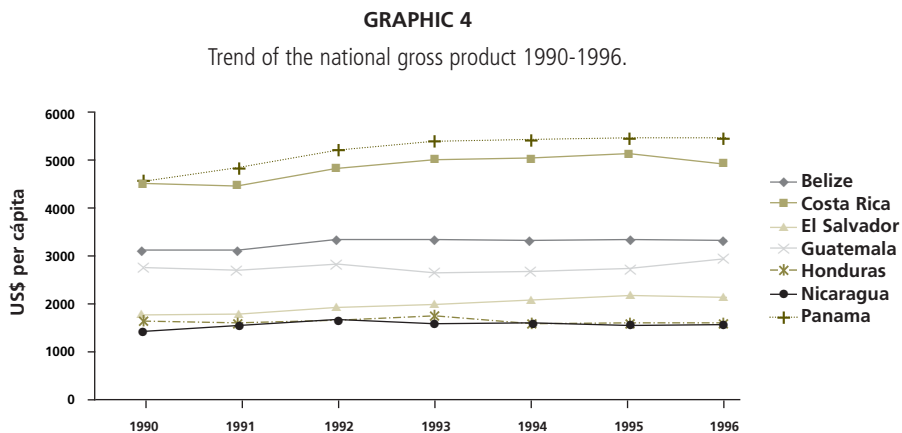
**Nicaragua:** Its NGP has increased from 1.565,2 million Cordobas in 1990 to 19.069,2 in 1997, in current values. The rural EAP corresponded to 41,0% in 1996. The ratio agriculture and livestock production/NGP has increased from 24,8% in 1990 to 28,2% in 1996. The land planted for internal consumption as well as that dedicated to export products has remained relatively the same.

**Panamá:** Its NGP has increased from 5.513,2 million balboa in 1990 to 7.906,1 in 1995, at current values. The rural EAP corresponded to 40,1% in 1996. The ratio agriculture and livestock production/NGP has gone down from 9,5% in 1990 to 7,6% in 1995. It has kept a steady relationship between surfaces planted for internal consumption and those dedicated to



export products. In reviewing the available data the trend from 1990 to 1996, according to PAHO/WHO numbers show that the NGP per capita (adjusted by PPP) for 1990 fluctuated from US\$1,411 in Nicaragua to US\$4,546 in Panama, showing an improvement for 1996 when the range of fluctuation was between US\$1,571 in Nicaragua and US\$5,452 in Panama. However, this is where the inequities are evidenced, since Panama has more than three times the NGP per capita than Nicaragua.

In general, the trend in the last decade, shows the following differentials between the countries, the most favored being Belize, Costa Rica, and Panama; while El Salvador, Guatemala, Honduras and Nicaragua have shown a relative stabilization (see Graphic 4).



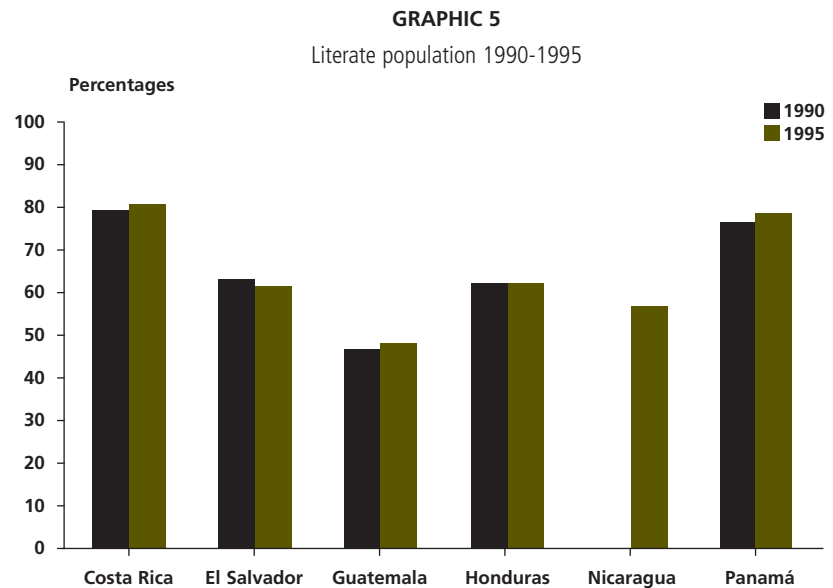




#### ◆ Other indicators

##### **Literate Population**

The data for 1995 shows that the range of literacy fluctuated between 55,6% for Guatemala to 94,7% for Costa Rica. The countries with the highest degree of literacy are Costa Rica and Panama, while Guatemala and Nicaragua show numbers between 55% and 65% of the population. This situation demonstrates a large gap in education, which must be taken into consideration for the explanation of the situation as well as for program proposals (see Graphic 5).



##### **Availability of Calories**

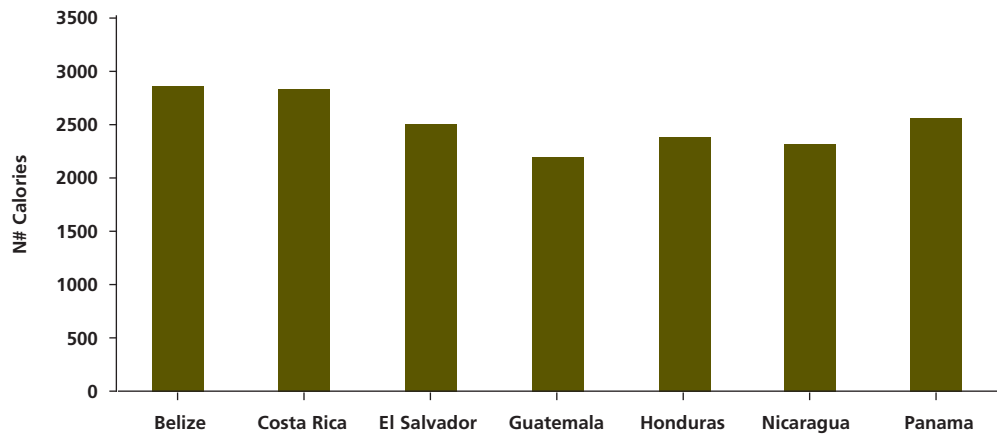
This information is based on data for 1996. It can be seen that Belize, Costa Rica, Panama and El Salvador show a per capita number of calories larger or equal to 2.500; while Guatemala, Honduras and Nicaragua are between 2.000 and 2.500 calories/day. An interest hypothesis to prove would be the interaction between nutritional status and the effect of the pesticides (see Graphic 6).

##### **Population under the poverty line**

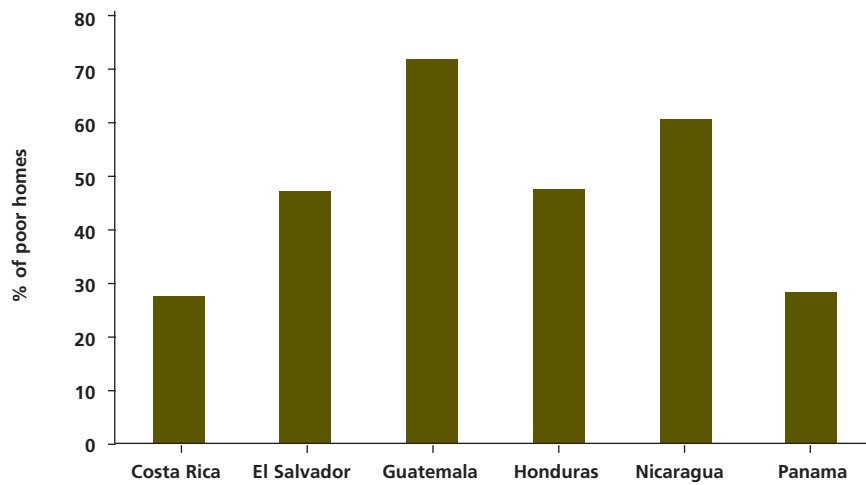
The available data for this indicator are for 1996. The population living in poverty shows that El Salvador, Nicaragua, Guatemala and Honduras have numbers above the 47.5% of poverty homes, with Guatemala standing out with almost 75%; while the numbers for Panama and Costa Rica fluctuate between 20% and 30%. It is observed, once again, that there is a marked gap between these countries, which confirms information such as availability of calories (see Graphic 7).



**GRAPHIC 6**  
Calories per capita 1996



**GRAPHIC 7**  
Poverty level 1996



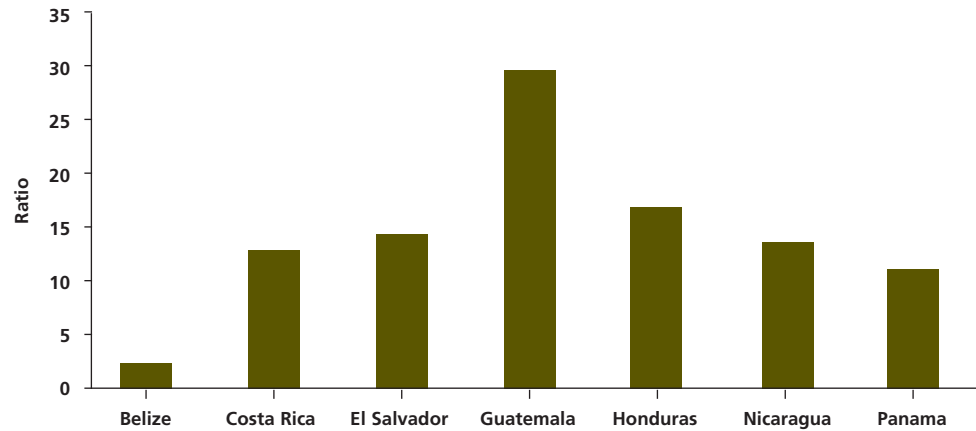


**Ratio of income**

The ratio of income between the 20% richest and the 20% poorer shows that the country with higher iniquity is Guatemala with a ratio of 30, followed by far by Honduras, El Salvador, Nicaragua, Costa Rica and Panama. The one with less iniquity is Belize, with a ratio of 2 (see Graphic 8).

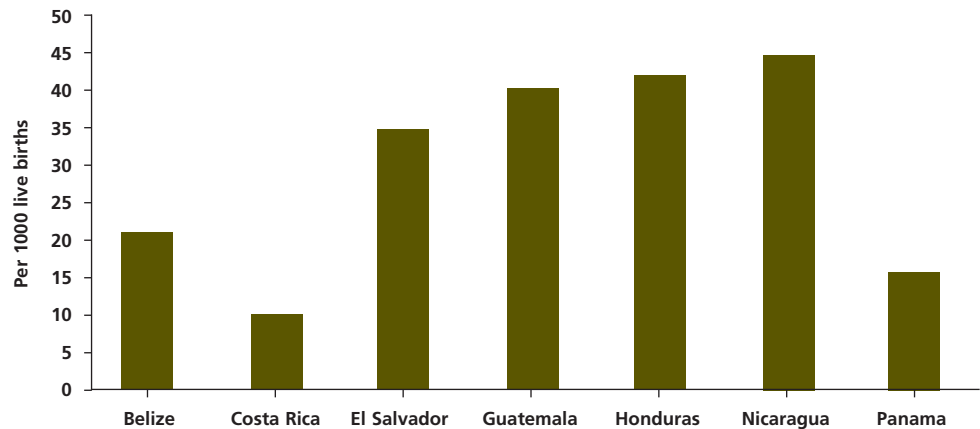
**GRAPHIC 8**

Ratio of income between the 20% richest and the 20% poorest 1996



**GRAPHIC 9**

Rates of infant mortality 1996-2000



PAHO/WHO. Special Analysis Program for Basic Health Indicators 2001.

***Infant mortality***

In relation to the infant mortality, the rates have abruptly fallen in the last thirty years, and this trend continued for the period 1990-94. While during the period 1980-84, the highest rates were around 80 per thousand live births, in 1990-94, the highest reached a little over 43 per thousand live births, with a similar trend for the period 1996-2000 with Nicaragua, Honduras and Guatemala having rates between 40 and 45 per thousand live births (see Graphic 9).

***Doctors per inhabitant***

The ratio doctor/population for 1995 is one doctor per each 1.000 to 1.500 inhabitants in all countries of the region. This has varied substantially for El Salvador, Guatemala, Honduras and Nicaragua since in 1980 the range was one doctor per each 2.000 to 3.000 inhabitants.



## ➤ PRESSURE

The Central American Isthmus is an area with an approximate extension of 510.744 km<sup>2</sup>. It is predominantly dedicated to agriculture and forest, with approximately 39% of the land apt for this type of exploitations, including arable land, permanent crops and areas for cattle grazing. The following table shows the differences in land use in each of the seven countries of the Central American Isthmus:

**TABLE 1**  
Land use in each country of the Isthmus<sup>2</sup>

COUNTRY <sup>2</sup>	LAND TOTAL (KM <sup>2</sup> )	NON AQUATIC LAND (KM <sup>2</sup> )	LAND IN AGRICULTURE (KM <sup>2</sup> )	AGRICULTURAL LAND (%)	POPULATION DENSITY IN AGRICULTURE (PERS/KM <sup>2</sup> )
Belice	22.960	22.800	1.033	4.53	176.50
Costa Rica	51.100	50.660	28.233	55.73	96.07
El Salvador	21.040	20.720	13.226	63.83	380.27
Guatemala	108.890	108.430	32.507	29.98	273.66
Honduras	112.090	111.890	43.525	38.90	113.74
Nicaragua	129.494	120.254	61.269	50.95	56.35
Panamá	78.200	75.990	20.966	27.59	111.42
<b>Total</b>	<b>523.774</b>	<b>510.744</b>	<b>200.759</b>		

<sup>2</sup> *The World Fact Book 1999, U.S. Government.*



In this extension of lands, the geological formations, the topography, the climate and the soils combine into a great diversity of ecological conditions which permit the cropping of a large variety of agricultural products. Among them plantain, bananas, all types of vegetables, oranges and tropical fruits, cotton, flowers, coffee, sugar cane, rice, rubber, soy, tobacco, sesame, wheat, corn and beans stand out. The following table summarizes main crops per country and the amount of land dedicated to agriculture:

**TABLE 2**  
Characteristics of the agricultural sector

COUNTRY	AREA OF THE COUNTRY DEDICATED TO AGRICULTURE (%)	MAIN CROPS *									
		COFFEE CANE BASIC	SUGAR	BASIC GRAINS			FRUITS	VEGETABLES	BANANA	TOBACCO	FLOWERS
				RICE	BEANS	CORN					
Belize	4.5						X		X		
Costa Rica	55.7	X	X				X		X	X	
El Salvador	63.8	X	X	X			X	X			
Guatemala	30.0	X	X	X				X		X	
Honduras	38.9		X				X	X	X	X	
Nicaragua	51.0	X	X	X					X	X	
Panama	27.6	X	X				X	X	X		

*5 main crops of each country, according to area cultivated and the economic importance*



# The Use of Pesticides in Central America

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*Status  
Exposure*

## ➤ STATUS

The climate and ecological variety of the Central American Isthmus determines, to a great extent, the types of crops in each country and region. The type of crop is then associated to particular types of pests. As a consequence, the specific pests of each crop are a very important factor to determine the amount, frequency of application and types of pesticides to be applied (insecticides, fungicides, nematocides, herbicides or others).

There are 107 pesticides prohibited in the Central American region, but this prohibition is not homologized in the seven countries. Of the 107 pesticides prohibited in the countries currently only the next six products (5,6%) are prohibited in all seven countries of the Central American Isthmus:

- 2,4,5 Trichlorophenoxyacetic (2,4,5-T ) acid
- Aldrin
- Chlordane
- Dieldrin
- Heptachlor
- Toxaphene

This situation could well be an indicator that there is no rigorous control of the use of pesticides. This reveals an important failure in the regulation of the countries of the Isthmus which, in turn, entails a higher exposure and possible greater effects on health factors and the environment.

### ◆ Use of pesticides in accordance with the chemical group

Based on the available information for four countries regarding pesticides used during the period 1992 – 1998 according to the chemical group they belong to, it could be observed that the group of the organophosphates is the one most prominently used. In absolute terms, the use of organophosphates gradually increased between 1992 and 1995. Its use almost tripled in 1995 (7.400 tons) when compared to the consumption of 1992 (a little less than 3.000 tons). Although, starting in 1996 its use has shown a tendency to decrease, it continues to be the group with the largest consumption. This explains, in part, why the organophosphates are the group responsible for most of the intoxications by pesticides.



The second group, in order of importance, is that of the Dithiocarbamates, which although it showed an important decrease in consumption between 1994 and 1995, increased in consumption close to 2.000 tons per year in the whole region for 1998.

In the third place in consumption are the pirethroids, which showed an unusual increase in 1996 and 1997, although the consumption decreased in 1998, its use is still high.

Another group of important pesticides is that of the carbamates, phenoxyacetics, triazine derivates, organochlorined and bipyridils; although in absolute terms their consumption is less than that of the organophosphates, the dithiocarbamates and the pyrethroids. With the exception of the organochlorined and derivates of triazines, between 1992 and 1996 there was an increase in its use. The use of bipyridils in particular, quadruplicated between 1992 (460 tons) and 1996 (1.600 tons), although its use decreased a little in 1997 and 1998.

In relative terms, the organophosphates continue to be the most used. This situation ratifies the fact that in absolute as well as relative numbers, this is the priority group to control in the whole region. The second group is that of the dithiocarbamates. Although their absolute and relative consumption has decreased, it follows in order of priority that of the organophosphates. The group of the pyrethroids and bipyridils calls for special attention due to their recent relative importance in the market since 1996 (See Graphics 10, 11 and 12).

#### ◆ Use of pesticides according to organism to be controlled

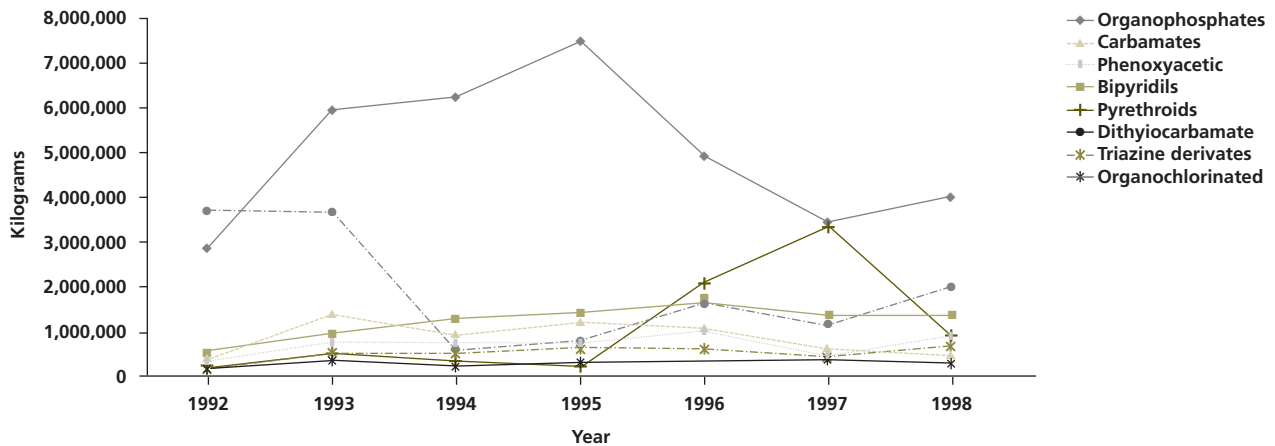
Based on the information from six countries, in absolute terms, it was observed that the consumption of fungicides fluctuated between 9.000 tons per year in 1992 up to a little more than 14.000 tons in 1998, presenting a marked decrease of consumption between 1999 and 2001. The use of insecticides showed an interesting behavior, since between 1992 and 1997 a marked increase was observed, going from 5.000 tons per year in 1992 to almost 15.000 tons in 1997, although certainly by 1998 an important decrease in consumption was observed to less than 10.000 tons per year. Finally, the use of herbicides also increased during the period of 1992 (6.000 tons) to 1999 (13.000 tons), following an increasing trend in 2000 and 2001, reaching almost 16.000 tons by this year.



In relative terms, although fungicides showed a variable proportional weight between 1992 and 1998, they tend to have a relative weight lower than for the end of the period in 2001. Herbicides, on the other hand, showed a relative use tending to constant increase during the period, and the proportional use of insecticides has tended to decrease during the same period, although in lesser proportion than the decrease observed in fungicides (see Graphics 13 y 14).

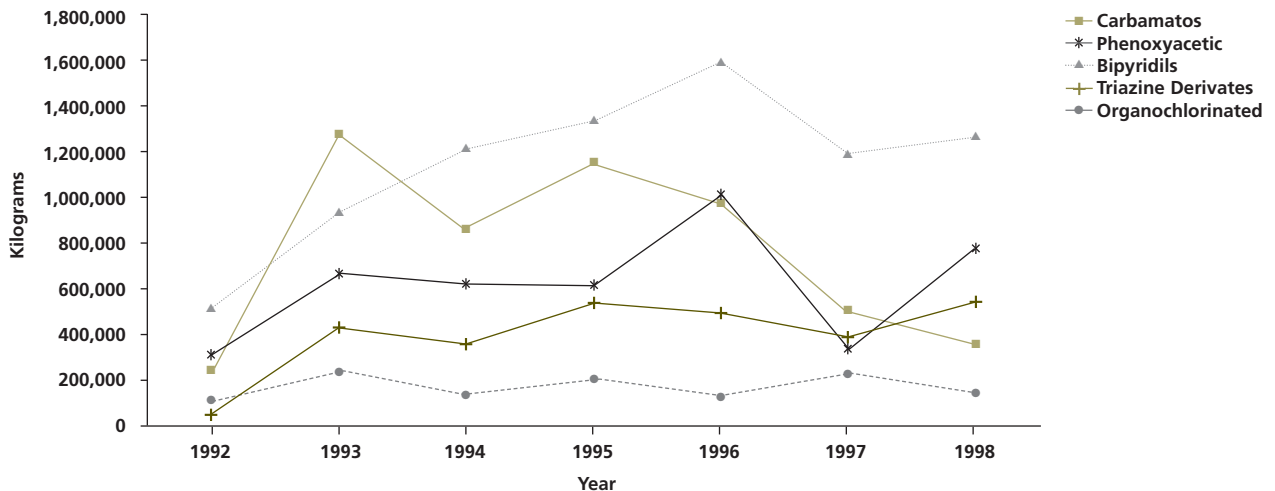
**GRAPHIC 10**

Imported pesticides according to chemical group. Subtotal for the region



**GRAPHIC 11**

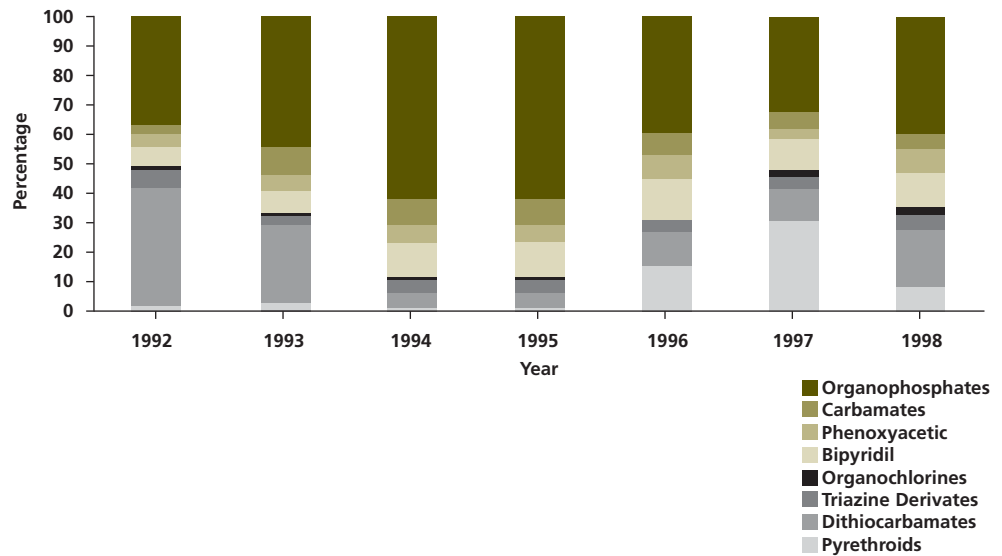
Imported pesticides according to chemical group. Region subtotal (Excludes organophosphates, dihiocarbamates and pyrethoridils)





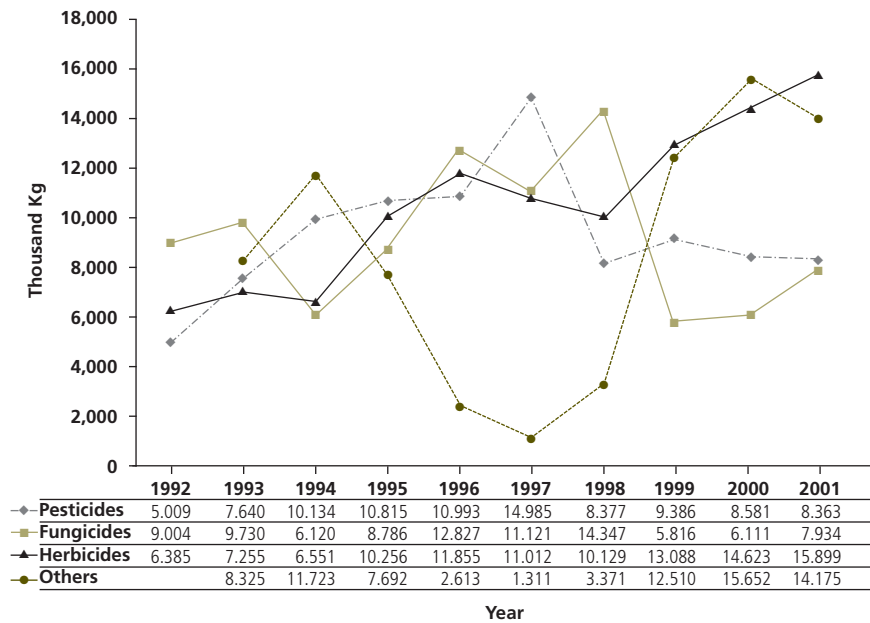
**GRAPHIC 12**

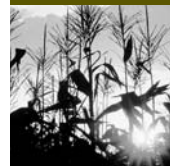
Imported pesticides by chemical group.  
Subtotal for the region



**GRAPHIC 13**

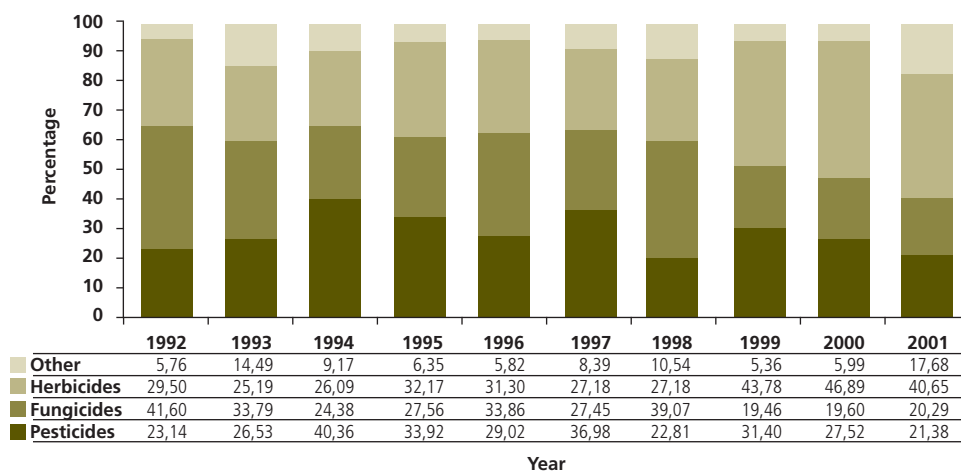
Insecticides imported according to organism to be controlled.  
Central American Isthmus 1992-2001





GRAPHIC 14

Percentual distribution of pesticides imported according to organism to be controlled 1992-2001



#### ◆ Origin of imported pesticides

The pesticides imported by the seven countries of the Central American Isthmus come from 38 American countries (North and South America), Europe, Asia and Africa, and are produced by more than 40 chemical manufacturers.

#### ◆ Pesticides manufacturing plants

There are manufacturing plants in all countries of the Central American Isthmus. 37 of them were registered for the year 2000.

#### ◆ Use of pesticides according to sector

The presence and use of these pesticides constitutes a real threat to the health of Central Americans. The largest amount of pesticides is used in agriculture (85%), followed by use in public health (10%) and other activities (5%). The agricultural industry continues to be very important for the economies of the countries in the area. The amount of land in relation to the total territory of each country dedicated to agriculture ranges from 4,5% Belize, 28% in Panama, up to 56% in Costa Rica and 64% in El Salvador.

Agriculture uses a large amount of the labor force in each country. The economically active population in agriculture ranges from 30% in Belize, 40% in Panama, 41% and 42% in Nicaragua and El Salvador respectively, to more than half of the population in Costa Rica (54,3%) and Guatemala (57,4%) Based on

these numbers, it is probable that for the year 2002 a minimum of five million inhabitants in the whole Central American Isthmus involved in agricultural activities will have been potentially exposed to pesticides. These estimates do not considered uses other than agriculture. If we consider all the uses, this number could be close to seven million inhabitants.

The opportunity for exposure to pesticides in agriculture, however, is due to two factors:

- (a) The amount of individuals living in lands dedicated to agriculture.
- (b) The amount of land dedicated to agriculture.

Based on this information, we have estimated an index of human density dedicated to agriculture, expressed in number of inhabitants per square kilometer dedicated to agriculture. The countries with the largest density in Agricultural areas are El Salvador (380 inhabs/km<sup>2</sup>), Guatemala (274 inhabs/km<sup>2</sup>), Belize (176 inhabs/km<sup>2</sup>) and Honduras, (114 inhabs/km<sup>2</sup>). The countries with the lesser index of density in agriculture are, therefore, Panama (111 inhabs/km<sup>2</sup>), Costa Rica (96 inhabs/km<sup>2</sup>), and Nicaragua, (56 inhabs/km<sup>2</sup>).

#### ◆ **Pollution of the environment**

Besides the harmful effects in humans, pesticides cause damage to the environment, animals and foodstuff. Some of the problems generated by the exaggerated use of pesticides are:

- Pollution of courses and masses of water by discharge of industrial wastes, cleaning of equipment and applications close to rivers and lakes.
- Destruction of beneficial natural enemies that help control pests.
- Intoxication and death of domestic animals.
- Intoxication of bees (which pollinate some crops).
- Death of fish.
- Increase in the resistance.
- Pollution of foodstuff caused by the accumulation of pesticides through the food chain, violation of security intervals in the cropping of foodstuffs and contamination during warehousing and transportation.

Following is an example of environmental contamination in one of the countries of the sub region in the year 1998.



### ◆ Pollution by pesticides in Honduras

Some natural events, such as the presence of hurricanes, may favor the exposure of the population to pesticides. During October 30 and 31, 1998, hurricane Mitch, with torrential rains, caused catastrophic floods in Honduras.

The Centro de Control y Prevención de Enfermedades de los Estados Unidos (CDC) (Center for the Control and Prevention of Diseases), together with the Department of Health Honduras, the Centro de Estudios y Control de Contaminantes (Center of Studies and Control of Polluters) (CESSCO) and PAHO carried out a research in the Istoca neighborhood in the Department of Choluteca, where the discharge of 300 to 400 barrels of pesticide was reported.

The study included the evaluation of environmental exposure (monitoring of water and soil), human exposure (biological monitoring of blood and urine) of 45 adolescents from 15 to 18 years old, and the analysis of water for human consumption in 155 houses.

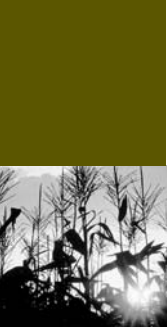
The more important findings were the following:

- Detection of high levels of chlorate pesticides (forbidden in Honduras for more than 15 years) adolescents. An organic chlorate pesticide, 1,1-dichloro-2,2-bis(p-chlorophenyl) ethylene (p-p'-DDE) was detected in 95% of the human serum samples. 79% of the samples showed levels of p-p'-DDE above 2ppb (reference for adults in the USA: 2-4 ppb).

Dieldrin was found in 23% of the samples in levels above 0.2 ppb (reference < 0.2 ppb).

77% of the urine samples examined for metabolites contained Diethylphosphate (DEP) and 18.6% had levels above the level of reference of 6.45 µg/g of creatinine. High levels of paranitrophenol (p-NP) and 3,5,6-trichloro-2-pyridinol (356 TCPY) in 91% and 60% of the samples, respectively, were also found.

- Evidence of exposure of adolescents to high levels of organophosphates three weeks after the hurricane. The p-NP and the 356 TCPY, metabolites of I Parathion and the Chlorpyrifos, respectively, were found in high levels in samples of urine, even three weeks after hurricane Mitch, which suggests a continued exposure of the residents to organophosphates.



- Pollution of the soil and water with organophosphates  
Parathion and Sulphaton were detected in the soil in concentrations above the level of Reference of Environmental Quality for Soils. Diazinon was identified in a water sample.

Thus, the state of the use of pesticides in the Central American Isthmus, which is modifying the environment, is also important for the analysis of potential exposure of humans and possible effects in their health. It is also important to orient future actions.

These potential effects are related not only to the excessive use of pesticides, but also to the manner in which its use has been modified. For example, consider the case in which pesticides have been an important tool in public health for the control of vectorial diseases. It is important, then, to analyze the handling of the problem by the Ministries of Health.

Although organophosphates are the group most used, other groups should also be the object of follow up and monitoring in order to prevent possible effects on the health of individuals and the environment. Although the main effects analyzed are the acute, there is still much to be done in terms of chronic effects of some of them and of possible residual effects.

The above calls for doubling efforts in the inter sectorial handling of pesticides, with the State as a directing entity on the one hand, through its agricultural and sanitary policies, and on the other, in its regulatory capacity and as controller of its own sanitary and environmental policies.



## ➤ EXPOSURE

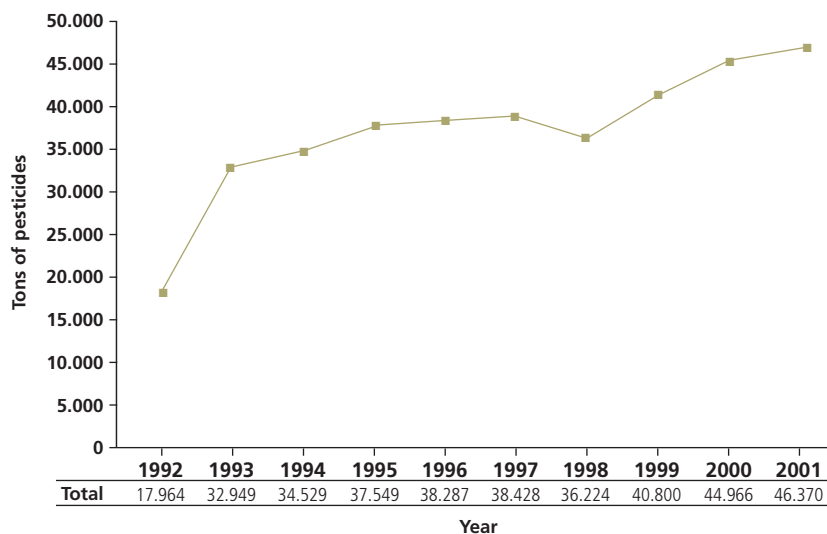
### ◆ Pesticides Importation and the load of pesticides per country

The countries of the Central American Isthmus are among the main importers of pesticides. It is estimated that this sub region imports close to 1.5Kg of pesticides per inhabitant yearly, which rate is three times higher than the world average estimated by the World Health Organization (WHO). To this potential damage to the health, is added the fact that approximately 35% of the pesticides imported have restricted use in the exporting countries.<sup>3</sup>

Importation of pesticides in the Central American Isthmus has shown a dramatic tendency to increase. Between 1992 and 1994, it was almost duplicated, growing from 17.964 to 34.529 tons (92,2%). Although in 1998 the increasing trend of 36.224 tons decreased slightly, as of 1999 imports continued growing, reaching 46.370 tons in 2001. That is, pesticides importation in the area almost tripled in 10 years (1992 to 2001).

**GRAPHIC 15**

Trend in the importation of pesticides



<sup>3</sup> Pan American Health Organization, Environment and Health in the Central American Isthmus Program (MASICA). PLAGSALUD Project.



Although at the Central American level an increase in the importation of pesticides was observed, the trend varies for each country in the following manner:

***Belize***

This country, the least populated of the region, is undergoing a change in its importation of pesticides from 952 tons in 1992 to 1.296 in 2000, slightly decreasing to 831 tons in 2001; this represents an increase between 1992 and 2000 of 36%. This fact increases the exposure and places the population that uses these elements at a greater risk. The trend has been to increase from year to year. This country joined PLAGSALUD project in 1997.

***Costa Rica***

Although it showed an increase in imports for the years 1994, 1997, it showed a decrease in the following years. It would be interesting to observe more attentively if the decrease on imports was due to a change in agricultural policies or if it was due to some other type of decision. It would be convenient to differentiate between the types of pesticides and their possible effects. The Project was initiated in the year 1995.

***El Salvador***

The PLAGSALUD Project started in the second phase (1997). Since then it has shown a slight increase, in figures already high. Importation in this country has progressively increased going from 3.812 tons in 1993 to 5.927 in 2001, which represents an increase of 55%.

***Guatemala***

This is the country with more problems in absolute terms, since it has seen the increase of importation at a very fast rate during the last nine years. It went from close to 4.000 tons per year in 1994 to 9.848 tons in 1999 and to 10.988 in 2001, this makes it the country of the region with the largest importation of pesticides in absolute terms. This increase in the exposure means a larger risk for the rural population. It joined the Project in 1997.

***Honduras***

Joined the Project in 1997, and since 1992 has shown fluctuating figures in imports, reaching 7.745 tons in 2001. It would be interesting to determine what political measures have been taken in the last four years that could influence in the decision of further regulation of pesticide importation, its use and its control.

**Nicaragua**

The PLAGSALUD project started in 1995. A constant trend can be observed in the increase of imports, going from 1.670 tons in 1992 to 5.136 in 2001, triplicating its imports during the period.

**Panama**

Its pattern is not very homogenous, since it shows two interesting breaking points, one in 1995, with a reduction of 5.917 tons, and a tendency to stabilization around 7.000 tons between 1997 and 2001. It will be necessary to research the possible policy changes associated to this period. The Project was introduced in 1977.

**Region**

For the region as a whole, the analysis must be divided into the countries of the first phase and those of the second phase. However, in general terms and independently from the program, what is observed is a marked increase in imports, going from almost 18.000 tons to more than 46.000, which means an increase of almost 255%. This speaks by itself of the increased risk among the population using pesticides. This increase has been more pronounced in the last three years. This somehow gives more validity to the need to remain with this type of programs and to help push measures for a detection centered more on the use of pesticides by type of chemical, areas of use, protection measures adopted, prompt notification of accidents and immediate attention for the prevention of lethality, which are the objectives of PLAGSALUD.

**Correlations**

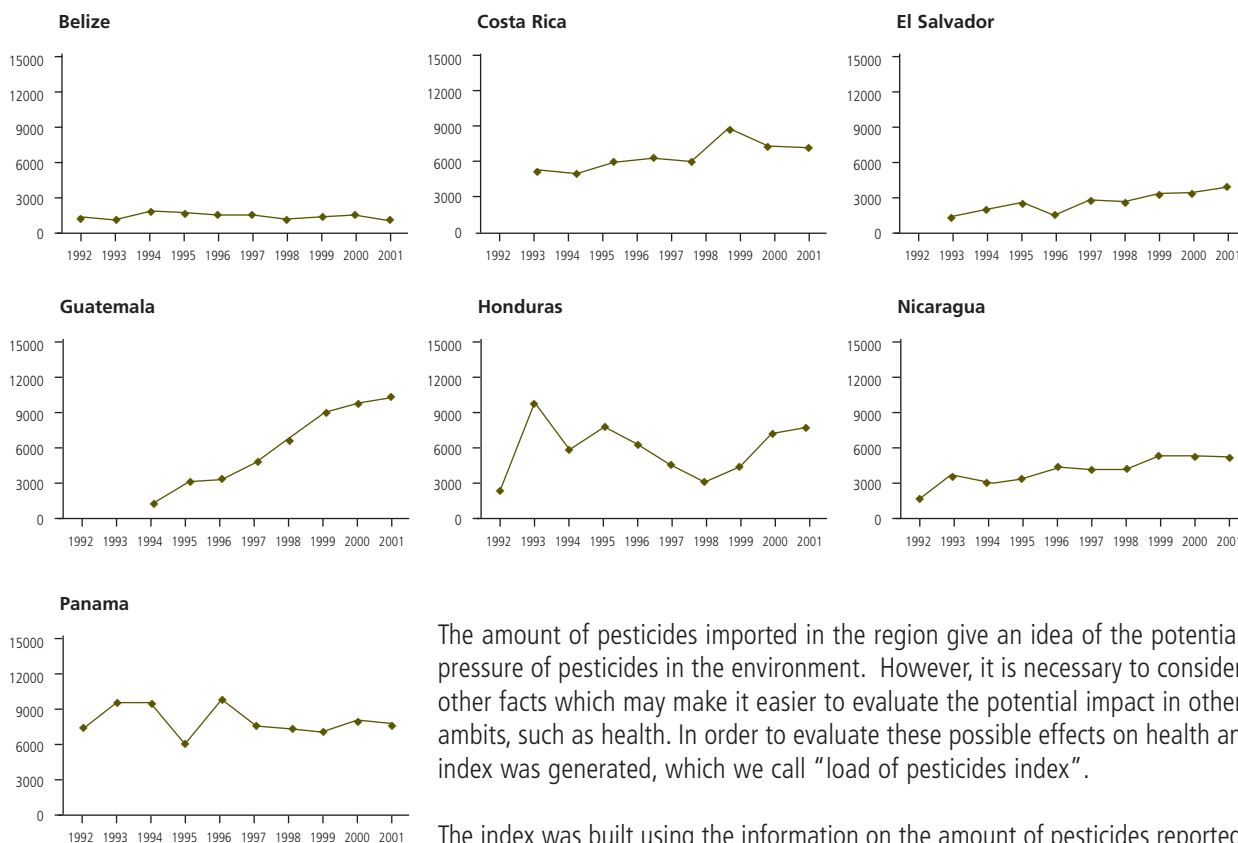
- **Belize:** No information available that would permit the correlations.
- **Costa Rica:** An interesting correlation is observed between the number of intoxications and the rates of intoxications with the number of pesticides used. An interesting point is the small correlation found between intoxications and the load of pesticides used ( $r=0.30$ ).
- **El Salvador:** A positive, but not significant, correlation is observed between intoxications and pesticides.
- **Guatemala:** No data available regarding the use of pesticides. However, the correlation between pesticides imported and intoxications is positive and statistically significant.
- **Honduras:** No data available that would permit the correlations.



- **Nicaragua:** A positive correlation between imported pesticides and intoxications is observed, which is statistically important.
- **Panama:** A positive correlation between imported pesticides and intoxications is observed, which is statistically important.

**GRAPHIC 16**

Pesticides importation (thousand of kgs).  
Central American Isthmus 1992-2001



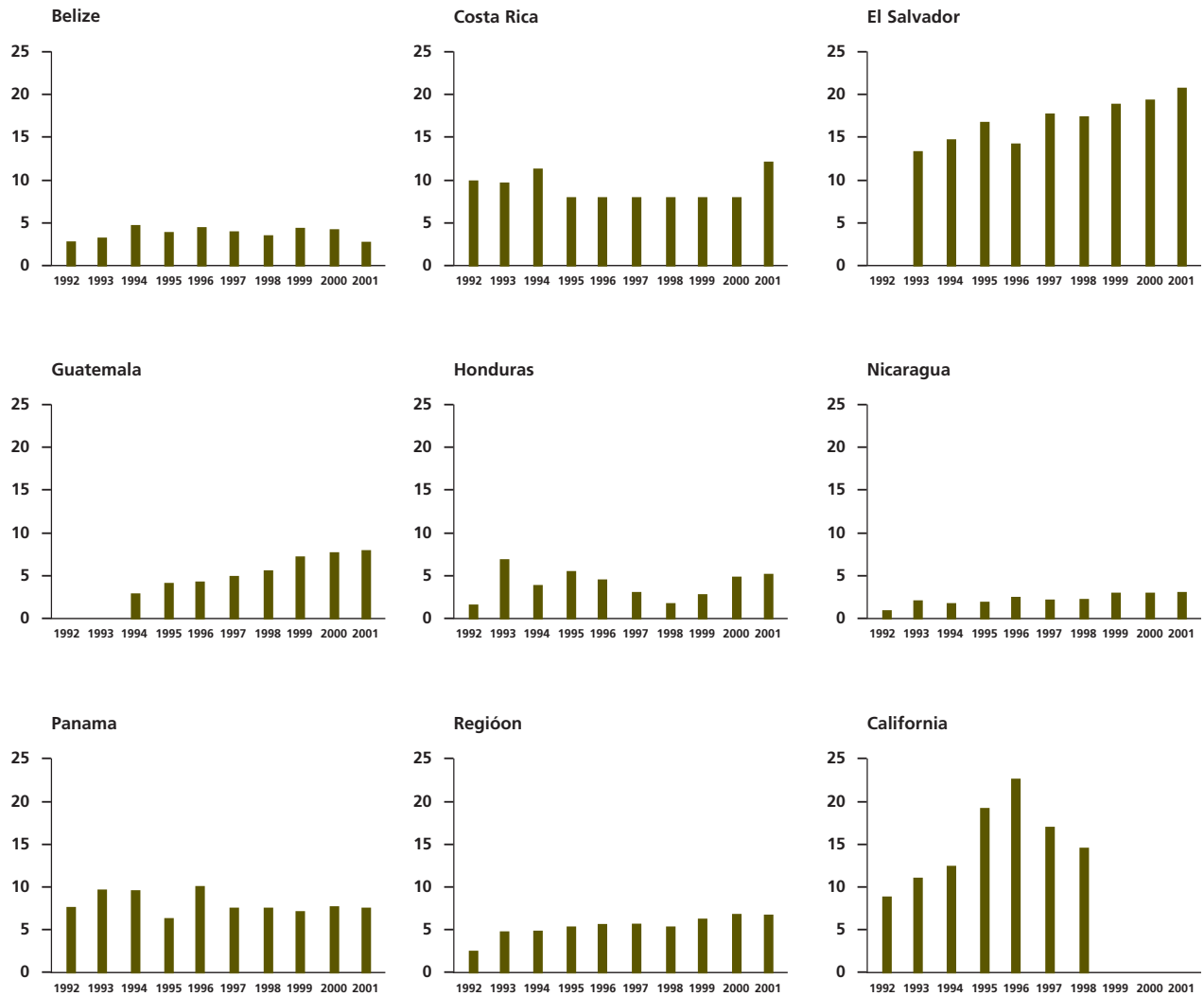
The amount of pesticides imported in the region give an idea of the potential pressure of pesticides in the environment. However, it is necessary to consider other facts which may make it easier to evaluate the potential impact in other ambits, such as health. In order to evaluate these possible effects on health an index was generated, which we call "load of pesticides index".

The index was built using the information on the amount of pesticides reported by each country; this, under the supposition that at least 80% of the pesticides are used in the agricultural ambit. The figure shows the distribution of this index by country in the region. For comparative purposes, the index corresponding to the State of California in the United States, where the largest amount of pesticides per land planted is consumed, has been included.



**GRAPHIC 17**

Load of pesticides index per country, region and the State of California (x tons/100 hectares).  
Central American Isthmus 1992-2001





# The Effects of Pesticides in the Isthmus

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*Effects  
Actions*

## ➤ EFFECTS

In general terms, the countries of the Central American Isthmus base their economies in agriculture. In 1997 it was estimated that the share of economic income associated to this branch fluctuated between 13,4% in Panama up to 46,4% in the case of Nicaragua. The rates for other countries were 27% for Costa Rica, 33% El Salvador, 35.2% Honduras, 38,5% Belize and 40% Guatemala.

Under these circumstances, it is not surprising that the potential for exposure to pesticides is considerable, since importation of pesticides tended to increase during the period 1992 to 2001 in almost all of the countries.

Some of the most used substances are highly toxic, in accordance with the WHO classification (The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification 2000-2002). In general, the countries in the Isthmus are facing serious problems with the control of pesticides (De Campos M, Finkelman J, 1998; Henao S, Finkelman J, et al, 1993). The epidemiological monitoring systems are still weak and, although in some countries like Costa Rica (Wesseling C, et al, 1993) there is an idea about the effects on health, little is known about the chronic effects.

### ◆ Materials and methods

To estimate the effect on health caused by exposure to pesticides in the countries of the Central American Isthmus, an epidemiological design of the ecological-analytical mixed type was used. This design permits the evaluation of the association between the changes in the levels of average exposure and the changes in the rate of the event, result of interest between different groups or analysis units. This increased the capacity for interpretation of estimated effects since two comparisons are done simultaneously, the change through time within the groups of the study and the differences between the groups of the study (Rothman KJ, Greenland S, 1998).



Two units of analysis were used: the unit of analysis at the country level and at the region (which was built adding to the available information at the country level). As indicators of negative events for the health factor were used: the incidence of acute intoxications and deaths associated to acute intoxication.

As indicators of exposures to pesticides two yearly indicators were used: the number of tons imported and a "load index" which was developed considering the pesticides imported in relation with the land surface of each country.

◆ **Data source**

Data regarding *acute intoxications* by pesticides were given by the different Ministries of Health and Social Security Institutions in each country. Information regarding deaths associated to pesticide exposure was provided by the health services and forensic agendas in each country.

The information regarding *imports* and the use of pesticides was obtained from the various registries of the different Ministries of Agriculture and Husbandry in each country.

The number of inhabitants for each country and year was obtained from the yearly inter surveys from 1992 to 1999 of the United Nations Organization (ONU), which are based in populations from 1980 to 1990 in each country and of 2000-2001 notified by the countries.

The incidence rate of intoxications was obtained dividing the number of intoxications by the total annual population. The lethality due to pesticides was obtained by calculating the proportion of the number of intoxications due to pesticides divided by the number of intoxications due to pesticides for a specific country and year.

The strength of the association between pesticides and the annual incidence rate of acute intoxication and lethality was obtained through the calculation of Poisson models with aleatory effects applied to a time series, which permit the calculation of ratio of incidence rates (RT) using the exponential of its estimators. In these models the independent variable was the frequency of intoxications by pesticides or the number of deaths due to pesticides in each country and year. The independent variables used were the number of pesticides imported (tons per country and year) and the load of pesticides, also by country and year.



## ◆ Results

### *Frequency of acute intoxications*

Based on the data of the seven countries of the Central American Isthmus for the period 1992 to 2001, a total of 43.368 cases of acute intoxication due to pesticides were detected and 4.323 deaths were associated to such exposures.

The following Tables and Graphics present the secular behavior of the rates of incidence and mortality of acute intoxications associated to pesticides and the lethality also associated to this exposure. The incidence rates and mortality expressed by 100.000 inhabitants show a general upward pattern for this period, particularly in El Salvador, Nicaragua and Guatemala. Costa Rica and Panama, although they also show an upward trend the rates of incidence show a downward trend for the last years. For 2001, with the exception of Belize all the countries of the region experienced a decrease in the frequency of intoxications.

The behavior of the lethality frequency, however, is not so uniform within the countries. While in Costa Rica, El Salvador and Panama the frequency shows a downward trend, in Nicaragua and Guatemala the trend observed is upwards. Remarkably, in 1999 Belize showed the highest lethality in the whole region and for the total period under study: 42,9%. Although no information was obtained for the previous years that would allow the study of the secular behavior, it is important to keep in mind this number for the potential it represents for public health policies in that country.

For comparative purposes, we have included the incidence rate of acute intoxications and lethality for the State of California, where it is well known that the use and load of pesticides per hectare is one of the highest in the world. .Regardless of that, the incidence rates of acute intoxications as well as the lethality associated to pesticides exposure are very low in comparison with those observed in the countries of the Central American Isthmus.

Besides, the intoxication rates calculated among the whole population of each country, the intoxication rates were also estimated for those that may be occurring with the group with the largest exposure to pesticides potential: the population working in agriculture. Since there was no precise information of the number of inhabitants living in agricultural areas, the populations at risk were calculated based on the proportion of economically active population dedicated to agriculture, and assuming that around 80% of the cases of intoxications happen in rural areas. Based on these calculations, Costa Rica, Nicaragua and El Salvador showed the highest rates of acute intoxications for the region.





Table 3 and Graphic 21 present the relationship between the secular behavior of the incidence of acute intoxications and lethality, by country. In general, it is observed that the trend in lethality associated to pesticides not necessarily follows the tendency shown by the rates of incidence. For example, in El Salvador, Costa Rica and Panama, although there is a trend upwards in the rate of acute intoxication, lethality tends to decrease. In other countries such Guatemala, Nicaragua and perhaps Belize, lethality instead showed a tendency similar to the rates of incidence of intoxications.

#### ◆ **Associations between indicators of exposure and events of interest**

Graphics 22 to 26 show the relationship between the rate of acute intoxications, the mortality, the lethality and the behavior of the indicators of exposure: imported pesticides and the load of pesticides. The import trends have always been upwards, that of intoxications although presenting increases up until 1997 linked to a greater report of cases, shows a tendency towards stability as of that date, regardless of increased importation; lethality and mortality to a lesser extent have been increasing, which is a cry of alert to the need of opportunely thinking of the diagnostic, improvement of clinical handling of the problem and increase in research regarding the effects of presently used pesticides in the health of the population.

The results, when modeling the indicators of exposure at the regional level indicate that the rate of incidence of intoxications due to pesticides is increasing at a rate of 9 to 11% for each 100 tons of pesticides imported per hectare of agricultural and non agricultural lands. Instead, at the regional level there is no clear association between these indicators of exposure and the lethality associated to pesticides (See Table 6).

By country, the force of association between the amount of pesticides and the rate of incidence of acute intoxications tends to be positive, although with variations between each of them. For example, in Nicaragua it can be observed that the rate of incidence of acute intoxications by pesticides significantly increases between 29% and 35% for each 100 tons of pesticides imported. In Costa Rica the rate of incidence increases significantly between 8 and 12% per each 100 tons of pesticides imported. In Guatemala the increase fluctuates between 9 and 10% also per each 100 tons of pesticides imported (see Table 7).

Unlike the analysis in the regional ambit, as far as the association between amount of pesticides and levels of lethality when analyzing the associations at the country level, the associations tend to be positive, particularly regarding the indicator of load of pesticides. In Nicaragua lethality increased significantly between 17 and 41% per each 100 tons of pesticides per hectare (See Table 8).



◆ **An approximation to the evaluation of PLAGSALUD impact**

The integral evaluation of the PLAGSALUD Project must consider various aspects at the short and long terms. At short term they include, for example, a number of local commissions of pesticides implemented, the number and type of trainings imparted, the agreements in the ambit of the country as far as the number and type of pesticides which will be eliminated or placed under control. In the long term (10 years or more) it is hoped to observe a significant decrease in the incidence rate of acute intoxications.

As a first approach to the impact of actions of PLAGSALUD in the Central American Isthmus, the change in incidence of intoxications associated to pesticides and lethality was estimated, comparing the respective frequencies before and after the program actions were started.

Tables 9 and 10 present the epidemiological analysis stratified and adjusted by the procedure of Mantel y Haenszel, a few years after the Project was started. It was found that the incidence rates of acute intoxications due to pesticides increased once the actions of the Project started. Given the temporary framework in which these comparisons take place, this finding is not surprising. As a matter of fact, it is an indicator that the actions of epidemiological surveillance could be sensibly improving in the countries of the area. Instead, when observing the adjusted estimator which compares lethality before and after the program was started, it can be noticed that there is no association. This is not surprising considering that the changes in lethality more than directly associated to the direct actions of the PLAGSALUD Project take place conditional upon the quality of medical attention and the resources each country has for this.



THE EFFECTS OF PESTICIDES IN THE ISTHMUS

TABLE 3

RATE OF INTOXICATIONS AND LETHALITY ASSOCIATED TO PESTICIDES IN THE CENTRAL AMERICAN ISTHMUS AND IN CALIFORNIA 1992-2001							
YEAR	INTOXICATIONS REPORTED*	DEATHS REPORTED	POPULATION TOTAL	POPULATION IN AGRICULTURE	RATE OF INTOXICATIONS (/100,000 ININHABS)	LETHALITY (/100 INTOXICATIONS)	RATE OF INTOXICATIONS (100,000 INHB IN AGRICULTURE)**
Belize							
1992			189.329	28.112			
1993			183.392	27.230			
1994			212.630	31.571			
1995			212.630	31.571			
1996			222.000	33.304			
1997			222.000	33.304			
1998			238.500	37.488			
1999	21	9	235.281	36.982	8,93	42,86	45,43
2000	22	2	240.204	39.847	9,16	9,09	44,17
2001	30	5	249.800	41.311	12,01	16,67	58,10
Costa Rica							
1992	257	14	3.245.086	649.666	7,92	5,45	31,65
1993	382	14	3.348.763	665.547	11,41	3,66	45,92
1994	583	26	3.452.432	673.583	16,89	4,46	69,24
1995	989	38	3.553.881	724.949	27,83	3,84	109,14
1996	794	34	3.652.334	753.403	21,74	4,28	84,31
1997	924	28	3.748.123	777.458	24,65	3,03	95,08
1998	655	21	3.841.496	741.063	17,05	3,21	70,71
1999	679	20	3.933.101	758.735	17,26	2,95	71,59
2000	757	16	3.840.000	777.619	19,71	2,11	77,88
2001	490	27	4.112.000	832.701	11,92	5,51	47,08

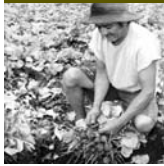


TABLE 3 (Continued)

RATE OF INTOXICATIONS AND LETHALITY ASSOCIATED TO PESTICIDES IN THE CENTRAL AMERICAN ISTHMUS AND IN CALIFORNIA 1992-2001							
YEAR	INTOXICATIONS REPORTED*	DEATHS REPORTED	POPULATION TOTAL	POPULATION IN AGRICULTURE	RATE OF INTOXICATIONS (/100,000 ININHABS)	LETHALITY (/100 INTOXICATIONS)	RATE OF INTOXICATIONS (100,000 INHB IN AGRICULTURE)**
El Salvador							
1992			5.314.729	802.397			
1993	1.016	167	5.429.454	808.739	18,71	16,44	100,50
1994	642	195	5.548.284	817.090	11,57	30,37	62,86
1995	362	85	5.668.595	842.807	6,39	23,48	34,36
1996	506	42	5.789.387	885.776	8,74	8,30	45,70
1997	931	103	5.910.713	989.453	15,75	11,06	75,27
1998	1.770	177	6.032.269	1.009.802	29,34	10,00	140,23
1999	2.304	288	6.154.063	1.030.190	37,44	12,50	178,92
2000	2.349	253	6.031.000	1.076.895	38,95	10,77	174,50
2001	2.071	243	6.517.798	1.163.818	31,77	11,73	142,36
Guatemala							
1992	642	2	9.213.583	1.581.788	6,97	0,31	32,47
1993	402	4	9.460.069	1.618.504	4,25	1,00	19,87
1994	237	3	9.714.497	1.659.158	2,44	1,27	11,43
1995	80	0	9.975.895	1.775.550	0,80	0,00	3,60
1996	436	1	10.244.050	1.816.946	4,26	0,23	19,20
1997	1.206	97	10.519.150	1.982.755	11,46	8,04	48,66
1998	1.017	108	10.801.110	2.035.901	9,42	10,62	39,96
1999	1.515	246	11.089.860	2.090.328	13,66	16,24	57,98
2000	1.060	183	11.385.336	2.257.143	9,31	17,26	37,57
2001	1.340	238	11.678.501	2.315.263	11,47	17,76	46,30

(\*) Cases reported in the whole country

(\*\*) Estimate based in the proportion of economically active population dedicated to agriculture, assuming that 80% of the cases of intoxication happen in rural areas, and that the proportion of the population dedicated to agriculture was relatively stable during the period



THE EFFECTS OF PESTICIDES IN THE ISTHMUS

TABLE 3 (Continued)

RATE OF INTOXICATIONS AND LETHALITY ASSOCIATED TO PESTICIDES IN THE CENTRAL AMERICAN ISTHMUS AND IN CALIFORNIA 1992-2001							
YEAR	INTOXICATIONS REPORTED*	DEATHS REPORTED	POPULATION TOTAL	POPULATION IN AGRICULTURE	RATE OF INTOXICATIONS (/100,000 ININHABS)	LETHALITY (/100 INTOXICATIONS)	RATE OF INTOXICATIONS (100,000 INHB IN AGRICULTURE)**
Honduras							
1992							
1993							
1994							
1995							
1996							
1997							
1998							
1999	471	22	6.315.753	1.197.220	7,46	4,67	31,47
2000	621	22	6.485.475	1.295.564	9,58	3,54	38,35
2001	509	46	6.341.717	1.266.847	8,03	9,04	32,14
Nicaragua							
1992	522	33	4.049.094	583.652	12,89	6,32	71,55
1993	692	30	4.172.289	599.383	16,59	4,34	92,36
1994	1.019	54	4.298.780	616.062	23,70	5,30	132,32
1995	1.298	93	4.425.627	654.586	29,33	7,16	158,63
1996	1.516	103	4.551.941	670.000	33,30	6,79	181,01
1997	1.951	136	4.678.680	692.014	41,70	6,97	225,54
1998	1.734	181	4.806.908	710.980	36,07	10,44	195,11
1999	1.789	245	4.938.364	730.424	36,23	13,69	195,94
2000	1.651	238	4.807.000	742.682	34,35	14,42	177,84
2001	1.126	145	5.208.000	804.636	21,62	12,88	111,95
Panama							
1992	128	25	2.491.217	374.731	5,14	19,53	27,33
1993	201	30	2.538.063	377.222	7,92	14,93	42,63
1994	188	27	2.584.699	379.514	7,27	14,36	39,63
1995	185	20	2.630.993	405.975	7,03	10,81	36,46
1996	316	13	2.676.870	408.975	11,80	4,11	61,81
1997	315	21	2.722.299	449.106	11,57	6,67	56,11
1998	406	23	2.767.250	456.522	14,67	5,67	71,15
1999	448	37	2.811.714	463.857	15,93	8,26	77,27
2000	474	34	2.767.000	481.641	17,13	7,17	78,73
2001	335	18	2.939.177	494.204	11,40	5,37	54,23



TABLE 3 (Continued)

RATE OF INTOXICATIONS AND LETHALITY ASSOCIATED TO PESTICIDES IN THE CENTRAL AMERICAN ISTHMUS AND IN CALIFORNIA 1992-2001							
YEAR	INTOXICATIONS REPORTED*	DEATHS REPORTED	POPULATION TOTAL	POPULATION IN AGRICULTURE	RATE OF INTOXICATIONS (/100,000 ININHABS)	LETHALITY (/100 INTOXICATIONS)	RATE OF INTOXICATIONS (100,000 INHB IN AGRICULTURE)**
Region							
1992	1.549	74	24.503.038	4.020.345	6,32	4,78	30,82
1993	2.693	245	25.132.030	4.096.625	10,72	9,10	52,59
1994	2.669	305	25.811.322	4.176.980	10,34	11,43	51,12
1995	2.914	236	26.467.621	4.435.438	11,01	8,10	52,56
1996	3.568	193	27.136.582	4.568.404	13,15	5,41	62,48
1997	5.327	385	27.800.965	4.924.090	19,16	7,23	86,55
1998	5.582	510	28.487.533	4.991.756	19,59	9,14	89,46
1999	7.227	867	35.478.136	6.307.736	20,37	12,00	91,66
2000	6.934	748	35.556.015	6.671.391	19,50	10,79	83,15
2001	5.901	722	37.046.993	6.918.779	15,93	12,24	68,23
California (USA)							
1992	1.856	1	30.866.860		6,01	0,05	
1993	1.435	1	31.399.094		4,57	0,07	
1994	1.332	3	31.901.659		4,18	0,23	
1995	1.593	2	32.397.935		4,92	0,13	
1996	1.580	2	32.884.241		4,80	0,13	
1997	1.319	1	33.364.095		3,95	0,08	
1998	998	2	33.856.037		2,95	0,20	
1999							
2000							
2001							

(\*) Cases reported in the whole country

(\*\*) Estimate based in the proportion of economically active population dedicated to agriculture, assuming that 80% of the intoxication cases happen in rural areas, and that the proportion of the population dedicated to agriculture was relatively stable during the period



THE EFFECTS OF PESTICIDES IN THE ISTHMUS

TABLE 4

RATE OF INTOXICATIONS* PER EXPOSURE TO PESTICIDES BY COUNTRY 1992-2001										
YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Belize								8,93	9,16	12,01
Costa Rica	7,92	11,41	16,89	27,83	21,74	24,65	17,05	17,26	19,71	11,92
El Salvador		18,71	11,57	6,39	8,74	15,75	29,34	37,44	38,95	31,77
Guatemala	6,97	4,25	2,44	0,80	4,26	11,46	9,42	13,66	9,31	11,47
Honduras								7,46	9,58	8,03
Nicaragua	12,89	16,59	23,70	29,33	33,30	41,70	36,07	36,23	34,35	21,62
Panama	5,14	7,92	7,27	7,03	11,80	11,57	14,67	15,93	17,13	11,40
Region	6,32	10,72	10,34	11,01	13,15	19,16	19,59	20,37	19,50	15,93
California (USA)	6,01	4,57	4,18	4,92	4,80	3,95	2,95			

(\*) per 100,000 inhabitants

TABLE 5

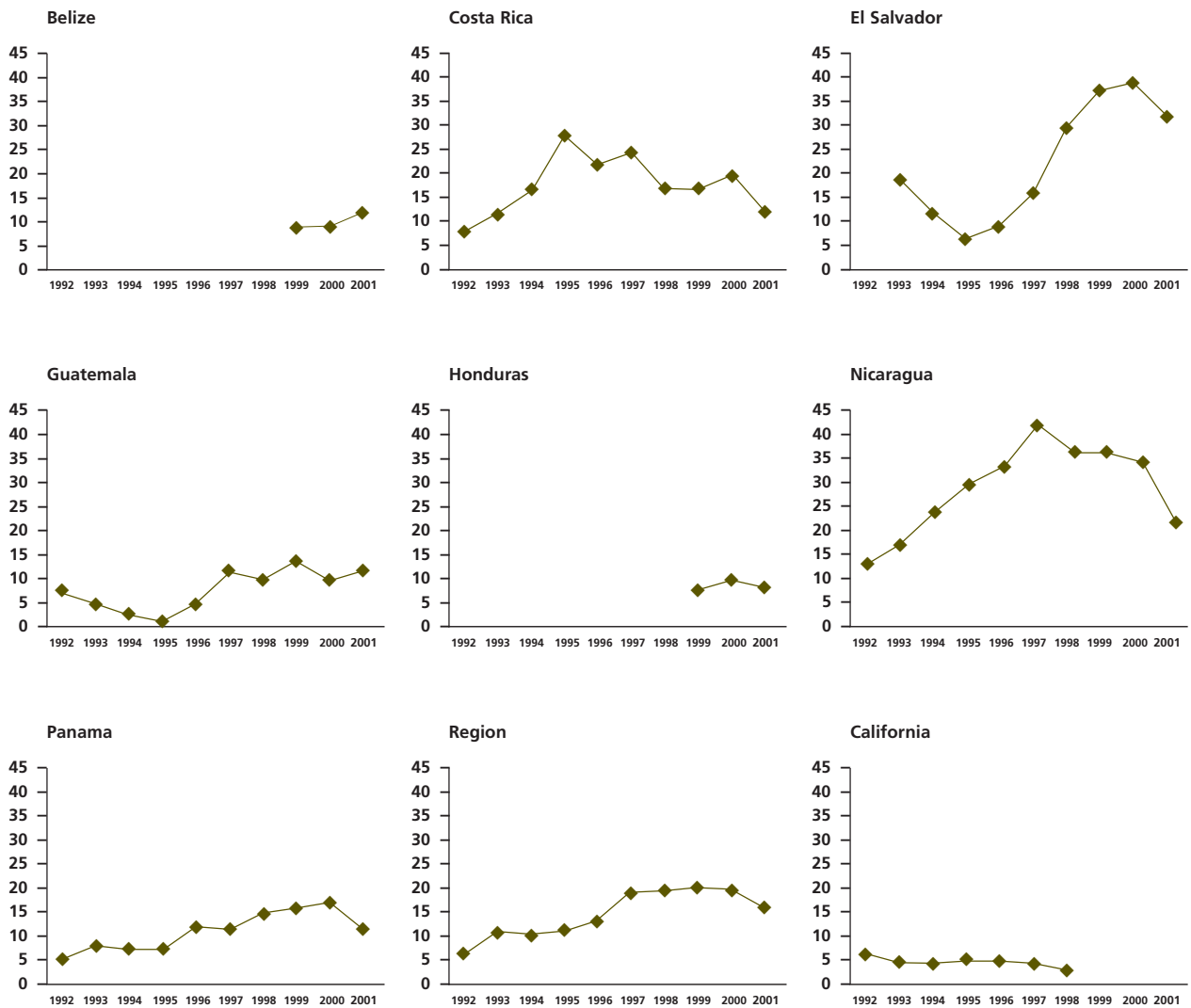
LETHALITY BY INTOXICATION FROM PESTICIDES BY COUNTRY 1992-2001										
YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Belize								42,86	9,09	16,67
Costa Rica	5,45	3,66	4,46	3,84	4,28	3,03	3,21	2,95	2,11	5,51
El Salvador		16,44	30,37	23,48	8,30	11,06	10,00	12,50	10,77	11,73
Guatemala	0,31	1,00	1,27	0,00	0,23	8,04	10,62	16,24	17,26	17,76
Honduras								4,67	3,54	9,04
Nicaragua	6,32	4,34	5,30	7,16	6,79	6,97	10,44	13,69	14,42	12,88
Panama	19,53	14,93	14,36	10,81	4,11	6,67	5,67	8,26	7,17	5,37
Región	4,78	9,10	11,43	8,10	5,41	7,23	9,14	12,00	10,79	12,24
California (USA)	0,05	0,07	0,23	0,13	0,13	0,08	0,20			

(\*) per 100,000 inhabitants



**GRAPHIC 18**

Rate of Intoxications (x 100.000) by pesticides per country, region and the State of California 1992-2001



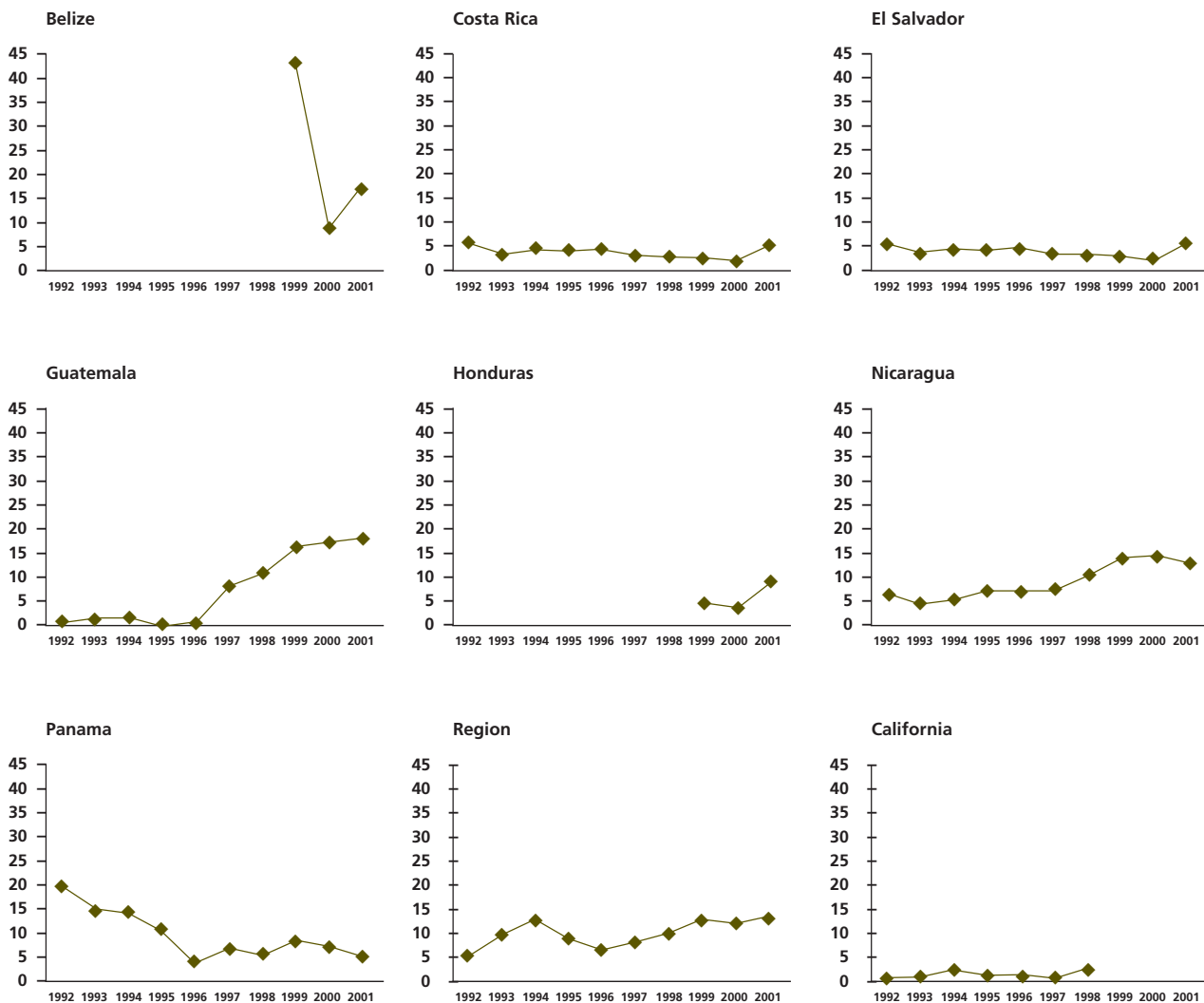




THE EFFECTS OF PESTICIDES IN THE ISTHMUS

GRAPHIC 19

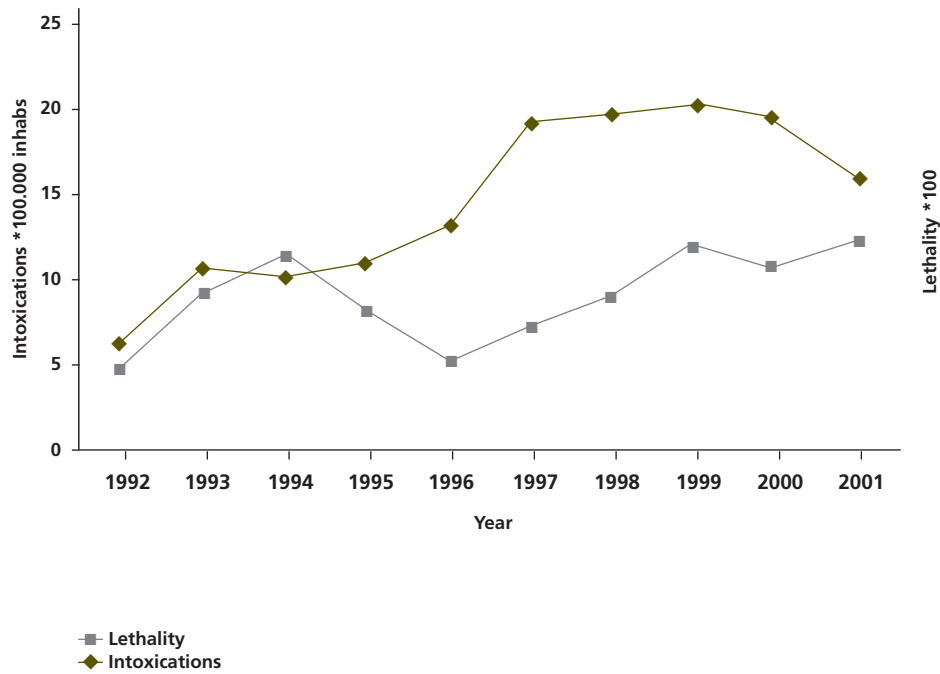
Lethality (x100) per pesticide by country, region and the State of California 1992-2001





**GRAPHIC 20**

Rate of Intoxications (x 100.000) vs. lethality (x 100) per pesticide by region and year.

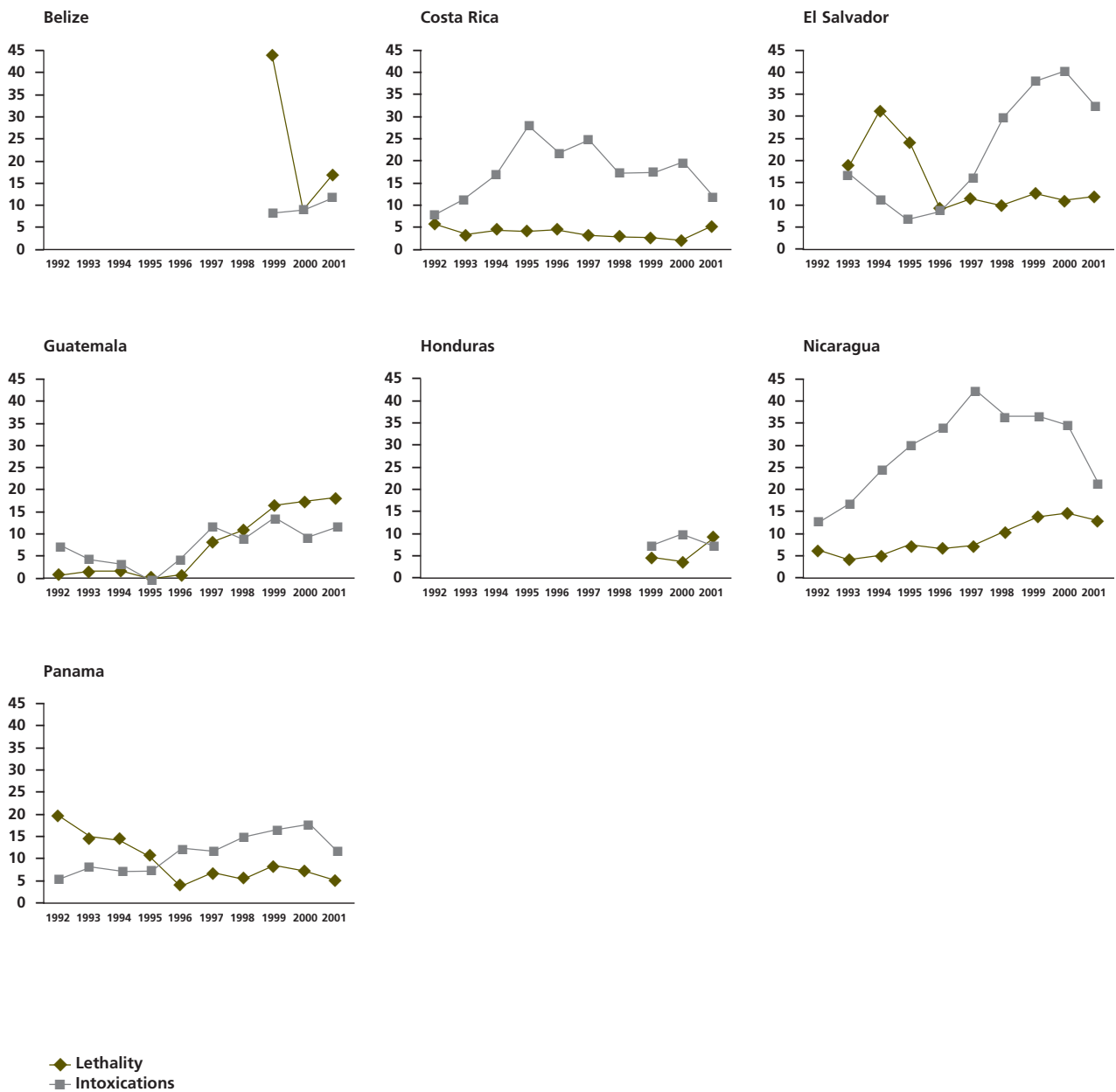




THE EFFECTS OF PESTICIDES IN THE ISTHMUS

GRAPHIC 21

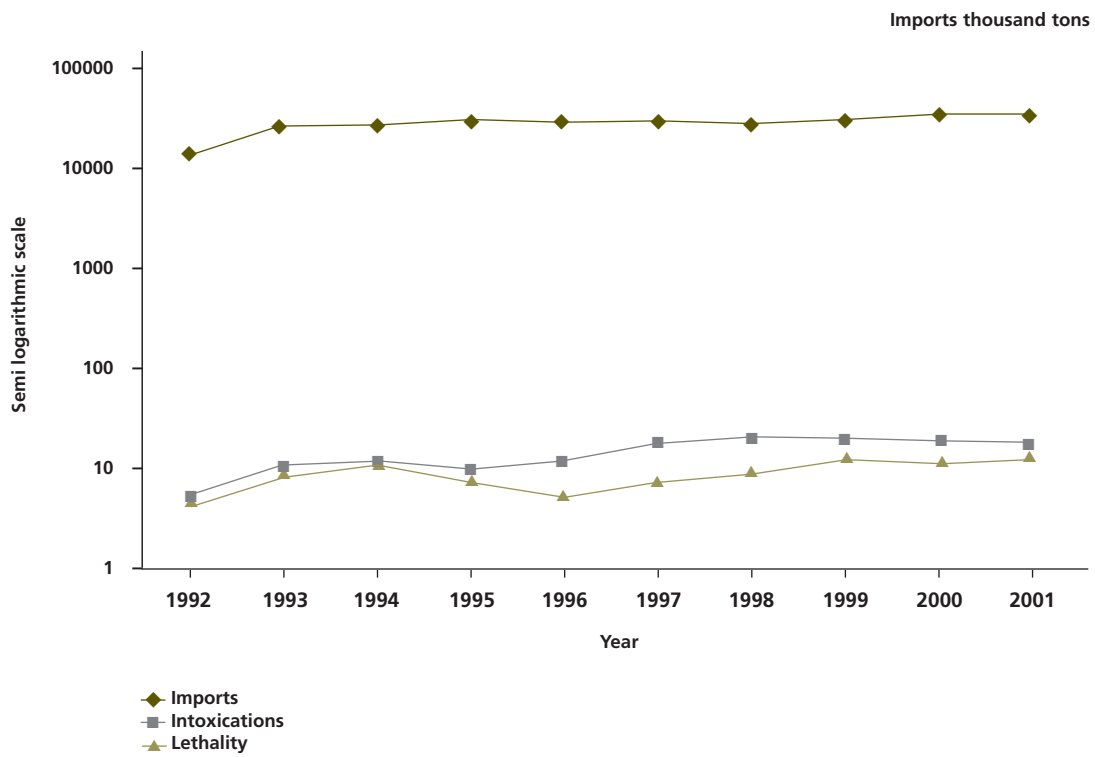
Rate of Intoxications (x 100.000) vs. lethality (x 100) per pesticide by country and year.





**GRAPHIC 22**

Intoxications (x 100.000), lethality (x 100) and pesticides imported (x tons) by region and year.

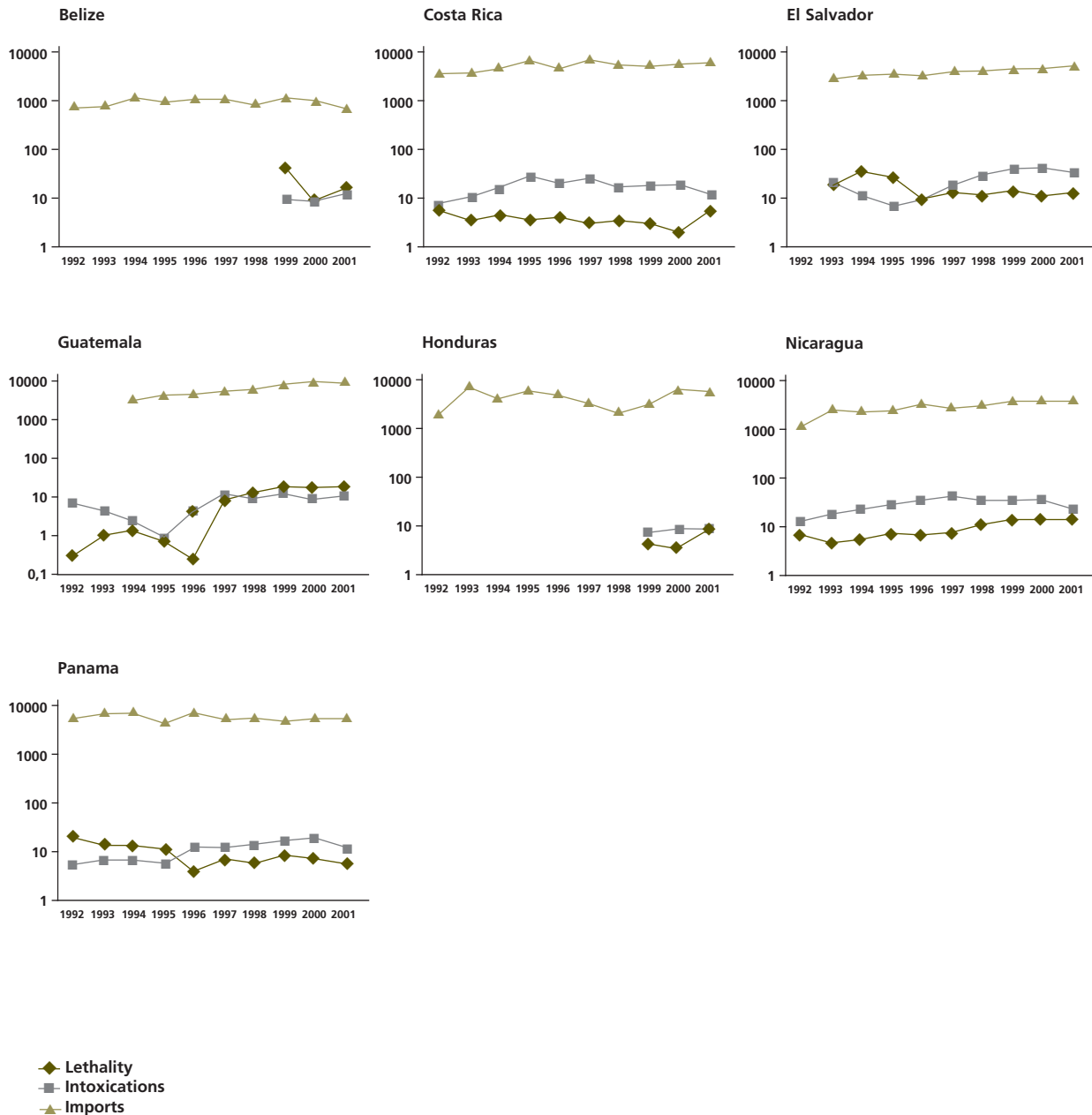




THE EFFECTS OF PESTICIDES IN THE ISTHMUS

GRAPHIC 23

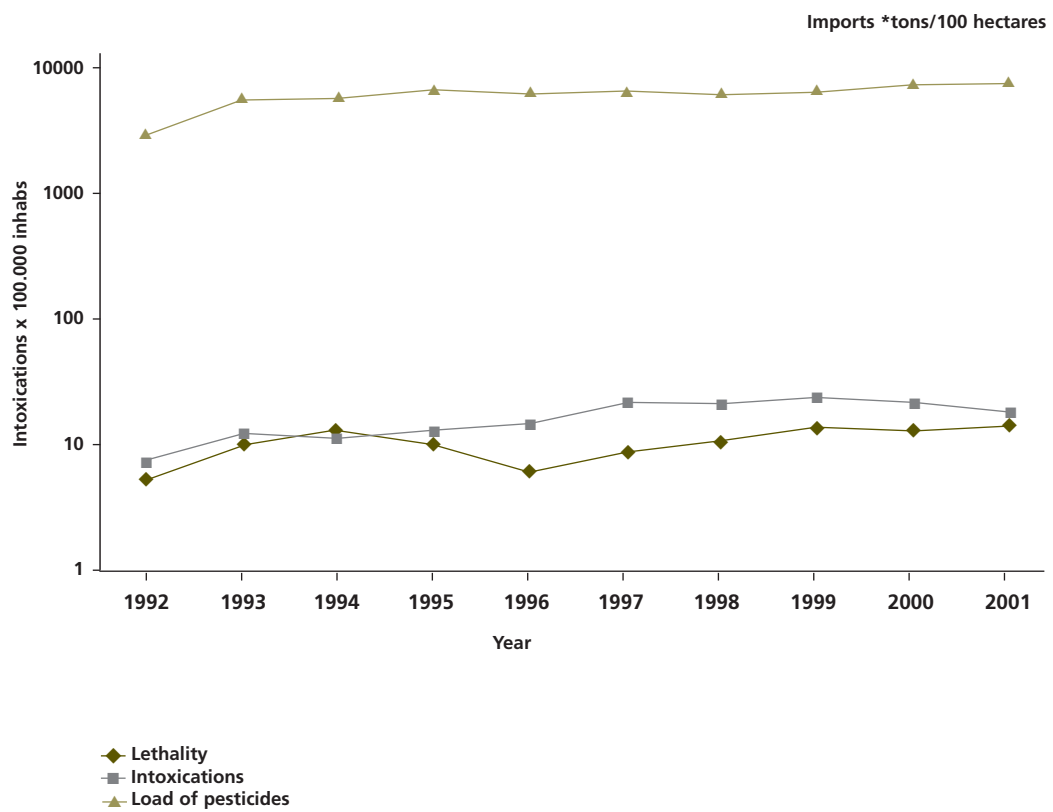
Intoxications (x 100.000 ), lethality (x 100) and pesticides imported (x tons) by country 1992-2001.





**GRAPHIC 24**

Intoxications (x 100.000 ), lethality (x 100) and load of pesticides imported (x tons/100 hectares) by region and year

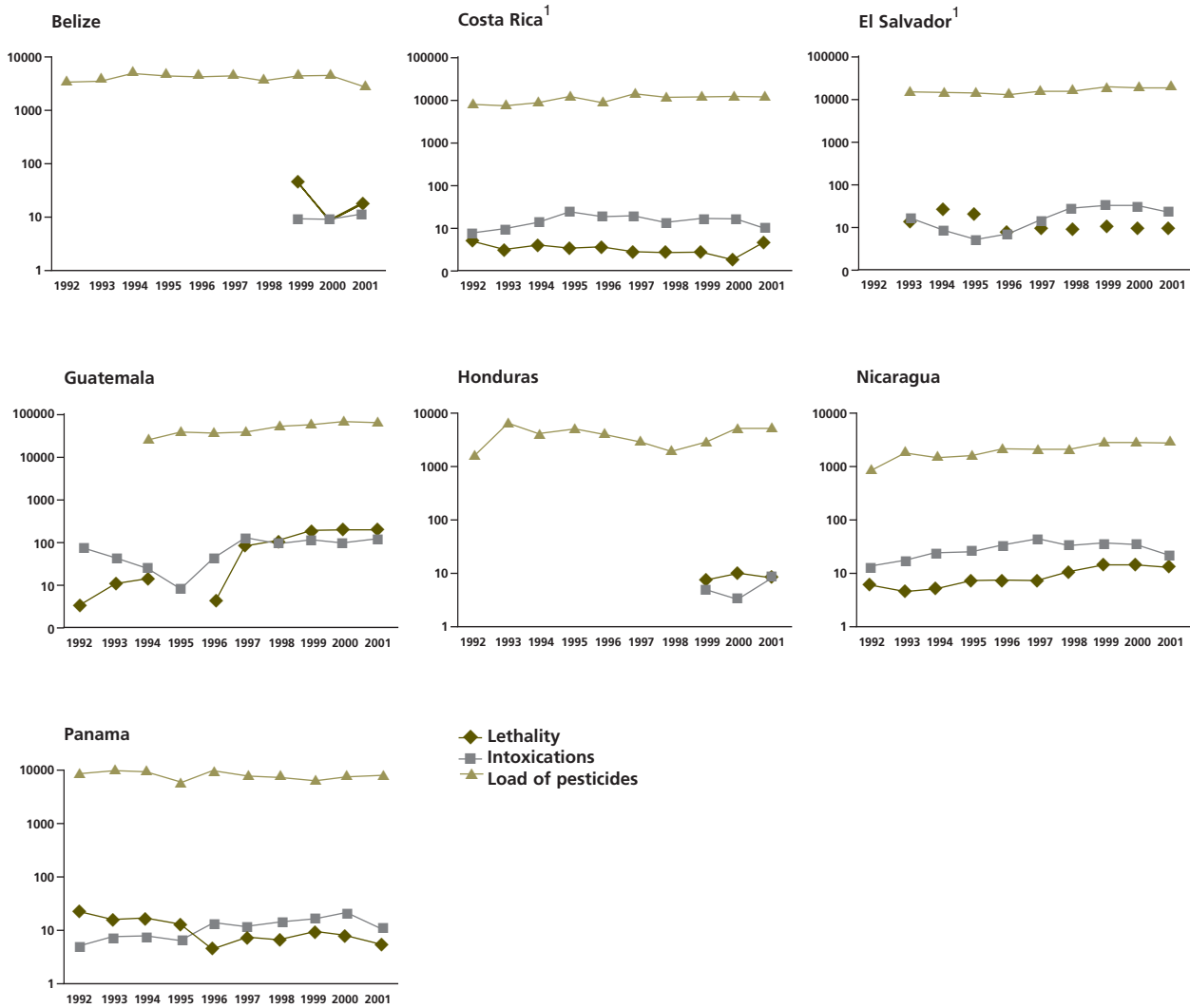




THE EFFECTS OF PESTICIDES IN THE ISTHMUS

GRAPHIC 25

Intoxications (x 100.000), lethality (x 100) and load of pesticides imported (x tons/100 hectares) by country 1992-2001.

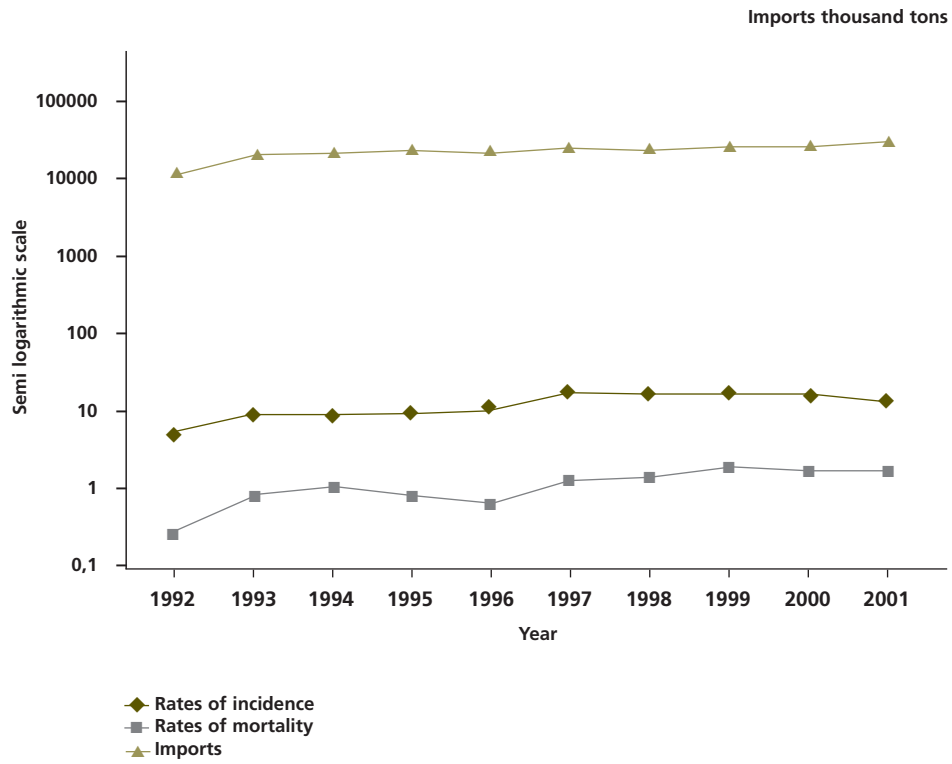


<sup>1</sup> Axis based on 100.000 tons by 100 hectares, imports over 10.000 tons by 100 hectares in the period.



**GRAPHIC 26**

Trend of the rates of incidence (TI), Mortality rates (TM) of Intoxications and importation of pesticides (in thousand of kg)







THE EFFECTS OF PESTICIDES IN THE ISTHMUS

TABLE 6

RATIO OF INCIDENCE RATES AND CONFIDENCE INTERVALS AT 95% USING AS UNIT OF ANALYSIS THE REGION			
INDICATOR	RTI	I.C.	95%
Rate of acute intoxications			
Imported pesticides (tons)	1,11	1,10	-1,11
Pesticides used (tons)	1,10	1,09	-1,11
Load of pesticides	1,10	1,09	-1,10
Lethality (/100 cases)			
Pesticides imported (tons)	1,02	1,01	-1,04
Pesticides used (tons)	1,02	0,98	-1,07
Load of pesticides	0,99	0,98	-1,01



TABLE 7

RATIO OF INCIDENCE RATES AND CONFIDENCE INTERVALS AT 95% USING AS A UNITY OF ANALYSIS THE COUNTRY			
COUNTRY/INDICATOR	RTI	I.C.	95%
<b>IMPORTED PESTICIDES (TONS)</b>			
Costa Rica	1,10	1,08	-1,12
El Salvador	1,90	1,82	-1,99
Guatemala	1,10	1,09	-1,10
Nicaragua	1,32	1,29	-1,35
Panama	0,93	0,91	-0,95
<b>PESTICIDES USED (TONS)</b>			
Costa Rica	1,24	1,22	-1,27
El Salvador	1,63	1,56	-1,70
Guatemala	0,86	0,85	-0,88
Nicaragua	1,20	1,18	-1,23
Panama	1,14	1,10	-1,19
<b>LOAD OF IMPORTED PESTICIDES</b>			
Costa Rica	1,05	1,04	-1,06
El Salvador	1,14	1,13	-1,15
Guatemala	1,11	1,10	-1,11
Nicaragua	1,40	1,36	-1,44
Panama	0,94	0,93	-0,96



TABLE 8

RATIO OF LETHALITIES AND CONFIDENCE INTERVALS AT 95% USING AS UNITY OF ANALYSIS THE COUNTRY			
COUNTRY/INDICADOR	RTI	I.C.	95%
<b>PESTICIDES IMPORTED</b>			
El Salvador	0,72	0,64	-0,80
Guatemala	1,03	1,00	-1,05
Nicaragua	1,23	1,14	-1,33
Panama	1,04	0,97	-1,11
<b>PESTICIDES USED</b>			
El Salvador	0,52	0,46	-0,58
Guatemala	1,24	1,16	-1,33
Nicaragua	1,07	0,99	-1,15
Panama	0,81	0,69	-0,94
<b>LOAD OF PESTICIDES</b>			
El Salvador	0,93	0,91	-0,96
Guatemala	1,03	1,00	-1,05
Nicaragua	1,28	1,17	-1,41
Panama	1,03	0,98	-1,08



TABLA 9

RATIO OF INTOXICATION RATES WHEN COMPARED TO THE RATES OF INTOXICATIONS BEFORE THE PROJECT AND ONCE THE PROJECT WAS STARTED (BASIS OF COMPARISON)				
COUNTRY/REGION	IRR	[95% CONFIDENCE INTERVALS]		M-H WEIGHT
Belize	-	-	-	0
Costa Rica	1.652670	1.548969	1.764270	795.3636
El Salvador	2.437544	2.331032	2.549332	1306.399
Guatemala	1.929602	1.813464	2.053421	718.8629
Honduras	-	-	-	0
Nicaragua	1.514957	1.443368	1.590543	1454.709
Panama	1.787504	1.642034	1.946109	398.1833
Crude	2.135541	2.083269	2.189249	
M-H combined	1.883286	1.836667	1.931090	
Test de homogeneity	(M-H)	chi <sup>2</sup> (4) =	225.06	Pr>chi <sup>2</sup> = 0.0000



THE EFFECTS OF PESTICIDES IN THE ISTHMUS

TABLE 10

RATIO OF LETHALITY COMPARED TO RATES BEFORE THE PROJECT AND ONCE IT WAS STARTED (COMPARISON BASE)				
COUNTRY/REGION	IRR	[95% CONFIDENCE INTERVALS]		M-H WEIGHT
Belize	-	-	-	0
Costa Rica	-	7.422214	-	0
El Salvador	.5231655	.4610121	.5937263	324.1407
Guatemala	21.91843	11.74369	46.20859	5.626673
Honduras	-	-	-	0
Nicaragua	1.582493	1.330046	1.892457	116.7641
Panama	.5755049	.42495	.7756066	61.47005
Crude	1.038303	.9528442	1.132205	
M-H combined	1.04974	.9631512	1.144113	
Test de homogeneity	(M-H)	chi <sup>2</sup> (3) = 247.72 Pr>chi <sup>2</sup> = 0.0000		



## ➤ ACTIONS

One of the most important results has been the identification of the following pesticides responsible for the higher morbidity and mortality caused by acute intoxications:

- Paraquat
- Aluminum phosphates
- Methylparathion
- Methamidophos
- Monochrotophos
- Chlorpyrifos
- Terbufos
- Ethoprophos
- Endosulfan
- Carbofuran
- Methomyl
- Aldicarb

Also, in accordance with information obtained by PLAGSALUD in the countries of the Central American Isthmus, of the 107 pesticides presently prohibited only six products ( 5,6%) are prohibited in all seven countries.

Among the great challenges to be faced by the countries of the Isthmus in which PLAGSALUD will be a companion, the following stand out:

- Development of alternatives to the use of pesticides such as integrated handling of pests (MIP) and organic agriculture. The latter represents a production system based in handling practices that consider the laws of nature, giving the appropriate conditions so that the biological activities in the agro systems develop in an optimum manner.
- The MIP as well as organic agriculture represents production methods less dependent, polluting and dangerous.
- Encouraging and consolidating citizen participation and, especially that of the workers and the most exposed community, allowing their continued participation in all stages of the decision making process. For all of the above the access to complete updated and understandable information on pesticides must be guaranteed.
- Establishment of controls to pesticides of higher risk for human health and the environment through:
  - Prohibition of pesticides not permitted in their countries of origin.
  - The prohibition of substances belonging to persistent organic pollutants (POP) and the listing of the Report of Previous Consent (RPC).
  - The establishment of stricter controls for the sale and use of pesticides which produce the highest number of acute intoxications.



## THE EFFECTS OF PESTICIDES IN THE ISTHMUS

- Homologation of prohibited pesticides in all countries of the Sub Region.
  - Adequate disposal not only of obsolete pesticides, but also of containers and remnants of formulated products.
  - Prohibition of their application by women and children.
- Improvement of capacity to monitor activities in compliance with existent legislation on this matter.
  - Improvement of hygienic conditions and safety for field workers and their families, who represent the population subject to greater exposure to these substances.

One of the concrete actions that the PLAGSALUD program has carried out is the proposal for an "Agreement for the Establishment of Regulatory Controls to Synthetic Pesticides" presented at the XVI Meeting of the Health Sector of Central America and the Dominican Republic (RESSCAD), in the year 2000.

The basic agreements proposed were:

1. To request from the pertinent authorities in each of the eight countries the establishment of measures leading to the **restriction** in the employment of the twelve pesticides responsible for the largest number of intoxications and deaths:
  - Paraquat
  - Aluminum phosphates
  - Methylparathion
  - Methamidophos
  - Monochrotophos
  - Chlorpyrifos
  - Terbufos
  - Ethoprofos
  - Endosulfan
  - Carbofuran
  - Methomyl
  - Aldicarb
2. To ask the eight countries to set up the pertinent procedures to prohibit in each country all the pesticides, in order to obtain the homologation of **prohibited** pesticides in the sub Region.

### ◆ Technologies of new impact

In the agricultural field synthetic pesticides have been in use in an indiscriminate manner and without any control, as most of the products are not specific, little or not selective at all. They are applied in high doses and more frequently than necessary and few times do they leave the farmers other options for combating pests.



The crisis of the conventional model of agricultural production has been excessively dependent on expensive and polluting inputs and has not been very sustainable from the economic point of view, or for human health and the environment.

In view of this situation, several new important strategies and tactics have come up as alternatives to combat pests, with minimum negative effects on the environment and human health: integrated pest management and organic agriculture.

The use of synthetic pesticides in the MIP is reduced to the minimum necessary when making them compatible with other tactics for handling of pests.

Organic agriculture is a global system of production that promotes and enhances the health of the agro ecosystems, including biological diversity, biological cycles and biological activity of the soil. It emphasizes the use of management practices over the use of non agricultural inputs. This can be done applying, whenever possible, agronomical, biological and mechanical methods, as opposed to the use of synthetic materials to perform any specific function within the system.

Organic agriculture includes all agricultural systems that promote ecological, social and economically healthy production of foodstuff and fibers, respecting the natural capacity of plants, animals and soil. Its goal is to optimize all aspects of agriculture and the environment. Also, organic agriculture reduces external inputs by abstaining from the use of chemical fertilizers and synthetic pesticides.

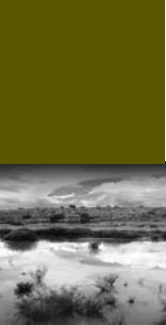




# Conclusions and recommendations

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- Importation of pesticides during the period increased from some 18.000 tons in 1992 to 46.000 tons in 2001.
- The rates of acute intoxication in the region of the Central American Isthmus fluctuated around 6,32 per 100.000 inhabitants in 1992 up to 20,37 in 1999, decreasing to 15,64 in 2001. The higher rates are registered in El Salvador and Nicaragua. Anyway, it is obvious that there is under registration, situation which has improved little by little in each country. It is necessary to establish certain standards for each country, in a concerted manner, to be used as base line for the improvement of the epidemiological surveillance of intoxications.
- The lethality reported is contingent to the notification. The lethality in the region has progressively increased, going from 4,78% in 1992 to 12,5% in 2001. Countries such as Belize, Costa Rica, El Salvador and Panama, have been able to decrease it, but this trend is not observed in Guatemala, Honduras and Nicaragua. This merits immediate action to improve the identification and the adequate handling of the cases on the part of health institutions.
- An interesting aspect is the association of importations with intoxications, which showed a positive correlation and statistically significant for Costa Rica, Guatemala and Nicaragua. The other countries showed positive correlation, but not significantly. A special case is that of Panama, which showed negative correlation. This must be verified. Also, it is important to mention that data mainly used was that from imports, but the most adequate correlation is that which is done using data from use, but this type of data has several limitations.
- the trend on importations has always been upwards; that of intoxications, although it presented increases up until 1997 linked to the larger number of cases reported, shows a tendency towards stabilization as of that date, although imports continue to increase; lethality and mortality are increasing which is a call of alert to the need to opportune thinking of diagnosis, improving the clinical handling of the problem and increasing research on the effect of pesticides presently in use on the health of the population.
- In terms of recommendations, it is observed that there has been an important advance in the notification in all the countries. This process must be continually strengthened.



## CONCLUSIONES Y RECOMENDACIONES

- It is necessary to strengthen and develop greater inter sectorial action leading to a greater compromise which involves not only the safe use of pesticides, but the promotion of alternative systems for the handling of pests.
- In accordance with recent publications, the main causes of intoxications per country have been clearly identified, which allows the recommendation of certain concrete actions for regulation and better control on specific points.
- It is necessary to develop more applied research directed to the evaluation of concrete interventions.
- The under registration of acute intoxications must be attacked through direct action on the determinants of this problem.
- Chronic effects have not been taken much into consideration. The follow up systems must be strengthened. A regional study would be very helpful.
- Biological monitoring systems must be expanded and controlled in terms of quality.

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Pan American Health Organization  
World Health Organization  
Health and Environment Division/HEP



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Occupational and Environmental Aspects of Exposure to Pesticides  
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