



# Claim No Easy Victories: Evaluating the Pesticide Industry's Global Safe Use Campaign

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**Summary.** — The pesticide industry's Global Safe Use campaign has reportedly produced a dramatic decline in pesticide-related health and environmental problems in Guatemala. This paper challenges this claim, reanalyzing existing data and further evaluating claims of the campaign's efficacy. The paper argues that the campaign's strategy inadequately links knowledge with structural constraints on behavior. It also suffers from the industry's contradictory definitions of the pesticide problem both as public perception and as a serious health and environmental threat. The paper suggests an approach common to the field of Industrial Hygiene be applied to reducing pesticide hazards. The paper concludes by locating the Safe Use campaign within larger struggles to re-regulate globalizing economic spaces. © 2000 Elsevier Science Ltd. All rights reserved.

*Key words* — pesticides, Guatemala, chemical industry, Safe Use, regulation

## 1. INTRODUCTION

A "Silent Revolution" is sweeping the globe, according to the international pesticide industry (GIFAP, n.d.). It is a revolution in the way farmers and others are using hazardous pesticides. This transformation in the technology's use has resulted in a dramatic decline in the scope of pesticide-related health and environmental problems, we are told. In Guatemala, for example, a 10-fold decline in pesticide poisonings over the past decade has been registered by the social security system, reportedly a direct result of the industry's "Safe Use" campaign to train and educate the Guatemalan populace over that same period (AGREQUIMA & GIFAP, 1995, p. 3). The impact of the industry campaign has recently been touted by popular media (Grimaldi, 1998) and by development practitioners who have embraced the safe use concept as central to efforts to solve the pesticide problem (Tobin, 1996).<sup>1</sup>

But what are the bases for such claims? Have pesticide hazards and related health and environmental problems really declined so dramatically? Has the industry's campaign been the source of these reported changes in the scope of the pesticide problem? In this paper we challenge the claims of the pesticide industry, arguing that a less sanguine and more scientific review of the data suggests a different reality

than that presented by industry promotional efforts. While we acknowledge the importance of safe use training, we explore the inherent weaknesses in strategies which inadequately link knowledge with more structural constraints on behavioral change. We then question whether the program is more appropriately understood as primarily an attempt to generate changes in safety, health and environmental conditions, or primarily as an attempt to improve consumer perception of the industry.<sup>2</sup> We conclude by arguing that the implementation of the Safe Use campaign is being shaped by a larger struggle to control processes of re-regulation in increasingly globalized economic spaces.

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\* We are grateful for the generous support of the John D. and Catherine T. MacArthur Foundation's Program on Peace and International Cooperation for supporting the preliminary research that led to this article. We have benefited from helpful discussions with several representatives of the pesticide industry, including Freddy Fernandez and Anarco Garcia. Further, we would like to acknowledge the helpful comments of Peter Hurst, Richard Fenske, Matthew Keifer, and Monica Moore. As should be apparent, the ideas presented in this paper represent our own views and not necessarily those of the people acknowledged herein. Final revision accepted: 7 February 2000.

## 2. THE PESTICIDE PROBLEM

Global pesticide use increased rapidly after the W W II as wartime technological advances were applied to peacetime production. First DDT and then an array of other organochlorine and organophosphate compounds were introduced into US agriculture and quickly thereafter into farming systems around the world. Chemical manufacturing became "the premier industry of the US" in the post war period (Perkins, 1982, p. 13). Pesticide sales increased steadily over the ensuing half century, reaching \$32 billion annually by 1997 (Agrow, 1998).

With the rise in pesticide use came a highly effective promotional campaign as the pesticide industry touted the new products. DDT took the lead in early public relations and advertising efforts, with one food company official observing that "The publicity given DDT might well be envied by a Hollywood movie star" (Brittin, 1950, p. 594). Soon the entire technology was being heralded as a "miracle technology," promising to bring world hunger and disease to an end.<sup>3</sup>

The celebration of the wonders of the agrochemical technology soon gave way, however, to a growing chorus of concern by scientists and public interest groups. The most dramatic statement of these concerns was made by Rachel Carson in her classic work, *Silent Spring* (1964). While pesticides were indeed boosting yields and bringing various pests under control, she warned that they were also accumulating in the environment and threatening the very existence of various forms of wildlife, and potentially of humans as well. Carson's critique played a crucial role in inspiring government regulation, including the creation of the Environmental Protection Agency (EPA), which grew directly out of growing public awareness of pesticide problems (Marcus, 1980).

Along with the problems associated with organochlorines emerged a second level of acute public health problems associated primarily with organophosphate pesticides. Unlike DDT, some of these chemicals could cause severe health effects and death after exposure to small amounts over only a few hours. By the end of the 1980s the problem of acute pesticide illnesses grew to a level of 2–3 million poisonings annually, mostly in the developing world (WHO, 1990). During the same period another problem, the long-term

health effects from the chronic exposure to relatively small levels of pesticides was also being reported. Studies implicated pesticides in the rising rate of breast cancer (Wolff *et al.*, 1993), in neurological damage to workers (Rosenstock *et al.*, 1991; McConnell, Keifer, & Rosenstock, 1993), and in a range of problems associated with endocrine disruption (Colburn, Dumanoski, & Myers, 1996).

The initial industry response to challenges to the new technology was swift and direct as it first attacked the messengers before addressing the message they carried. It equated Carson's position to a sort of latter day Luddite vision associated with:

...the end of all human progress, reversion to a passive social state devoid of technology, scientific medicine, agriculture, sanitation, or education. It means disease, epidemics, starvation, misery, and suffering incomparable and intolerable to modern man (Darby, 1962).<sup>4</sup>

As scientific research and popular media reports gave further credence to Carson's charges, the industry held steadfast to a strategy of denial and counterattack on those who would challenge the appropriateness of the technology. A passage from the 1981 annual report of Bayer Chemical Company captures the basic thrust of the industry's response to their critics: "In view of the challenge posed by world hunger, emotional attacks against conscientious agricultural chemical research are attacks against human unity" (Barry, 1987, p. 91).

Yet even as the industry sought to discredit its critics, some within the chemical manufacturing sector were recognizing that changes in the way pesticides were promoted and used were necessary and inevitable. In the mid-1960s the pesticide industry formed the Groupement International des Associations Nationales de Fabricantes de Produits Agrochimiques (GIFAP), to lobby on behalf of the pesticide industry. GIFAP undertook a range of lobbying and promotional efforts aimed largely at influencing international development and regulatory policies such as those being pursued by the Food and Agriculture Organization of the United Nations (Chapin & Wasserstrom, 1983).

By the early 1970s GIFAP and the FAO had begun to collaborate on a series of seminars to promote "new and better ways" to distribute and use pesticides in the developing world (Dinham, 1991, p. 63). As the criticism of the pesticide technology grew, the FAO began to

confront challenges from within the UN to its dominant role in international pesticide policy. In response to pressures from the UN Environmental Program (UNEP) and the World Health Organization (WHO), the FAO Director General proposed a Code of Conduct on the Distribution and Use of Pesticides, in part as a strategy to head off other agencies and affirm the FAO's jurisdiction over the technology and related policy issues (Paarlberg, 1991). The Code of Conduct was developed over the ensuing five years with the close cooperation of GIFAP and amid escalating criticism from various non-government organizations ((NGOs) and others. After 10 revisions, a final version of the Code was adopted in 1986, absent numerous proposals for making the Code mandatory or enforceable. The Code of Conduct included some much needed reforms in pesticide marketing and use, such as improvement of labeling of products to provide for proper protective measures, proper dosage, etc. In particular, there was considerable attention given to technician and user training and the proper use of pesticides. But the Code of Conduct left behind broader measures to reduce pesticide hazards, including mandatory or enforceable reductions in the use of the most hazardous pesticides.<sup>5</sup>

### 3. THE GLOBAL SAFE USE CAMPAIGN

In June 1991, the pesticide industry launched what has become one of their most ambitious nonproduct specific voluntary initiatives to date, the Global Safe Use Pilot Projects. With a commitment of \$1,059,000 from the GIFAP (now renamed the Global Crop Protection Federation, GCPF) headquarters in Brussels, the Safe Use campaign was launched with pilot projects in 3 countries, Guatemala, Kenya and Thailand (GCPF, 1998). Here, we focus exclusively on the Guatemalan case.<sup>6</sup> In the first of three phases, the Guatemala pilot project focused on a variety of training and education activities, along with efforts to test and distribute more effective safety equipment and establishment of appropriate pesticide waste disposal facilities. Training topics included the protection of humans and their environment, the prevention and treatment of pesticide poisoning, how to dispose of empty containers, and pesticide regulations. Training materials for agricultural technicians, distributors, users, school children, housewives and others were

developed and used in a wide ranging effort at public education. The program has also aimed to establish centers for the control of pesticide poisoning.

The Safe Use project has attracted considerable attention. Near the end of 1991, USAID joined the industry campaign in Guatemala with the complementary Pesticide Management Activity (PMA), a three year, \$4 million project intended to provide additional training, including training in the use of alternative pest control strategies such as Integrated Pest Management (IPM). This project has ended, with mixed reviews of its success (Tobin, 1996).

According to industry sources, at the end of the first phase of the Safe Use program in mid-1994, the industry had trained 800 government extension agents. These trainees in turn became trainers, and spread the message to other target groups who in turn would have a "cascade effect" as they "shared what they have learned with their employees, fellow workers and families" (GIFAP, n.d., p. 3). In addition, the industry reported that the Safe Use program had trained 226,000 farmers and housewives, 2,800 schoolteachers and 67,000 schoolchildren, 700 pesticide distributor employees, 330 technical and sales people and 2,000 physicians and paramedical personnel (GIFAP, n.d., p. 4).

At the same time, GIFAP contracted with the Panamerican Agricultural School of Zamorano, Honduras, to carry out a field audit of its project. A Zamorano study team, GIFAP reported, interviewed 700 farmers, housewives and distributors in "various regions of Guatemala," including a control group of 350 persons who were not trained. The Zamorano study found "a notable increase in knowledge about safe use of pesticides" and "a significant change in attitude among target groups trained."<sup>7</sup> For example, 88% of "trained" children interviewed reported they did not reuse empty agrochemical containers, as opposed to 13% of untrained child interviewees. Eighty-four percent of trained farmers reported reading pesticide labels, in contrast to 56% of nontrained farmers who said they did not read labels (GIFAP, n.d., p. 4).

In a second phase beginning in 1995, the program narrowed its focus to small vegetable growers. A more personal approach was implemented with field visits demonstration plots and master trainers who resided in target communities to coordinate pesticide training activities. In this phase, AGREQUIMA

reported that 7,169 farmers, 3,475 housewives, 105 extensionists, 188 dealers, 152 teachers, and 6,145 students were trained. Most recently, the Safe Use Project has entered a "self-sustaining" phase in which non-Guatemalan industry sponsors have retired and AGREQUIMA has taken over full responsibility for the program. Under Agreement No. 021-917 signed in 1997 with the Ministry of Agriculture, Livestock and Food, the Guatemalan pesticide industry now collects a levy of 0.05% on imported pesticide active ingredients or commercial products. AGREQUIMA administers the funds from this tax for training activities (Hurst, 1999a, pp. 16, 31).

The program has recently reduced its training efforts to concentrate on a target population of some 7,000 trainees (Hurst, 1999a, p. 29). Another significant change has been a shift toward greater emphasis on IPM in the industry campaign (GCPF, n.d.). While some have complained that this represents an attempt to capture the increasingly popular alternative paradigm and make it pesticide based (Benbrook, 1996), it appears in some cases, such as Product Stewardship, that the industry is promoting strategies that may lead to reduced pesticide dependency (ILO, 1999).<sup>8</sup>

#### 4. A CRITIQUE OF THE SAFE USE CAMPAIGN

The industry's literature infers from the numbers of people it has trained and the conclusions of the outside audit that the Safe Use program has led to profound changes in the way pesticides are used in Guatemala (GIFAP, n.d.). Significantly, in February

1998, Anarco Garcia, Project Director for AGREQUIMA, presented the results of the Safe Use campaign to the International Congress on Pesticide Use in Developing Countries held in San Jose, Costa Rica. In his talk, Mr. Garcia presented a graph of the Guatemalan Social Security System's reported pesticide poisonings over a two-decade period (see Figure 1). He noted that while the system only captured roughly 60% of the total cases in Guatemala, it was clear from the data that pesticide poisonings had fallen dramatically. He then observed that the decline occurred over the same time period in which the industry had implemented the Safe Use campaign, a relationship, he concluded, that was not coincidental. Several months later an article appeared in one of Guatemala's leading newspapers, noting that pesticide poisonings reported by the IGSS had dropped from 1,453 in 1987 to 121 in 1997, again attributing the decline to the Safe Use campaign carried out by the pesticide industry (Grimaldi, 1998). According to the GCPF, the Safe Use program has

made a real and sustained contribution to the safe and responsible use of crop protection products. It has proved that human behavior can be changed, but that to do so requires detailed and continuous training and education programmes GCPF, 1998, p. 14).

But are such claims about the success of Safe Use programs valid?

The Safe Use campaign appears to have been carried out on a remarkably wide scale, and it clearly represents a serious effort to address the pesticide problem in Guatemala. But in the pesticide industry's haste to respond to continued criticisms of the negative effects of the technology and their responsibility for the



Figure 1. Pesticide poisonings, 1972-97. (Source: Epidemiology Section, Guatemalan Social Security Institute.)

problems it creates, the claims also appear to have overreached supporting data.

(a) *The ecological fallacy*

The industry's claims that its Safe Use program has had a demonstrable impact on pesticide-related illnesses involve what is commonly referred to in the social scientific literature as an ecological fallacy. An ecological fallacy essentially involves using population or group-level data to draw conclusions about individuals (Blalock, 1982). In this case, the industry and its supporter's rest their assertions about the success of the Safe Use program on country-level time-series data from 1972-97, a period during which a dramatic drop in pesticide poisonings apparently occurred (Figure 1). But this link between the project and the intoxication rate is tenuous at best. For example, data on pesticide intoxication in Guatemala are highly unreliable because of underreporting of poisonings, a major problem common throughout Central America and elsewhere (Cole, McConnell, & Murray, 1988; Keifer & Pacheco, 1991; Murray, 1994).

The apparent decline in Guatemala's intoxication rate <sup>9</sup> is probably shaped by many complex factors, one of the most important of which is the traditional failure of local and national authorities to gather and record complete data. Underreporting of pesticide poisoning is likely to have increased in Guatemala over the past two decades as Guatemala's long civil war weakened the country's health care system. This weakening was in part due to a reported decline in the number of health workers in rural areas where pesticide poisonings most frequently occur, which in turn contributed to a decline in the ability to keep systematic statistics. More recently, many Guatemalan public sector activities all but stopped due to the combined effects of economic recession, structural adjustment policies recommended by the International Monetary Fund (IM F) and implemented by its government, and the restructuring of Guatemalan state/civil society relations set in motion by the peace process (Spence *et al.*, 1998). <sup>10</sup>

One critical example of how declining health sector capacity has misrepresented pesticide poisonings comes from the IGGS health information system from which Figure I was drawn. The illness reporting system was completely abandoned for nearly two years in the mid-1990 in Escuintla, the department traditionally

with the highest rate of pesticide poisoning in the country (Campos & Finkelman, 1998). This was precisely the period to which industry spokespersons have pointed as evidence of the success of the Safe Use campaign.

Clearly, no reliable evidence has yet been provided which demonstrates the impact of the Safe Use campaign on pesticide poisonings in Guatemala. We do know from recently conducted studies that acute pesticide illness remains very high in Guatemalan agricultural zones, with the most reliable estimate placing poisoning rates at nearly 10,000 per year (Campos & Finkelman, 1998). <sup>11</sup>

(b) *Training: confounding outputs with outcomes*

The evidence the pesticide industry presents of the success of its Safe Use training efforts has chiefly consisted of lists of large numbers of farmers, workers, housewives, schoolchildren, extension workers and distributors who have received training. If the interest of the industry lies merely in discharging its responsibility by putting accurate information about pesticides out in the public as widely and as clearly as possible, then these tallies of individuals reached with their message can be considered evidence of effectiveness. But, if the industry is truly committed to producing behavioral changes as their literature implies, this kind of data confounds outputs, numbers of participants, with outcomes, presumably, adoption of safer pesticide practices.

Moreover, it is unclear whether the numbers of trainees are actually based on assumptions about the success of its "trainee becomes trainer" approach. Were, for example, the elevated numbers of trained farmers and schoolteachers based on predictions of how many were likely to be reached by trained schoolteachers, distributors and extension agents sharing their knowledge about pesticides, or were they individuals who directly participated in training activities? Industry literature has provided neither a systematic explanation of the mechanisms by which this cascade effect has occurred nor concrete evidence that the multiplier effect has actually had an impact.

Heavy publicity by the pesticide industry has brought its Safe Use program under growing scrutiny. For example, as part of its broader interest in Voluntary Initiatives within the chemical industry, the European International Food Workers Union (IUF) has recently

expressed concern about the claims of the Safe Use programs' successes. Safe Use training, it suggests, in many cases appears to be carried out by pesticide salespeople who have a conflict of interest because they promote the purchase of pesticides as well as their safe use (Hurst, 1999a; also see Murray, 1994, p. 121). The IUF also expressed concern that training may have, amounted to general talks of 1-2 h to village audiences of farmers and workers, a mode of training less effective than small group, teacher-led training courses (Hurst, 1999a, pp. 17, 27). Moreover, the very high turnover among agricultural workers in Central America is likely to undermine the effectiveness of occasional workplace training sessions.<sup>12</sup> Industry reports that the Safe Use project has responded to these kinds of criticism by moving to more teacher-based instruction, installing master trainers in villages (GIFAP, n.d., p. 5; Hurst, 1999a, p. 15).<sup>13</sup>

(c) *Knowledge versus behavioral change*

The Safe Use program in Guatemala aims to "provide education and training and ensure that pesticides are used rationally and safely in the agricultural production process" (AGREQUIMA & GCPF, 1998). The program employs a training model which assumes that a linear relationship exists between the transfer of knowledge and changes in behavior. The groups targeted for training are instructed in the use of application equipment, protection equipment, collection centers for empty containers, rustic storehouses and the triple washing technique. They are also given information on labeling, color coding for toxicity, the signs and symptoms of intoxication, and first aid.

The Zamorano survey in July 1994 concluded that "an evident increase in knowledge about safe use of pesticides was obtained" and that "a significant change of attitude among trained target groups is palpable" (GIFAP, n.d., p. 4). Unfortunately, these findings of increased knowledge and changed attitude may not necessarily indicate changes in behavior, for at least three reasons. First, recipients of training often temporarily exhibit desired changes in attitude and even behavior because of "Hawthorne effects"<sup>14</sup> introduced by the project. Project participants' knowledge of and enthusiasm for Safe Use may be temporary, and may decline as the training experience recedes in time. Second, project participants

may not be representative of the target population as a whole but instead may be self-selected out of a group interested in receiving training in general or in pesticide issues in particular. Significantly, the Zamorano survey's finding that 84% percent of trained farmers reported reading pesticide labels suggests that the respondents may not have been representative of a population in which 32% do not speak Spanish and nearly 36% cannot read or write (Campos & Finkelman, 1998). Third, the possession of accurate knowledge about pesticides and their safe use may not lead to actual safe practice.

Indeed, if we understand common sensical action as that which responds appropriately to a given situation, common sense may actually lead users to engage in practices which are unhealthy for themselves and for the environment. There are in Central America a vast array of structures which create a context in which unsafe practice may be the sensible, if not the only possible line of action. In a case of mass worker poisoning in Honduras, for example, a group of 15 young workers were poisoned after applying carbofuran with their bare hands, then eating lunch without washing, resulting in pesticide exposure through a combination of dermal absorption and oral ingestion (Murray, 1994). These melon workers were not provided with gloves or other safety equipment, nor was adequate water made available for washing. The simple protective measure of washing hands, therefore, would have required leaving the field, losing the brief rest period provided for lunch (reportedly only 20 min). Taking such measures may have jeopardized their employment.<sup>15</sup>

Pesticide practices are shaped by larger structural influences above and beyond the presence or absence of accurate knowledge of the product. The inappropriate use of pesticides is driven by many complex factors, including credit systems and government policies which promote chemical intensive farming, aggressive marketing by distributors, lack of information on alternative pest control measures, farmers' lack of education adequate to understand the health and environmental effect of pesticides or, in the presence of such information, risk aversion which actually precludes easy adoption of new pesticide practices (Garcia, 1998). In other words, Safe Use campaigns which focus on delivering a clear message with information on pesticide dangers and appropriate use will not necessarily produce changes in actual behavior.

Actual changes in pesticide practice will follow the transfer of information only when users experience safe use as possible within a given organizational context.

This implies that, among other measures (see below), the Safe Use curriculum might better take into account the broader context of pesticide use. Rather than bringing farmers and other interested parties together to receive generic and centrally vouchsafed and homogenized information about pesticides, training might more fruitfully incorporate greater user participation in identifying what current practice's are and why they exist, and what organizational changes could be made to help make Safe Use more practical and accessible.<sup>16</sup>

(d) *Common sense and non-sense: framing the problem*

The Safe Use campaign's faith in the efficacy of knowledge transfer is rooted in the assumption that more rationality is the answer to pesticide problem. Much of the industry's public discussion of pesticides and pesticide use indicates that it places its own perspective squarely in the realm of "common sense" and that of its critics in the realm of "non-sense." A recent speech by the GCPF president, for example, lays out the rationality, indeed, the inevitability of pesticide use given world population increases, impending crises in arable land and clean water availability, as well as declines in supplies of nongrain food, such as fisheries (Hagaman, 1998, p. 1). In an article entitled "Common Sense and Pesticides," two writers for the Latin American Crop Protection Association's house bulletin, *Tierra Fertil*, argued that

those who radically oppose the use of pesticides in agriculture, without offering alternatives of similar efficiency, cost and ease, perhaps ignore the fact that existing alternatives to pesticide use are not necessarily more secure for humans or the environment. A large part of the controversy around the use of pesticides would not exist in the presence of common sense (Re & Felipe, 1998).

These industry commentators not only ignore the externalities which shape pesticide use. Their criteria for "common sense" options—similar efficiency, cost and ease—preclude recognition that environmental health and safety concerns may also be rational criteria for selecting appropriate production technology. This common sense ideology

pervades the Safe Use program. According to the Safe Use proponents, the issue is that farmers and distributors often do not use pesticides properly, creating problems which, because of government and public ignorance of "the facts," result in unreasonable criticisms of the industry and its role in helping ensure food supplies for the future.

(e) *A public relations or a real problem?*

The industry's claim to the only common sense perspective on the pesticide problem raises serious concerns over the design of the Safe Use campaign. The program's potential impact may be compromised by the fact that the pesticide industry's support for Safe Use is motivated by two contradictory definitions of the problem. Is the pesticide problem one of serious health and environmental hazard or fundamentally one of public perception?<sup>17</sup> The GCPF's president stated clearly that the industry has a responsibility to help minimize the dangers its products pose to worker health and environment.

We understand that our responsibility does not end once our products leave the factory door. We are making an important effort to help with the appropriate management of our products, from the moment of discovery of a molecule to the moment the user discards the container (Hagaman, 1998, p. 2).

Yet there is also evidence that at least part of the industry sees the health and environmental issues of pesticide use as mainly a problem of public perception. For example, a recent GIFAP publication asserts that "the risks associated with rational use of these products and practices are exaggerated and misinterpreted by regulators, government offices [sic] and the public in general" (GIFAP, n.d., p. 1). We do not suggest that the pesticide industry choose between promoting safe pesticide use and engaging its critics with public relations campaigns. It is to be expected that the industry pursue both agendas. We believe, however, that the industry should decide whether the pesticide problem is real or merely one of public perception.

Attempting to conduct and evaluate the Safe use campaign on the basis of two contradictory definitions of the problem has led to a confusion in strategy, implementation and evaluation of the initiative. For example, the ambivalence underlying the industry's definition of the

pesticide problem helps explain why it evaluates and reports the Safe Use program's effectiveness in such apparently superficial ways. If the problem is defined as one of perception, the Safe Use campaign's principle objective may legitimately be seen as merely to achieve clear and effective communication about pesticides and their use. Progress toward that objective can be measured by the clarity of the message about pesticides, the variety of methods of communication and the number and type of people "reached." Moreover, if the purpose of the program is to convince potential government regulators and consumers of agricultural products in the North that the pesticide industry is behaving responsibly, then the campaign might be deemed successful even if intoxication rates among users remain constant or rise.<sup>18</sup> If the problem is one of perception, claims of success may be more effective in reaching public relations goals than scientifically verified, but perhaps less dramatic measures of success. On the other hand, if the pesticide problem is defined as real, industry's primary objective should involve actually altering pesticide-related behavior. Progress toward that objective should be measured by rates of new safe use practices, rates of intoxication, etc. Careful and systematic measures and standards of success should be devised and data collected in a transparent fashion by third parties who could lend credibility to industry efforts.

#### 5. STRATEGIC AND POLICY RECOMMENDATIONS: IMPLEMENTING AN INDUSTRIAL HYGIENE APPROACH TO THE PESTICIDE PROBLEM

The Safe Use initiative's message is essentially "use pesticides safely, but by all means use pesticides" (M Murray, 1994), a strategy that may run counter to sound worker and public health policy. The public health aspects of the Safe Use campaign are based primarily on an assessment of the risks of acute intoxication by pesticides. Little is presently known about the long-term chronic health effects of low rates of exposure to pesticides. The problem of longterm hazards such as cancer, birth defects and endocrine disruption, which can occur from chronic low-level exposure to toxic substances, are largely ignored in the developing world. These potential problems may eventually invalidate the basic premises of the safe use

Training and education. This will occur if research demonstrates that exposure to pesticides at levels unavoidable even with safety equipment and training can cause health problems of a nature or scope deemed unacceptable to regulators and/or the public at large. In other words, safe use of many existing pesticides may ultimately be deemed not possible.

Until more is known about the long-term effects of low-level exposure, an effective response to pesticide hazards in the developing world will require a range of measures pursued by a variety of industry, government and popular interests. We suggest this multiplicity of actions and actors can best be understood by employing an Industrial Hygiene matrix commonly pursued in many industrialized countries of Europe and North America. The Industrial Hygiene matrix (Plog, 1996) combines both government regulation and voluntary action by industry. In this approach, intervention in hazardous work is generally implemented in a hierarchical fashion, i.e. beginning with the highest impact level first, and moving down through organized levels of action until reaching the interventions that have the least impact and which depend on the efficacy of steps higher in the hierarchy. The hierarchy begins at the level of Engineering Controls, then moves down as necessary to Administrative Controls (including training) and as a last resort, reliance on Personal Protective Equipment.

##### (a) *Level 1- engineering controls*

Engineering controls represent the first and highest level of impact intervention. How do they relate to pesticide hazards in the developing world?

##### (i) *Eliminate the hazard*

The pesticide industry should move beyond the defense of individual company interests and individual products to recognize that elimination of a small number of the most problematic products is in their long-term interests. In most countries, no more than three or four pesticides account for the majority of the acute poisonings. In Central America, these products usually fall in what the World Health Organization has identified as Category 1 Chemicals, highly to extremely toxic pesticides. Eliminating these pesticides would result in a significant reduction of pesticide hazards. Various studies



of pesticide poisoning in the developing world and studies evaluating use practices, safety equipment, etc. (Cole et al., 1988; Murray, 1994; Fenske, 1993), suggest that Category I pesticides are difficult to use safely. There is historical evidence that when these products have been eliminated, a profound impact on pesticide poisonings has occurred. For example, in Guatemala, the most dramatic drop in reported pesticide-related illnesses (Figure 1) occurred from late 1970s to the mid-1980s. This was the period when cotton production collapsed throughout Central America. Cotton production had been closely related to both rates of pesticide use and poisoning because of the types of pesticides traditionally used in this subsector and the intensive labor involved. Cotton at the time accounted for roughly 80% of all the Category 1 pesticides used, and 80% of illnesses (ACAITI, 1977). As cotton production declined, the volume of Category 1 pesticides used as well as the number of workers exposed were drastically reduced, and the number of pesticide illnesses reported declined dramatically.<sup>19</sup>

Consistent with the logic of the Industrial Hygiene problem-solving hierarchy, we believe the historical evidence suggests that the pesticide industry should support efforts, via voluntary initiatives or through vigorous support of government regulatory action, to remove the most hazardous chemicals from the developing world, which primarily include Category 1 products.<sup>20</sup>

(ii) *Substitute safer products*

The second measure within the first level of the Industrial Hygiene matrix is to substitute safer products for those deemed highly hazardous. There are viable alternatives to the hazardous products used in Central America, albeit at times somewhat more expensive. The pesticide industry should be encouraged to continue and deepen its promotion of IPM, even as critics observe that the industry's version of IPM emphasizes pesticide use more than they would like (Benbrook, 1996; Rosset & Altieri, 1997). Nevertheless, the industry must be more aggressive in pursuing the substitutions necessary to support step one discussed above. The price differentials between the hazardous Category 1 pesticides and their substitutes could be addressed through a variety of methods, including greater emphasis on IPM, and efforts by industry, international donor agencies and Central American govern-

ments to subsidize and otherwise promote the use of these relatively safer technologies.<sup>21</sup>

(b) *Level 2 - implement administrative controls*

Job rotation and other measures to eliminate exposure to hazards are the next level of protection in the Industrial Hygiene strategy. Efforts to control unsafe pesticide use should consider the organizational context of agricultural production. Particularly where there is high turnover in agricultural workers, safe use promotion should target those who organize the application of pesticides. In order to encourage organizational changes which result in reduced pesticide intoxication, different approaches for different crop/pesticide combinations may need to be employed. They should also take into account the level of capitalization of production, a variable which includes the extent to which seasonal waged labor is used. Government and pesticide companies, for example, could explore the possibility of requiring certification of pesticide users before allowing the purchase and use of particularly toxic chemicals.<sup>22</sup> This strategy could be combined with incentive programs to encourage farm operators to implement safe use practices on their farms.

Training and education lie at the bottom of this second level of Administrative Controls in the Industrial Hygiene hierarchy. Here, the Safe Use campaign can be seen as an integral part of solving the pesticide problem. But safe use can be appropriate only after the worst pesticides have been removed and IPM and other effective substitutes have been pursued. Training should then be made as appropriate as possible to specific application contexts. Current training practices appear to involve gathering select groups of farmer and worker users in central locations to listen to lectures, or at best, to participate in teacher-led discussions. More appropriate training might require taking education to the users on their own ground and would be more likely to incorporate a more representative group of pesticide users. Farmer and worker users should also be more closely involved in the preparation and implementation of training for safe pesticide use. For example, carefully selected focus groups including farmer and worker users, as well as middle-level administrative staff, could together identify the types of pesticide risk in their operations, as well as the structural constraints inhibiting the actual implementation of safe use

practices. Training which addresses particular sets of pesticide risks, structural constraints and possible responses could be developed for a finite, but representative number of production situations.

Safe use training and education efforts should be subject to external monitoring. External monitoring will first help ensure that interventions yield concrete improvements in pesticide problems, and second, that the legitimacy and credibility of interventions remain at appropriate levels. NGOs such as trade unions could be enlisted to provide not only external monitoring, but possibly relevant organizational expertise. At the ILO Tripartite Meeting on Voluntary Initiatives in the Chemical Industry, union representatives repeatedly expressed a desire to help design and implement external verification of such voluntary initiatives. The IUF has made such a proposal for the pesticide industry's Safe Use program (Hurst, 1999a).<sup>23</sup> Government agencies should be involved as well, mobilizing their regulatory powers and lending legitimacy to trainers in local communities and on local farms.

*(c) Level 3-personal protective equipment*

Finally, the Industrial Hygiene hierarchy includes personal protective equipment (PPE) as the measure of last resort. Nowhere is this more obvious than in the developing world where PPE is neither readily available nor designed for hot tropical climates.

Furthermore, research has shown that PPE often gives a false sense of safety when in fact pesticide residues are still reaching the user (Fenske, 1993). This step should only be taken after the most hazardous pesticides have been eliminated, IPM and less hazardous categories of chemicals substituted, and other training and educational activities implemented.

## 6. CONCLUSION

Safe Use campaigns are important contributions to the resolution of the pesticide problem, and industry should be given due credit for its efforts. But making inaccurate claims concerning the impact or promise of these efforts only reinforces existing doubts about the industry's commitment to addressing the pesticide problem. A basic problem appears to be a confusion within the industry over the basic definition of the pesticide problem and appropriate respon-

ses. This in turn has led to confusion over the design and implementation of the Safe Use campaign. Is the problem primarily one of perception, as suggested by some industry sources? If so, the Safe Use campaign can arguably be seen as an appropriate activity for the public relations departments of the pesticide companies. Or is the pesticide problem real, so that reports of serious public health problems and environmental degradation should be taken seriously? If the latter is the case, then the Safe Use campaign is first and foremost an effort to reduce pesticide hazards and their impact.

Currently, both views of the pesticide problem appear to influence the campaign, which helps to explain why on the one hand a fairly sophisticated training and education campaign can be developed, while on the other, clearly unscientific conclusions about its impact can be reached. Such confusion not only serves to discredit the campaign but more importantly, it undermines broader capacities to address the pesticide problem. It diffuses concern and diverts attention and resources at a time when more ambitious efforts complementary to the Safe Use campaign, as suggested above, might well allow the campaign to actually achieve the impact some are already claiming.

We believe that the industry must begin by unequivocally conceptualizing the pesticide problem as real. If it sees the problem as more than one of public perception in countries where its principle markets are located, then other measures to improve pesticide practices like the improvement of training and the implementation of the Industrial Hygiene problem-solving hierarchy, along with third party monitoring, are likely to emerge more easily. In addition, we would argue that more scientific research needs to be carried out into the actual field implementation of the Safe Use campaign to determine what kinds of training might be most effective at actually achieving sustained behavioral change. This kind of assessment should be carried out by social scientists and disseminated in scholarly outlets for broader consideration via peer review. Assessments of the pesticide problem and efforts to address it should not be left to the domain of people with public relations or sales responsibilities within the pesticide industry. In developing new pesticide products, the industry invests many millions of dollars annually and gives the task to their best scientists. We would urge the industry to take a similar scientific

approach to developing and evaluating the impact of their Safe Use campaign.

The Safe Use campaign and related industry voluntary initiatives are part of a larger process of globalization in which industry actors are struggling to re-regulate the international spaces across which they operate (Raynolds & Murray, 1998; Tickle & Peck, 1995). Neoliberal economic reform has lowered tariff and regulatory barriers to transnational corporations' capacity to act within any single nation-state's borders. Corporations have moved quickly to devise strategies which allow them to respond to -variations in regulation by implementing diverse standards and policies in the different countries in which they operate. At the same time, workers and communities also struggle to re-regulate their worlds, expanding the issues they give attention to, incorporating national and global phenomena into their vision of local problems, and devising strategies which allow them to meet transnational corporations on more even ground. More effective approaches to safe use will aim to develop new, broader cooperation among the diverse social actors involved in the pesticide industry and its markets.<sup>24</sup>

At the ILO Tripartite Meeting, the chemical industry showed itself not to be monolithic in its response to proposals for change. Considerable support was expressed publicly among some industry participants for more worker involvement and participation in Voluntary

Initiatives. Yet the pesticide industry's willingness to engage the problem as more than public perception or to incorporate external verification and monitoring, cannot be taken for granted. Industry remained unanimous in its resistance to an autonomous role for workers and their representatives in monitoring the training initiatives. They also resisted the development of global performance indicators and standards which would be necessary to institute real change in the context of a global economic system.

It should be apparent that the pesticide problem cannot be solved without the active participation of the pesticide industry. This is a lesson the critics of the industry must recognize. But, as the response to the pesticide industry's Safe Use Initiative suggests, it may be premature once again to claim an easy victory. The industry must recognize that engaging their critics more seriously may be the only way to achieve meaningful changes and resolution of the pesticide problem. This will require a serious re-evaluation of current efforts to downplay the problem and cast it in terms of faulty rationality or erroneous perception, an approach which turns the search for solutions to the pesticide problem into public relations rather than a scientific research and development endeavor. Ironically, if the dominant industry position persists, it may yet be the critics of the pesticide industry who save it from itself.

## NOTES

1. We refer to the array of public health, environmental and economic problems associated with the agrochemical technology as "the pesticide problem" in keeping with a long tradition of scholarly and popular works on this subject. See Carson (1964), Weir and Shapiro (1981), Bull (1982), Dinham (1993) and Murray (1994).

2. Pesticide use is but one part of an industrial agricultural model promoted in the Third World since the end of WW II. Though agriculture includes subsectors in which families engage in intensive, marketoriented production, the industrial model of which pesticides are a key component promotes highly capitalized production requiring continual industrial inputs and extensive mechanization. It encourages monocropping of cash crops for exports, the sizing up of agricultural operations and the concentration of land holdings. This agricultural model, moreover, is deeply embedded in a broader development model pursued by

governments and promoted through international development assistance as well as international financial agencies, which encourages urbanized, industrial development at the expense of rural areas. Critics have pointed to the social inequities and environmental damage entailed in the model, and argue plausibly that it is ultimately unsustainable. Nevertheless, we believe that until more progress can be made in developing and implementing alternative approaches to development, encouraging safer pesticide practices among the millions of producers and workers in the developing world who currently have no other alternative, under the conditions proposed herein, remains a worthwhile endeavor.

3. See Dunlap (1981) for a more detailed account of the debates and campaigns emerging from this era.

4. It is interesting to note Carson's own words, which give a far more temperate view of her argument:

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- It is not my contention that chemical insecticides must never be used. I do contend that we have put poisonous and biologically potent chemicals into the hands of persons largely or wholly ignorant of their potential for harm .....I contend, furthermore, that we have allowed these chemicals to be used with little or no advance investigation of their effect on soil, water, wildlife, and man himself. Future generations are unlikely to condone our lack of prudent concern for the integrity of the natural world that supports all life (Carson, 1964, p. 12).
5. One dimension of the Code of Conduct, that countries receiving pesticides exercise Prior Informed Consent, may become mandatory if enough countries agree endorse the change from voluntary to mandatory compliance.
  6. An independent evaluation of the other two pilot projects is reportedly being considered by the IUF (Hurst, 1999c, personal communication).
  7. We requested the complete report with supporting data, protocols, etc, from the Panamerican School of Agriculture in Zamorano, but were informed they were contractually prohibited from disclosing study information. This was confirmed by industry sources. We subsequently requested this same information from the appropriate industry representatives, but to date have not received either the final report or supporting protocols.
  8. While working in the Guatemalan Highlands in 1998, we were told of instances where industry representatives encouraged small farmers in the Guatemalan highlands to reduce pesticide use based on non-chemical alternatives. We concluded that in some instances the Safe Use trainers were indeed promoting practices other than pesticide-based control measures. How representative these examples are is unknown.
  9. Pesticide poisonings have traditionally been identified as episodes in which an individual demonstrates symptoms consistent with pesticide exposure, as diagnosed by a licensed health care provider.
  10. This is a common condition of countries like Guatemala in transition from authoritarian to democratic regimes (see Karl, 1995).
  11. It is also interesting to note that no significant change in the overall profile in the importation of the most hazardous pesticides has occurred during the period of the Safe Use campaign in Guatemala.
  12. In an earlier study (McConnell, Pacheco Anion, & Murray, 1992), we found that as few as 5% of workers trained in the use of pesticide safety equipment at the beginning of the pesticide application season in Nicaragua were still on the job by the end of the pesticide application season.
  13. It should be noted, nevertheless, that these permanent promoters in the communities could well be seen as part of the traditional pesticide sales network.
  14. The name comes from the experience of researchers attempting to increase worker productivity at the Hawthorne plant of Western Electric in the late 1920s. This study experimented with changes in environmental conditions to achieve increased productivity. The researchers found, however, that productivity increased significantly not only in the test group, but also in the control group. The increase in morale and productivity was not, however, a lasting one as a period of strikes and labor discontent broke out soon after completion of the study (Perrow, 1986, pp. 79-80). One of the lessons of the Hawthorne study, which led to the use of the concept "the Hawthorne Effect," was that the subjects' experience of being studied, including the attention researchers gave them, may be the primary source of modifying their behavior, and it may be only temporary.
  15. See Berman (1978) for an extended discussion of structural realities which underlie workers seemingly irrational pursuit of unsafe practices.
  16. Indeed, the IUF is calling for structured training and education courses that are linked to practical schemes, in order to better ensure that the benefits of training can actually be put into effect by course recipients (Hurst, 1999a, p. 28).
  17. Industry representatives interviewed in Latin America objected strongly to the characterization of Safe Use as a public relations initiative. Yet we believe that the broader context of industry behavior gives credence to the notion that the Safe Use Program is shaped by a view that the industry's real problem is one of public perception based on the analysis presented in this paper. We recognize, however, that the industry is not monolithic; while some within the industry support the Safe Use campaign primarily as a public relations tool, others genuinely promote it with sincerity and commitment to helping alleviate pesticide hazards in the developing world.
  18. Indeed, there is some evidence that other well publicized voluntary initiatives taken by the chemical

industry have been followed by modest increases in public approval ratings within industrialized countries, despite the lack of external verification that the programs actually have a positive impact on safety, health and environment (Hurst, 1999b, p. 5).

19. We recognize the decline could also reflect changes in reporting, but in this period we also have reliable data on the decline of cotton production and pesticide use (Murray, 1994).

20. Obviously governments have the first and foremost responsibility for carrying out regulatory measures. Yet in much of the developing world, and particularly in Guatemala, government regulatory capacity is extremely weak. In this context, industry's assumption of a more aggressive self-regulatory approach combined with more political support for aggressive government action, would seem more consistent with industry's commitment to a "cradle-to-grave" stewardship of the technology.

21. The term "subsidy" has fallen out of fashion with the near hegemony of neoliberal market policies. But, the safety, health and environmental externalities currently not taken into account by pesticide manufacturers and distributors represent a strong subsidy of the industry. Moreover, subsidizing the price of less toxic pesticides and alternative technologies may result in lower public expenditures on pesticide-related health and environmental problems.

22. Such a program is being jointly developed in Belize by PAHO and the Belizian government, with funding from the government of Denmark.

23. The difficulties of setting up trade unions as external monitors was clearly apparent in the Tripartite meeting. Industry demonstrated a deep reluctance to expand worker participation in Voluntary Initiatives to include oversight powers. Moreover, union and industry representatives referred to unions alternatively as insiders with intimate knowledge of the industry's practices and outsiders whose participation could lend additional credibility to Voluntary Initiatives. This raises crucial questions about whether worker monitors could enjoy sufficient autonomy to serve as effective evaluators.

24. Nevertheless, the obstacles to cooperation among the diverse parties involved in the pesticide industry remain great. For example, the GCPF recently organized a meeting at the headquarters of the World Bank to draw up a plan to integrate agro-chemical industry and public sector organization efforts to promote IPM and sustainable farm management. The meeting failed to meet its objectives because public sector participants perceived a conflict of interest in industry between reducing reliance on chemical controls and meeting pesticide sales targets. They also saw a gap between published industry policies and actual practices of companies in the field. These issues of mistrust and conflicts of interest would need to be addressed before IPM-related partnerships could be possible (Lynch, van der Wulp, von Grebner, & Wightman, 1999).

## REFERENCES

- AGREQUIMA & GIFAP (1995). Se reduce el numero de pacientes accidentados en el trabajo por el uso de Plaguicidas. *Uso y Manejo Seguro Noticias March*, 3.
- AGREQUIMA & GCPF (1998). *Resultados del Programa de Uso y Manejo Seguro de Plaguicidas, y Guía Para el Pago de Contribuciones en las Importaciones Terrestres, Aireas o Maritimas de Plaguicidas*. Guatemala City: AGREQUIMA, Global Crop Protection Federation.
- Agrow (1998). *Agrow reports*. Richmond, UK: PJP Publications.
- Barry, T. (1987). *Roots of rebellion: land and hunger in Central America*. Boston: South End Press.
- Benbrook, C., & Edward Groth III *et al.* (1996). *Pest management at the crossroads*. Yonkers, New York: Consumers Union.
- Berman, D. M. (1978). *Death on the job: occupational health and safety struggles in the United States*. New York: Monthly Review Press.
- Blalock, H. M. (1982). *Conceptualization and measurement in the social sciences*. Beverly Hills: Sage Publications.
- Brittin, W. A. (1950). Chemical agents in food. *Food Drug, and Cosmetic Law Journal*, 5(September), 590-597.
- Bull, D. (1982). *A growing problem: pesticides and the Third World poor*. Oxford: Oxfam.
- Campos Marit de & Finkelman, J. (1998). *Situacion Actual del Uso y Manejo de Plaguicidas en Guatemala*. Guatemala City: OPS/OMS.
- Carson, R. (1964). *Silent spring*. Greenwich, CN: Fawcett Publications.
- Chapin, G., & Wasserstrom, R. (1983). Pesticide use and malaria resurgence in Central America and India. *Ecologist*, 13(4), 115-126.
- Colburn, T., Dumanoski, D., & Myers, J. P. (1996). *Our stolen future: are we threatening our fertility intelligence and survival? - a scientific detective story*. New York: Dutton Books.

CLAIM NO EASY VICTORIES

- Cole, D. C., McConnell, R., Murray, D. L., & Pacheco Aonton, F. (1988). Pesticide illness surveillance: the Nicaragua experience. *Bulletin of the Pan American Health Organization*, 22 (2), 119-132.
- Darby, W. J. (1962). Silence, Miss Carson. *Chemical and Keifer*, M. C., & Pacheco, F. (1991). *Engineering News*, 40, 60-63
- Dinham, B. (1991). FAO and pesticides: promotion or proscription? *Ecologist*, 21(2), 61-65.
- Dinham, B. (1993). *The pesticide hazard: a global health and environmental audit*. London: The Pesticide Trust.
- Dunlap, T. R. (1981). *DDT: scientists citizens and public policy*. Princeton, NJ: Princeton University Press.
- Fenske, R. A. (1993). *Fluorescent tracer evaluation of protective clothing performance*. Cincinnati: Risk Reduction Engineering Laboratory, USEPA.
- Garcia, J. E. (1998). *El mito del manejo 'seguro' de los plaguicidas en los países en desarrollo (de la A a la Z)*. Paper presented at the International Conference on Pesticide Use in Developing Countries: Impact on Health and Environment. PPUNA\_SIDA. Heredia, Costa Rica. 23-27 February.
- GIFAP (n.d.). *Proteccion de cultivos: proyectos de use y manejo seguro en America Latina*. Guatemala City: Grupo Internacional de Asociaciones Nacionales de Fabricantes de Productos Agroquimicos.
- GCPF (n.d.). *Integrated pest management: the way forward for the crop protection industry*. Brussels, Belgium: Global Crop Protection Federation.
- GCPF (1998). *Safe Use Pilot Projects: Guatemala, Kenya, Thailand*. GCPF Sponsored Pilot Projects Fostering the Safe and Responsible Use of Crop Protection. Global Crop Protection Federation, Brussels, Belgium.
- Grimaldi, L. (1998). Disminuyen accidentes por use de plaguicidas. *Prensa Libre*, 18-19.
- Hagaman, J. L. (1998). Discurso por el Presidente del GCPF. *Tierra Fertil*. 2.
- Hurst, P. (1999a). *The global pesticide's industry's Safe Use and Handling Training Project in Guatemala*. Geneva: International Labour Organization.
- Hurst, P. (1999b). *Voluntary initiatives affecting training and education on safety health and environment in the chemical industries*. Geneva: International Labour Office.
- Hurts, P. (1999c). European International Union of food Workers, at the Tripartite Meeting on voluntary initiatives affecting training and education on safety, health and environment. ILO, Geneva, Switzerland, 22-26 February, personal communication.
- ICAITI (1977). *An environmental and economic study of the consequences of pesticide use in Central American cotton production*. Instituto Centroamericano de Investigacion y Tecnologia Industrial, Tegucigalpa, Honduras.
- ILO (1999). *Conclusions on voluntary initiatives affecting training and education on safety, health and environment in the chemical industries*. The Tripartite Meeting on Voluntary Initiatives Affecting Training and Education on Safety, Health and Environment in the Chemical Industries, 22-26 February, Geneva: ILO
- Karl, T. L. (1995). The hybrid regimes of Central America. *Journal of Democracy*, 6(3), 72-86.
- Keifer, M.C., & Pacheco, F. (1991). *Reporte de encuesta de subregistro de intoxicaciones con plaguicidas sobre el año 1989, region 2, Leon, Nicaragua*. Managua: CARE International.
- Lynch, S., van der Wulp, H., von Grebner, K., & Wightman, J. (1999). Summary of IPM Roundtable Organized by GCPF in Washington, DC, 19 October (mimeo).
- Marcus, A. (1980). Environmental Protection Agency. In J. Q. Wilson, *The politics of regulation*. New York: Basic Books.
- McConnell, R., Pacheco Anion, F., & Murray, D. L. (1997). Hazards of closed pesticide mixing and loading systems: the paradox of protective technology in the third world. *British Journal of Industrial Medicine*, 49(9), 615-620.
- McDonnell, R., Keifer, M., & Rosestock, L. (1993). Elevated tactile vibration threshold among workers previously poisoned with methamidophos. *American Journal of Industrial Medicine*, 49(9), 615-620.
- Murray, D. L. (1994). *Cultivating crisis: the human cost of pesticides in Latin America*. Austin, TX: University of Texas Press.
- Paarlberg, R. L. (1991). Managing pesticide use in developing countries: the limits of international cooperation. In P. M. Haas, R. O. Keohane, & M. A. Levy, *The effectiveness of international environmental institutions: introduction and analytical framework*. Cambridge, MA: Center for International Affairs, Harvard University.
- Perkins, J. H. (1982). *Insects experts and the insecticide crisis: the quest for new pest management strategies*. New York: Plenum Press.
- Perrow, C. (1986). *Complex organisations: a critical essay*. New York: Random House
- Plog, B. A. (1996). *Fundamentals of industrial hygiene* (4th ed.). Ithaca, NY: National Safety Council.
- Raynolds, L. T., & Murray, D. L. (1998). Yes we have no bananas: re-regulating global and regional trade. *International Journal of Sociology of Agriculture and Food*, 7, 7-44.
- Renan A. A., & Felipe, A. C. (1998). El sentado comuny los plaguicidas. *Tierra Fertil* 2
- Rosenstock, L. et al. (1991). Chronic central nervous system effects of acute organophosphate pesticide intoxication. *Lancet*.
- Rosset, P. M., & Altieri, M. A. (1997). Agroecology versus input substitution: a fundamental contradiction of sustainable development. *Society and Natural Resources*, 10, 283-295.
- Spence, J. et al. (1998). *Promise and reality: implementation of the Guatemalan peace accords*. Cambridge, MA: Hemisphere Initiatives.
- Tickle, A., & Peck, J. A. (1995). Social regulation after Fordism: regulation theory, neo-liberalism and the global-local news. *Economy and Society*, 24(3), 357-386.

## WORLD DEVELOPMENT

- Tobin, R. J. (1996). Pesticides the environment and US foreign policy. *International Environmental Affairs*, 8(3), 244-266.
- Weir, D., & Shapiro, M. (1981). *Circle of poison: pesticides and people in a hungry world*. San Francisco: Institute for Food and Development Policy.
- WHO (1990). *The public health impact of pesticides use in agriculture*. Geneva: World Health Organization.
- Wolff, M. S., et al. (1993). Blood levels of organochlorine residues and risk of breast cancer. *Journal of the National Cancer Institute*, 85 (8), 648-652.