

expensive. At many firms they will not be approved, even if they reduce harmful emissions or reduce costs, unless they bring a return on capital invested equal to or greater than alternative investments.

- *Product analysis.* Products can be examined to reduce adverse environmental impacts. Eastman Kodak makes a life-cycle assessment. It looks at factors such as raw materials used, energy consumed, fugitive emissions, and potential for recycling. SC Johnson uses a "greenlist" to rate ingredients for household products. Its chemists have many raw material choices for the surfactants, solvents, propellants, fragrances, and other ingredients that go into brands such as Raid, Off!, Drano, Saran Wrap, and Windex. Before choosing one, they look at a scorecard ranking substances from 0 to 3 based on estimates of toxicity. A 0 means "restricted use" and requires higher management approval, 1 is "acceptable," 2 is "better," and 3 is "best." Chemists try to achieve higher scores as they formulate products. In 2001 the company had an average score of 1.23 and set a goal of raising its score to 2.0. By 2008 it had achieved a score of 1.62.⁵⁵
- *Environmental marketing.* The presence of environmental risks creates markets. Sale of pollution control equipment is an old example. Innovative companies create new demand. Swiss Re, a colossus of the insurance industry, saw global warming as an opportunity. It now sells weather derivative contracts that work like put or call options, allowing buyers such as agricultural corporations to hedge against crop losses from warmer weather. It also sells catastrophe bonds that insure against disasters such as a giant U.S. hurricane or a major European windstorm. These bonds pay investors high interest rates, but if the catastrophe happens, they lose some or all of their principal.⁵⁶ Other companies find opportunities in their current business models. Walmart's mission is "saving people money so they can live better." It set a goal of selling 100 million compact fluorescent bulbs every year and achieved this by 2007. It estimates this saves customers \$3 billion in annual electricity costs and it expects to get some of these savings back in customer purchases—in effect, stealing revenue from utility corporations.
- *Environmental metrics.* In the past, few companies had environmental goals. Activities that posed risks were largely unmeasured. That is changing. In 2003 a group of investors combined with the United Nations to measure CO₂e emissions in the largest 500 global corporations. Then a little more than 40 percent reported emissions; by 2009 the percentage had doubled to 82 percent. Today, companies measure environmental performance toward environmental goals. Office Depot uses a "dashboard" that matches objectives with key performance indicators. One of its objectives is to "increasingly be green" and a corresponding indicator is "CO₂ emissions from store deliveries." Since measurement started, these emissions have fallen from 91,300 tons in 2006 to 53,200 tons in 2009.⁵⁷

⁵⁵ SC Johnson & Sons, 2009 Public Report: *Doing Our Part* (Racine, WI: SC Johnson, 2009), p. 23.

⁵⁶ Bernard Belk and Roman Hohl, "Agribusiness Corporates Can Insure against Volatility in Grain Volumes," *Trade Finance*, February 2009, p. 6; and Ian McGugan, "Insuring Catastrophe," *Financial Post*, December 5, 2009, p. FP11.

⁵⁷ "2009 Office Depot Environmental Dashboard & Key Indicators," at www.officedepotcitizenship.com/environmental_dashboard.php.

Dow Chemical issues quarterly updates of its performance on a set of environmental goals it intends to achieve by 2015. One goal is to cut the transportation of hazardous chemicals by 50 percent. By 2009 the number of ton-miles (one ton of freight moved one mile) dropped from 1,400 million to 851 million since 2005 when measurement began. Walmart has asked its 100,000 suppliers to calculate the full environmental costs of each product it sells. It plans to tag store items with a simple sustainability index.

CONCLUDING OBSERVATIONS

In the previous chapter we described how industrial activity harms the environment and explained major regulatory programs to mitigate the damage. In this chapter we looked more deeply into the methods underlying this regulation. We began with a story about railyard diesel exhaust to illustrate one molecular-level danger to human health in modern industrial society. Then we explained how such a danger is evaluated and how a regulatory approach is then chosen to mitigate it. We also give some illustrations of how companies are greening their operations.

The discussion emphasizes the strengths and weaknesses of both science-based risk assessment and a range of regulatory approaches. Command regulation is the most powerful, effective tool in the regulatory arsenal. Market approaches are more flexible and less expensive but have permitted companies to pay and continue polluting. Voluntary regulation is inexpensive, but often accomplishes little. Finally, voluntary corporate action can bring slow and modest, but widespread change. As thousands of companies around the world set out to measure their environmental impact and reduce it, their actions may be sufficient to slow the growth of pollution, if only in a small way.

In sum, much progress has been made in protecting both ecosystems and human health. Notwithstanding, the sum of human action is so far inadequate to avert rising global damage. The consequences of this failure will fill future chapters.

Harvesting Risk

This is the story of a scavenger. Ascending on shrewdness, Amvac Chemical Corporation has expanded from a small Los Angeles pesticide company into a multinational corporation with revenues of more than \$200 million.¹ It keeps expanding. In the last several years it has added five new product lines, two foreign sales offices, and two factories.

¹ Amvac operates as a wholly owned subsidiary of a holding company named American Vanguard Corporation and is the company's main business.

Amvac's growth is based on a singular strategic vision. It stands apart from agrichemical industry giants as they create and market new pesticides. It waits while the big companies build brand names and markets for these molecules. Then, when a product has aged or become less attractive to the original owners, Amvac offers to buy it. Once Amvac has the brand rights, it pushes sales in remaining niche markets or, sometimes, opens new markets by registering additional crop applications or exporting to foreign customers. In this way, as the global behemoths shed shrinking, failing, dangerous, or obsolete products,

the opportunistic scavenger captures fresh streams of revenue.

Amvac's goal is to acquire one or two niche product lines every year and in recent years it has done so. Big agricultural chemical companies discard pesticides for many reasons. As they integrate businesses after mergers, they may decide to drop redundant brands. When Novartis and AstraZeneca merged their agribusinesses in 2000, Amvac got two vegetable crop insecticides and a herbicide used in cranberry fields. Sometimes big companies cast aside products when sales are inadequate. In the 1990s DuPont created a soil insecticide named Fortress that effectively controls corn rootworms, the most destructive cornfield pests. But sales missed targets. So Amvac bought Fortress in 2000 and with it entry into the Midwest corn market. It built a new sales team and within a year Fortress sales that would have disappointed DuPont were adding materially to Amvac's revenues.

In some cases products have matured or become outdated. Larger firms at the forefront of advancing biotechnology are shifting their focus from chemical poisons to genetic lines of insect-resistant seeds. As they do, Amvac has acquired older pesticides, including some organophosphates belonging to a family of pesticides that is on the way out in the industry.

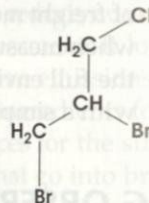
Organophosphate molecules are effective pest killers and still widely used, but they are being superseded by both biotechnology products and by pesticides that better target pests and pose less risk. Some organophosphates are exceptionally dangerous to human health in terms of both acute and long-term exposures. A few are so toxic that they defy safe use, leading to personal injury lawsuits and regulatory crackdowns. Even in these instances Amvac sees opportunity. Faithful to the logic of its niche strategy, it has acquired rights to some of the most poisonous brands even as bigger companies cease their production. Then, it has sought new markets for them while defending them against alarmed regulators. Here are several stories about Amvac pesticides.

DIBROMOCHLOROPROPANE

Dibromochloropropane, or DBCP, is a chemical soil fumigant that kills parasitic worms feeding on fruit and vegetable crops (see Exhibit 1). It belongs to an aging class of organochlorine pesticides developed after World War II. Most of these molecules, which

EXHIBIT 1 Dibromochloropropane

Source: National Institutes of Health, <http://ntp.niehs.nih.gov/ntp/htdocs/structures/2d/TR028.gif>.



Chemical Formula: $C_3H_5Br_2Cl$

include DDT, are used now only in a few poor countries. They are stable molecules that linger in the environment and accumulate in human tissue. Beginning in the 1960s, DBCP was used in the United States and around the world on cotton, potato, banana, and pineapple crops. Dow and Shell manufactured it until 1977, when it was discovered to cause sterility in men at formulating plants.²

Regulators immediately banned DBCP in California. On the day of the ban, Dow and Shell suspended its production and marketing. Although the story of worker infertility got extensive media coverage, many farmers still wanted to use DBCP. So Amvac stepped in to fill the void and became its leading maker. Due to bad publicity, domestic sales had fallen, so Amvac supplied foreign markets. It replaced Dow and Shell as a supplier for Dole Fruit and other companies using DBCP on large banana plantations in Central America and the Caribbean.

By 1979 the EPA had gathered extensive data on DBCP and concluded it had no safe uses. The agency proposed a ban. Amvac disputed the evidence and finally persuaded regulators to allow an exception for Hawaiian pineapple crops. It agreed to promote safe application and to monitor local groundwater for contamination. In 1983 Amvac applied for a temporary exemption from the regulatory ban in South Carolina so that DBCP could be used in peach orchards. The EPA agreed, basing its decision on university research sponsored by Amvac. Outraged environmentalists stopped the exemption with a lawsuit.³ Two years

² Helen Dewar, "Workers at Pesticide Plant Found Sterile in California Tests," *The Washington Post*, August 5, 1977, p. A3.

³ Ward Sinclair, "The Return of DBCP," *The Washington Post*, February 1, 1983, p. A1.

later, Hawaiian wells for drinking water were found contaminated by runoff from pineapple fields and the EPA finally banned all applications of DBCP anywhere in the United States.

By this time evidence of DBCP's dangers was strong and before the end of the decade a substantial body of research backed up the agency's decision. DBCP causes sterility in both animals and humans. Studies showed that men who inhaled small concentrations produced fewer sperm and were more likely to father girls. With longer exposures their testicles atrophied and sperm production fell to zero.

DBCP is so dangerous that current regulations set safe inhalation exposure for workers at one part per billion over an eight-hour day. DBCP also causes cancer in rats and is classified as "reasonably anticipated" to be a human carcinogen. Like other molecules in the organochlorine family, it persists in the environment. After application it slowly evaporates from soil or surface water into the air, where it resides for up to three months before breaking down. In soil, it can linger for several years.⁴

DBCP bore a crop of lawsuits for Amvac. Villagers who drank contaminated water in Hawaii sued Amvac, along with Dow, Shell, and Dole Food Company, after researchers found unusual clusters of breast cancer, heart defects, learning disabilities, and infertility among them.⁵ Amvac settled its part of the case for \$500,000 in 1999. With the others, it was also named in multiple actions by Nicaraguan plantation workers charging that the companies continued to sell DBCP in developing nations after it was banned in the United States despite knowing it caused sterility, testicular atrophy, and other injuries.

These workers opened a broad legal war against Amvac and the others but it has fizzled. The last of the banana workers cases were dismissed in 2010 after the discovery that attorneys had engaged in widespread fraud, recruiting plaintiffs by sending

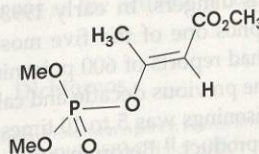
men to labs that faked sperm tests to show sterility.⁶ Another case, by banana and pineapple workers in the Ivory Coast, alleged the companies used DBCP for genocide and crimes against humanity. However, because the workers could not prove the companies intended to commit genocide they lost the decision.⁷

MEVINPHOS

Mevinphos (see Exhibit 2) is an insecticide developed by Shell in 1954.⁸ It protects fruit and vegetable crops against aphids, leaf miners, mites, grasshoppers, cutworms, and caterpillars. It belongs to the organophosphate family of pesticides, which disrupt transmission of nerve impulses by blocking the action of critical enzymes. Organophosphates are unstable and break down rapidly in the environment so growers can use them to combat infestations that come just before harvest. Their drawback is an extreme and broad toxicity. They poison any living organism with a nervous system, including humans, fish, and animals. Consequently, large agrichemical companies are moving away from organophosphates to newer molecules that not only are less toxic but also more narrowly target pests.

EXHIBIT 2 Mevinphos

Source: Environmental Protection Agency, Report on Tolerance Reassessment Progress and Risk Management Decision, EPA 738-R-00-014, September 2000, p. 4.



Chemical Formula: $C_7H_{13}O_6P$

⁶ Steve Stecklow, "Fraud by Trial Lawyers Taints Wave of Pesticide Lawsuits," *The Wall Street Journal*, August 19, 2009, p. A1.

⁷ *Abagninin v. Amvac*, 545 F.3d 733 (2008).

⁸ Mevinphos is technically an alpha or beta isomer of 2-carbomethoxy-1-methylvinyl dimethyl phosphate. Exhibit 2 shows alpha-Mevinphos. It has been sold under the trade name Phosdrin in at least four formulations. See Department of Pesticide Regulation, *Mevinphos: Risk Characterization Document* (Sacramento: California Environmental Protection Agency, June 30, 1994), p. 5.

⁴ U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, *Toxicological Profile for 1,2-Dibromo-3-chloropropane* (Washington, DC: Public Health Service, September 1992); and Environmental Protection Agency, "1,2-Dibromo-3-chloropropane (DBCP) (CASRN 96-12-8), Integrated Risk Information System, at www.epa.gov/iris/, last revised October 28, 2003.

⁵ Malia Zimmerman, "Water Quality Lawsuits Target Chemical and Agricultural Giants," *Pacific Business News*, October 8, 1999, p. 4.

After their introduction in the 1950s, organophosphates such as mevinphos were second choice pesticides. Growers preferred to use organochlorines until concerns about the inability of nature to break them down turned the market toward the shorter-lived organophosphates. By the late 1970s mevinphos was being sold in large quantities. DuPont held the rights to it. Amvac manufactured some mevinphos at its Los Angeles factory under contract for DuPont.

As mevinphos was used more widely, concerns about its safety grew. Multiple reports of farmworkers sickened by contact with it alarmed regulators. In 1978 the EPA restricted its use, so that only certified applicators could spray it on fields.

In 1988 the leader of the United Farm Workers, César Chávez, held a 36-day hunger strike to protest the use of organophosphate pesticides, including mevinphos, on grapes. He believed their use recklessly endangered the health of field hands. In fact, subsequent research confirms multiple effects in exposed farmworkers. For example, after prolonged exposure they show deficits in coordination, information processing, and other neurologic symptoms.⁹ Children of Latina women in agricultural communities show impaired behavioral development.¹⁰

A few months after Chávez's hunger strike, DuPont ended mevinphos production. Amvac, however, was willing to embrace it. DuPont sold its exclusive rights to Amvac, which continued to sell mevinphos even as the EPA was gathering further evidence of its dangers. In early 1993 the agency called mevinphos one of the five most dangerous pesticides. It had reports of 600 poisonings and five deaths over the previous decade and calculated that the rate of poisonings was 5 to 10 times higher than for any other product.¹¹ Before banning mevinphos,



César Chávez, president of the United Farm Workers, receives a small piece of bread from Ethel Kennedy, widow of former Attorney General Robert Kennedy. Her symbolic action ended a 36-day hunger strike in 1988 undertaken to protest the exposure of grape pickers to mevinphos and other pesticides.

Source: © Bettmann/CORBIS.

however, it allowed Amvac to suggest risk-reduction measures that might allay its concerns.¹²

Meanwhile, Amvac saw a new market opportunity. Large agrichemical companies had taken several other organophosphate insecticides off the market to placate the EPA. Apple growers in Washington were concerned that they would be unable to fight off ruinous late-season aphid infestations. Amvac believed that mevinphos could be safely used, even though regulators in Washington allowed pesticides to be mixed in open vats before spraying. Other states, for example California, required closed-vat mixing. Amvac negotiated with Washington's regulators, promising to train workers in the use of respirators and safe application.

That summer there were immediate reports of mevinphos poisonings in Washington orchards. In all, there were 26 documented cases. No one died, but seven workers were hospitalized. Martin Martinez, who later sued Amvac, was told to mix a concentrate of mevinphos with water, load a sprayer, and apply it. "My vision started to get blurry," he said. "I started to get nauseous. I began to vomit."¹³ These are classic symptoms of organophosphate poisoning. He was hospitalized for seven days.

⁹ Joan Rothlein et al., "Organophosphate Pesticide Exposure and Neurobehavioral Performance in Agricultural and Nonagricultural Hispanic Workers," *Environmental Health Perspectives*, May 2006.

¹⁰ Brenda Eskenazi et al., "Organophosphate Pesticide Exposure and Neurodevelopment in Young Mexican-American Children," *Environmental Health Perspectives*, May 2007.

¹¹ David Holmstrom, "Control of Farm Chemicals Needs Overhaul," *Christian Science Monitor*, October 6, 1994, p. 7; and *Andrews Litigation Reporter*, "Settlement Reached between Farm Workers and Pesticide Maker," May 31, 2002, p. 1.

¹² Environmental Protection Agency, *R. E. D. Facts: Mevinphos*, EPA-738-F-94-020, September 1994, p. 2.

¹³ Arthur C. Gorlick, "Orchard Workers File Lawsuit," *Seattle Post-Intelligencer*, September 13, 1995, p. B4.

Martinez and others had been trained. They were supposed to wear respirators, face shields, and chemical-resistant clothing. However, mevinphos is so toxic that even a slight mistake is very dangerous. Some poisonings took place in hot weather, when applicators shed articles of clothing. Absorption through skin is rapid. Ten drops of concentrate spilled on flesh is a lethal exposure for a 150-pound person. Inhalation is also dangerous. A 150-pound person who failed to adjust a respirator properly would begin to show effects such as dilation of the pupils after breathing little more than one ten-thousandth of an ounce.¹⁴

Once inside the body, mevinphos interferes with the regulation of nerve impulses, disrupting the central nervous system and major organs. One of the earliest symptoms of exposure is compromised reasoning ability, which compounds the danger because a worker loses the ability to appreciate an urgent peril. High exposure eventually leads to irregular heart beat, convulsions, unconsciousness, and death. Breathing air with only 10 parts per million of mevinphos over one hour killed 50 percent of rats in one study.¹⁵

Three orchard workers, including Martinez, sued Amvac alleging that mevinphos was a defectively designed product. It was so unsafe, they argued, that it should never have been marketed for orchard use. At one point, the case went to the Supreme Court of Washington, which handed down a ruling on a point of product liability law. It noted that a pesticide, by its nature, was a dangerous product. Its costs to society could be eliminated only by sacrificing the lethal qualities that made it effective. The question was, when was a pesticide too dangerous, too lethal?

The court ruled that a pesticide could be sold as an unavoidably unsafe product if its advantages greatly outweighed the risks posed by its use.¹⁶ It would be up to a lower court to decide if mevinphos passed this test. However, Amvac ended the lawsuit by settling with the orchard workers for approximately \$750,000. According to one of their lawyers, Amvac "was

willing to sacrifice farmworker's lives and safety for profits. It had to be held accountable."¹⁷

Meanwhile, Amvac defended mevinphos before the EPA but was unable to convince the regulators it could be safely used. All pesticides must have EPA registration for legal use. With the agency prepared to cancel registration of mevinphos, Amvac voluntarily requested its withdrawal.

The EPA now classifies mevinphos as hazardous waste and bans any agricultural use in the United States. Nevertheless, Amvac continued to sell it in Mexico, South Africa, and Australia.¹⁸

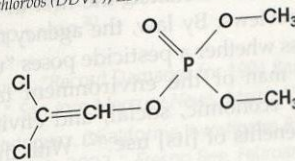
DICHLORVOS

Dichlorvos, or DDVP (see Exhibit 3), is another aging member of the organophosphate family abandoned by the big agrichemical firms but still sold by Amvac. It was synthesized in the late 1940s and first marketed by Shell in 1961. It targets a broad range of insect pests including flies, fleas, ticks, mites, cockroaches, chiggers, caterpillars, moths, and weevils. Like other members of the organophosphate family, it disrupts transmission of nervous impulses.

At first DDVP had many agricultural applications. It was used in silos, hoppers, and tobacco warehouses to protect stored crops. In feedlots it was sprayed over animals to control fleas and ticks. Farmers mixed it in feed to deworm horses and pigs. Canning and packing facilities applied it to control insects. It was sprayed over wide areas for mosquito control and used as the active ingredient in popular

EXHIBIT 3 Dichlorvos

Source: Environmental Protection Agency, *Interim Reregistration Eligibility Decision for Dichlorvos (DDVP)*, EPA 738-R-06-013, June 2006, p. 11.



Chemical Formula: $C_4H_7Cl_2O_4P$

¹⁴ Based on a "no observable effect level" in humans of 0.025 mg/kg, see Department of Pesticide Regulation, *Mevinphos: Risk Characterization Document*, p. 1.

¹⁵ *Ibid.*, p. 1.

¹⁶ *Guzman v. Amvac Chemical Corporation*, 141 Wn.2d 493, at 509-10.

¹⁷ Co-lead counsel Richard Eymann, quoted in "Precedent-Setting Farm Worker Pesticide Poisoning Suit Settles," *Public Justice*, Summer 2002, p. 11.

¹⁸ T. Christian Miller, "Pesticide Maker Sees Profit When Others See Risk," *Los Angeles Times*, April 8, 2007, p. A1.

household insecticides. Resin strips impregnated with DDVP were placed in homes, public buildings, buses, aircraft, and ships to control pests such as cockroaches.

By the late 1970s many companies manufactured it, including Amvac. Total annual output in the United States rose as high as 4.2 million pounds.¹⁹ Then, scientific studies raised doubts about its safety and by the early 1980s annual use fell below 1 million pounds.

Like all organophosphate pesticides, dichlorvos poisons the nervous system. Acute exposure causes perspiration, nausea, vomiting, diarrhea, headache, and fatigue. Long-term, low exposures can also bring on these symptoms. Very high exposures cause convulsions and loss of consciousness. However, compared with similar pesticides, dichlorvos does not pose exceptional risks from contact during application. The main concern has been that it may cause cancer in humans.

Studies show it is an animal carcinogen. Rats and mice that inhale or ingest high doses of dichlorvos produce thyroid, adrenal, pituitary, and stomach tumors. Epidemiological studies suggest that dichlorvos can also cause cancer in humans. One showed a significantly elevated risk of leukemia among farmers in Iowa and Minnesota who used dichlorvos, even when they had used it as long as 20 years in the past. Another showed an elevated rate of non-Hodgkin lymphoma among Nebraska women who had used dichlorvos. Still a third found a "significantly increased risk" for brain cancer among children in homes using Amvac's No-Pest Strips.²⁰ The statistical power of these and similar studies is weak because they are based on small numbers of people with likely exposures to multiple pesticides. Nevertheless, they have ominous implications.

In 1980 the EPA initiated the first in a series of dichlorvos reviews. By law, the agency must regularly reassess whether a pesticide poses "unreasonable risk to man or the environment taking into account the economic, social, and environmental costs and benefits of [its] use."²¹ With this criteria,

even very dangerous pesticides can stay on the market if their risks are controlled and outweighed by their utility.

After the first review in 1980, the EPA classified dichlorvos as a "suspected" human carcinogen that acted by mutating genetic material in cells. A second review seven years later led to its classification as a "probable" human carcinogen. This bad news caused the market for it to shrink even more. One by one, agrichemical firms stopped selling it until only Amvac was left. The company was determined to keep it on the market.

Amvac has a large budget for supporting the registration of its older pesticides in the face of doubts by increasingly skeptical regulators. In 1995 the EPA sought to cancel most uses of dichlorvos. Amvac responded by submitting supportive data, but the agency found it unpersuasive. So Amvac agreed to cancel almost two dozen applications, including aerial spraying and all uses in restaurants and food processing plants.²²

Meanwhile, Congress in 1996 required the EPA to review pesticides under a new, tougher standard that required a "reasonable certainty of no harm."²³ The agency finally finished its dichlorvos review in 2006. It allowed continued marketing, but further restricted its uses. Amvac agreed to cancel registration for more applications, including all home uses except impregnated resin strips. In 2010 it agreed to cancel five additional fogging and spray applications.²⁴

Dichlorvos can no longer be applied on lawns and turf, in cracks and crevices, and with handheld foggers. In addition, dichlorvos-impregnated pest strips in homes are limited in size. Larger strips containing more than 16 grams can be used only in garages, sheds, and crawl spaces occupied less than four hours a day. They can be used in vacation homes and cabins only if the dwellings are vacated for four months after use. Smaller strips and flea and tick collars for cats and dogs that contain less than 16 grams of dichlorvos are still in use. According to the EPA, the air concentration of dichlorvos in a room where a

¹⁹ Renu Gandhi and Suzanne M. Snedeker, "Critical Evaluation of Dichlorvos' Breast Cancer Risk," *Program on Breast Cancer and Environmental Risk Factors in New York State*, Critical Evaluation #7, March 1999, p. 1.

²⁰ *Ibid.*, p. 3.

²¹ Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (as amended), 7 U.S.C. §136(bb)(1).

²² Environmental Protection Agency, "Dichlorvos (DDV); Deletion of Certain Uses and Directions," 60 FR 19480-19581, April 19, 1995.

²³ This was the Food Quality Protection Act of 1996.

²⁴ Environmental Protection Agency, "Product Cancellation Order for Certain Pesticide Registrations," 75 FR 26227, May 11, 2010.

dog or cat is wearing one of these collars averages less than one-fortieth of the exposure level at which poisoning symptoms are detectable.²⁵ Recently, Amvac has targeted customers trying to control bedbugs with ads for hanging dichlorvos-impregnated strips that release vapors into a room.

Exposure of the U.S. population to dichlorvos is estimated as infinitesimal, 0.000007 milligrams per kilogram of body weight each day.²⁶ Even so, regulators believed that dichlorvos residues in food posed a cancer risk to the general population and that there were unacceptable risks to the nervous systems of those who mixed, handled, and applied it. The greatest danger is from skin contact. Based on animal studies, estimates are that short-term absorption of as little as 0.25 ounce of dichlorvos through the skin would cause death in 50 percent of applicators weighing 150 pounds.²⁷ This makes dichlorvos one of the most toxic pesticides in use.

Inhalation toxicity is lower, but still greater than most other pesticides. Current EPA estimates are that inhaling 198 parts per million over an eight-hour period would be fatal to 50 percent of exposed adults. Overall, the EPA believed that these risks outweighed the benefits for all but a few remaining applications.

Meanwhile, other countries have banned dichlorvos. In 2002, the United Kingdom rejected evidence submitted by Amvac and suspended all uses. Angola, Fiji, Denmark, and Sweden have also banned it. Amvac continued exporting dichlorvos to Australia, Canada, and Mexico.

COSTS AND BENEFITS OF PESTICIDES

Poisonous agrichemicals have high social and environmental costs. Their use on crops and in homes causes tens of thousands of acute exposure injuries each year. Long-term exposure from residues in

foods, drinking water, and soil causes an unknown number of chronic illnesses including cancer, birth defects, liver poisoning, and neurological deficits. Many pesticides, especially the older organochlorines and organophosphates, do not discriminate between pests and other forms of life. They kill wildlife and pets along with target insects. An accurate calculation of monetary losses from such problems is infeasible.

Accidents increase the cost burden. Years ago a Southern Pacific freight train derailed on a steep curve above the Sacramento River north of Mt. Shasta in California. One tank car carried 13,000 gallons of metam sodium, a herbicide manufactured by Amvac. The resulting spill virtually sterilized a long stretch of the river, annihilating life right down to the moss on the rocks. It killed 200,000 fish and wiped out a celebrated trout-fishing area.²⁸ Lawsuits claimed that Amvac failed to identify properly and label its shipment, and it agreed to pay \$2 million, although it bore no responsibility for the train's derailment.

A later mishap with metam sodium is more typical of accidental exposures. In Arvin, California, 72 workers processing carrots and 178 town residents were sickened when metam sodium manufactured by Amvac drifted from fields where it was being sprayed.²⁹ The applicator paid a \$60,000 fine.

If the costs of pesticide use are great, so are the benefits. The major benefit is availability of a bountiful, affordable food supply. Pesticides control fungal infections, insects, and weeds that would otherwise decimate U.S. crop yields. Without control measures, 50 to 90 percent of fruit and vegetable crops would rot from fungal infections before harvest. To protect them, growers use about 100 million pounds of fungicides annually. Doing so saves an estimated \$13 billion in crop value.³⁰

²⁸ Scott Thurm, "Record Damages for 1991 Rail Spill Settlement," *San Jose Mercury News*, March 15, 1994, p. A1.

²⁹ Robert Rodriguez, "California Investigates Rise in Pesticide-Caused Illnesses in 2002," *Fresno Bee*, February 27, 2004, p. 1; and Miller, "Pesticide Maker Sees Profit When Others See Risk," p. A25.

³⁰ Statement of Jay Vroom, in *Review of the EPA Pesticide Program*, Hearings before the Subcommittee on Conservation, Credit, Rural Development, and Research of the Committee on Agriculture, U.S. House of Representatives, 109th Congress, 2nd Session, September 28, 2006, p. 50.

²⁵ *Ibid.*, p. 165. This figure is based on a margin of exposure of 39 for infants, who are presumed more sensitive to dichlorvos vapor than adults. Margin of exposure is the ratio of the dose at a "no observable adverse exposure level" to an observed or estimated dose.

²⁶ Environmental Protection Agency, *Interim Reregistration Eligibility Decision for Dichlorvos (DDVP)*, EPA 738-R-06-013, June 2006, app. J, p. 151. There are 31,000 milligrams in one ounce.

²⁷ *Ibid.*, table 4.1a, Guideline No. 870.1200, p. 123.

Pesticides kill mosquitoes, ticks, rats, and other vectors that carry illnesses such as the plague, Lyme disease, and encephalitis. They make human habitations more comfortable by controlling cockroaches, mold, mildew, termites, ants, and spiders.

Herbicides reduce soil erosion, save water, and reduce fuel and labor costs for growers. Their use facilitates increasingly popular no-till agriculture in which farmers poison weeds rather than plowing them under. With less plowing there is less erosion, which means lower water treatment costs, less flood damage, and larger reservoir capacity.

Herbicides also kill unwanted growth that competes with crops for water. Without them, crop protection would require as many as 1.1 million hours of hand weeding in peak growing season. The labor force to employ at this job does not exist. Organic farmers, who cannot use herbicides, spend \$1,000 per acre weeding their crops compared with only \$50 for growers using chemical weed controls. One study estimated the overall benefits of herbicides at \$26 billion in 2005.³¹

Finally, pesticides preserve wildlife habitats and protect endangered species. Without their use vastly expanded acreage would be required to grow necessary food crops. More land would be converted from its native state to farms, ranches, plantations, and orchards.

So pesticides clearly have both great costs and great benefits. There are other methods for controlling agricultural pests, but they complement pesticides rather than replace them. Cultivation techniques such as tilling and crop rotation make environmental conditions less favorable for destructive organisms. Biological control methods include release of insect predators such as wasps, lacewings, or lady bugs and the spread of friendly bacteria that compete with damaging strains. In the 1990s, big companies launched bioengineered seeds and their use has soared. Some crops are bred to have insect-resistant traits. Others are genetically manipulated to survive specific herbicides, giving farmers more alternatives for fighting weeds that over time become resistant to popular chemicals.

The rise of biological alternatives has not ended long-term growth in pesticide sales, which have

risen an average of 11 percent a year since 1995 and reached a high of \$10 billion in 2007.³² For the time being, pesticides are still needed to protect the food supply and quality of life to which Americans are accustomed. In the words of an agricultural researcher:

[S]ome people want a total ban on pesticides, but they must be ready to accept termites in their houses, fleas in their carpets, moldy vegetables, food-borne toxins, food shortages with soaring prices, and outbreaks of long-forgotten diseases.³³

AMVAC MOVES AHEAD

Amvac now has more than 40 pesticide brands. It manufactures them at four plants in California, Idaho, Missouri, and Alabama and sells them in the United States and through foreign sales offices in Costa Rica, Mexico, Brazil, Switzerland, and the United Kingdom.

Amvac emphasizes profitability. Three directors—its two founding entrepreneurs and the son of one founder, now president and CEO—own 22 percent of its stock. Compensation of its president and CEO, which was \$806,303 in 2009, is based on four factors: “achieving financial results that equal or exceed” targets, introducing new compounds, controlling manufacturing costs, and defining “a clear vision and strategy.”³⁴ The ongoing shift to biological pest controls sustains its strategy. As industry giants continue to discard older pesticides, they create opportunities for Amvac.

Amvac adopted a seven-page Code of Conduct and Ethics in 2006. It states: “[O]ur efforts are focused on achieving the business and personal ethical standards as well as compliance with the laws and regulations that are applicable to our business.” It intends its code to “ensure decisions that reflect care for all of

³² Bureau of the Census, *Statistical Abstract of the United States: 2010*, 129th ed., table 813.

³³ Keith S. Delaplane, “Pesticide Usage in the United States: History, Benefits, Risks, and Trends,” Cooperative Extension Service, University of Georgia College of Agricultural and Environmental Sciences, *Bulletin* 1121, November 2000, p. 1.

³⁴ American Vanguard Corporation, *Notice of Annual Meeting and Proxy Statement*, April 27, 2010, pp. 18 and 21.

³¹ *Ibid.*, p. 50.

our stakeholders."³⁵ The only mention of the environment is this brief section.

The Company is committed to doing all that it can to assist in minimizing the degradation of our natural environment. Accordingly, employees should always take care in disposing of any waste materials or releasing any discharges into the air or water and comply with all applicable regulations and procedures required by law and by Company Code. If an employee is unclear about what is required, he/she must not dispose of any material or release any discharges until he/she has determined what procedures apply.³⁶

A recessionary climate beginning in 2008 weakened Amvac. Sales dropped as farmers had difficulty getting credit and distributors cut their inventories. But by cutting costs, reducing long-term debt, and cutting its dividend, the company maintained a strong balance sheet, positioning itself for renewed growth and predicting rising pesticide demand when prosperity returned.

Amvac's presence is a lesson in capitalism. Legal opportunities for profit elicit the requisite effort.

³⁵ American Vanguard Corporation, *Code of Conduct and Ethics*, adopted March 8, 2006, at www.amvac-chemical.com, p. i.

³⁶ *Ibid.*, p. i.

Actions are justified by their overall utility. Doubtless Amvac's strategic thinkers would be inspired by the words of a Robert Frost poem.

But a crop is a crop,
And who's to say where
The harvest shall stop?³⁷

Questions

1. Does Amvac have an ethical strategy? Does it pursue its strategy in an ethical manner?
2. Do you believe that Amvac is faithful to its ethics code? Does the code adequately address the consequences of its operations? What might be added or changed to improve it?
3. Should the law prohibit Amvac and others from exporting pesticides barred from use in the United States?
4. Is the value to society of pesticides such as dibromochloropropane, mevinphos, and dichlorvos great enough to warrant the risks they pose?
5. If economic and market conditions remain favorable for Amvac's strategy, would you buy its stock?

³⁷ "Gathering Leaves," in Edward Connery Lathem, ed., *The Poetry of Robert Frost* (New York: Holt, Rinehart and Winston, 1969), p. 235.