Agriculture
in the Pacific Southwest Region

Region 9 Agriculture Strategic Plan

FY2003 through FY2008

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Contents

Executive Summary

Agriculture is a major industry in the Pacific Southwest, providing food and fiber for the nation and for export to the world. Good stewardship of agricultural working lands can provide benefits to the environment such as sustaining clean water and habitat for wildlife. The U.S. Environmental Protection Agency's Pacific Southwest Region support the agriculture industry in becoming better stewards of the land by fostering collaborative, innovative actions to comply with regulations and move beyond them toward a more sustainable future. The Region also uses regulation and enforcement as a tool to ensure that agricultural practices are not damaging the environment and threatening public health, that those who follow the law are not placed at an unfair advantage and that those that violate the law face consequences. This strategic plan for the Region's work on agriculture describes:

- the agricultural economy in the Pacific Southwest region
- the ecological and sociological context of agriculture issues
- the policy and organizational context of the Region's work on agriculture
- the Region's strategies for addressing environmental issues in agriculture

Global Context

The first step in solving a complex problem is to understand the context and the factors which affect it. Globally, humanity is degrading ecosystem services including regulation of climate, screening of solar radiation, availability and fertility of topsoil, the cycling of fresh water and nutrients, and the pollination of flowering plants, to name a few that affect agriculture. Agriculture depends on many of these ecosystem services. Many sociological factors affect agriculture today, including our reliance on technology, markets, and trade to solve problems in agriculture. This planning document describes these factors because economically and environmentally viable agriculture requires active, well-informed consideration of these issues.

Policy Context

A holistic perspective that reflects the intrinsic multi-media nature of agriculture informs the Region's work, and Congressional mandate and EPA policy direct it. Broadly speaking, Congress authorizes EPA to implement or oversee programs that address specific media – air and water – and specified wastes and chemicals such as pesticides. And the agency and regional strategic plans set the environmental goals and priorities for programs. The Region chooses projects and *creates policies and partnerships* where agri-environmental issues and its authority to act coincide.

Agriculture Strategy

The Region's strategy for agriculture includes four approaches:

- collaborate with and fund stakeholders who are able and willing to work toward the same vision of ecologically sound agriculture;
- develop and/or implement regulations, strategies, incentives and policies designed to achieve progress toward ecologically sound agriculture.
- communicate and provide information to internal and external stakeholders and
- foster environmental stewardship to improve and restore the environment.

The Region applies these approaches to EPA's goals and objectives for protecting the quality of air and water and the health of communities and ecosystems.

Context

Government agencies design and implement programs to solve problems and benefit the public and the first step in solving a complex problem is to understand the context. In this case, the problem is the effect of agriculture on human health and the environment in the Pacific Southwest region, within the context of global ecological and sociological factors that affect and are affected by agriculture. An economically and environmentally viable agriculture requires active, well-informed consideration of these factors.

Agriculture in the Pacific Southwest

After air to breathe and water to drink, food is the most basic requirement of human life. A sufficient, affordable, and healthful food supply is essential to our quality of life, and agriculture provides it. Agriculture is fundamental to our society in other ways also. In the United States, we use two fifths of our land for agriculture,[1] and the way we use it affects our air and water, the diversity of life on earth, and our enjoyment of it. It can also affect quality of life our posterity will enjoy.

A full quarter of the land area in the Environmental Protection Agency=s Pacific Southwest Region supports the most productive agricultural economy in the United States.[2] California alone is home to $30 billion agricultural industry;[3] its San Joaquin Valley is the single richest agricultural region in the world.[4] California employs 27 percent of U.S. farm workers,[5] operates a third of the nation=s largest dairies,[6] and produces 64 percent of our vegetables and melons.[7] California is the nation=s sole producer of a dozen crops and the leading producer of five dozen more.[8] Arizona, despite its desert climate, ranks second nationally in production of ten commodities, and in the top ten for eleven more.[9] Hawaii, with its year-round growing season and isolation, supports a variety of agricultural products. Long known for sugarcane and pineapple, Hawaii=s farm economy is in transition to a much more diversified product mix [10] with many smaller operations. Hawaii now leads the nation in sales of several tropical commodities. It is also an ideal location for developing new seed crops, including some that are genetically modified to resist certain pests and pesticides.[11] Nevada, with rangelands over 82% of its area, has a productive agricultural sector dominated by beef and hay production.[12]

While plentiful and diverse foods provide the raw materials of a healthy diet, such intensive agricultural production over such vast areas affects the region=s environment and, in turn, its people=s health. In the Pacific Southwest region, air pollution from agricultural sources includes particulate matter from farm machinery, road dust, burning, plowing, and harvesting; ground level ozone from volatile organic compounds (VOCs) and nitrogen oxides emitted by farm machinery; more VOCs from pesticides;[13] VOCs, ammonia, particulates, and methane (a global warming gas and ozone precursor) from animal feed lots;[14] and stratospheric ozone depletion from the soil fumigant methyl bromide.[15] Nationwide, agricultural pesticides, fertilizers, silt, and salts in irrigation drainage and other agricultural runoff are the leading source of water pollution.[16] In California, the use of the most toxic pesticides per acre of farmland increased by 54 percent between 1991 and 1998[17] and the total volume of pesticide use in California agriculture rose by 66 percent, though by 2003 the volume had receded by 20 percent.[18] Still, in 2001 California alone used almost a third of all pesticides used in U.S. agriculture.[19] Moreover, agriculture consumes about 80 percent of California=s water supply.[20] These are some of the conditions that the Region’s work on agriculture is designed to address.

Global Ecological Context

Ecological factors surrounding agriculture include earth's limited capacity to provide the ecosystem services that support human society and, indeed, life on earth.

Ecosystem services and carrying capacity

"The environment" is the set of conditions and processes on earth that support life, including human life. So when we speak of environmental issues, we are speaking about human health and welfare. A few examples of these life-giving processes, often called "ecosystem services," include nutrient and carbon cycling, soil creation, pollination, and water cycling and purification. Ecosystem services include natural resources that humans (and other species) depend on – precipitation, fresh water, fertile topsoil, flowering and fruiting plants, grasslands, forests, and more. Ecosystem services provide their benefits at finite rates and in finite quantities, though they may have seemed infinite when earth's population was smaller. The upper limit of the population that the earth's ecosystem services can support is sometimes called "carrying capacity." [21]

Ecological overshoot

The fundamental environmental issue today is humanity's appropriation of ecosystem services and resources in excess of the earth's long-term carrying capacity.[22] This condition, which can exist in the short-term at the cost of future carrying capacity, is often called "ecological overshoot."[23] Most if not all of the environmental problems we hear about today – global warming, loss of habitat and biodiversity, endangered species, deforestation, declining fisheries, urban sprawl, pollution of air, water, and land, and loss of topsoil and soil fertility, to name some – are manifestations of overshoot. Many of the social problems we hear about today – hunger, war, refugees, migration – stem from the same root: too many people striving for an unsustainable share of limited resources. Globally and domestically, agriculture both contributes to and suffers from ecological overshoot.

Sociological Context

Ecological overshoot is the result of the evolution of human social organization over millennia, culminating in a society that exhibits a number of factors that affect agriculture.

Technology

So far, our society has been unable to address the increase in human population and expectations for material standards of living that have led to excess appropriations of ecosystem services. Society has found it easier to focus on another factor in the equation, the efficiency of our use of resources. Many people including some sustainability advocates hope to address overshoot through technological advances that increase resource-use efficiency.[24]

Throughout the 19th and 20th centuries, agriculture relied on the introduction of mechanical and biological technologies to address its challenges. Improved crop varieties, easily available pesticides, cheap artificial fertilizer, and oil-powered mechanization made possible large-scale mono-cropping and increased yields, but also resulted in unexpected problems. One example, famously documented in Rachel Carson's *Silent Spring*, is the use of organochlorine pesticides like DDT, initially seen as a fail-safe solution to insect pressures on crop yields but with disastrous effects on bird populations. Scientists and citizens skeptical of technological solutions often cite these as lessons on the limitations of risk assessment methodologies and the potential for technological innovation to outpace our capacity to assess and mitigate potential harm, particularly at the ecosystem scale. More recent oft-cited examples are the use of genetically modified organisms and the development of nano-scale materials. The potential danger here is not just in the visible effects of technology on non-target species, but in the invisible effects on the whole ecosystem.

Economy

Our society relies on certain social technologies as well: the market and trade for allocating resources, including labor, legal constructs for organizing business operations, government funding to influence decision-making, and regulation to maintain and supplement market functions. All of these factors affect agriculture.

The market

The market is the social technology that allocates scarce resources to many competing demands. Today's decentralized market distributes the modern economy's inputs and outputs more efficiently than the most powerful computer possibly could. However, the market has several well-known weaknesses. The market, per se, is unable:

- to provide producers and consumers with the perfect information necessary for theoretically correct decision-making,
- to account for unpriced public goods, such as clean air and open space, and externalities, such as pesticide runoff into surface water, and for the finite nature of ecosystem services;
- to contain the scale and self-interest of firms, which can undermine competition and community;
- to ensure an equitable – as opposed to efficient – distribution of resources, income, and wealth.[25]

These weaknesses, all of which affect agriculture, might require actions outside of the market to correct the market's functioning, so that it performs closer to the theoretical ideal.

Business form and size

The form, size, and number of business units in agriculture also affect agriculture's environmental and social performance.

Sole proprietorships and family partnerships once predominated as the legal form for agricultural business. These businesses tended to be smaller in acreage and income, and their owners generally lived on or very close to their operations and actively managed them with a close eye to the health of their land.

Technological innovation to increase efficiency in agricultural production prompted an increase in the size of operations and an accompanying shift in the legal organization of agricultural firms. Today, the agribusiness corporation dominates the agriculture sector of the economy, including the production, processing, and distribution industries.

A corporation is a legal entity for organizing work, channeling investment, and managing financial risk, all of which can be good for agribusiness. Large corporations often have resources to invest in innovation and management systems that incorporate environmental and social considerations that small firms lack. However, directors of large agricultural corporations answer to far-flung investors and may have slight connection to the land and local economy. Pursuing efficiency and profitability, large agribusiness corporations replace labor and local knowledge with technology, and substitute size and standardization for ecological integration.

Large corporations' wealth, access to credit, tax advantages, technological resources, and political influence make them more than fair competition for family farms, which have declined in numbers by over 40,000 per year over the last 40 years. In 1994, the farm income of 94 percent of farm households would have placed them at or below the poverty line. Income disparity has only increased in the years since then. [26]

Labor

Labor is one of the most costly resources in agriculture, and this cost has driven the application of technology to agriculture. However, viewing labor as only a high-cost input misses its larger role in agricultural and rural economies, as a source of market demand and of human and social capital in rural communities. Recently, market-incentive programs have begun to incorporate labor standards to correct this short-coming of the market.

Policy

Subsidies and incentives

Historically, government price supports and other payments have shaped agricultural production in the US and abroad. While such subsidies helped stabilize commodity prices for some producers and provide for plentiful and cheap staple foods for consumers, they also distorted market signals and encouraged overproduction of certain commodities and the consolidation of agricultural operations. Further, subsidy policies have become a large part of global trade debates, forcing nations with a history of subsidizing their agricultural industries to revisit these policies. In the US, with another Farm Bill reauthorization approaching, the dialogue focuses on the possibility of shifting from direct crop payments, price supports, and energy subsides, toward a new framework that compensates the conservation of ecological values on agricultural lands.

International trade

International trade can increase the welfare of trading countries under certain conditions. But the principle of "comparative advantage" that governs trade in classical economic theory assumes that national borders constrain the movement of money and labor. In today's world, where capital crosses borders as easily as goods but labor does not, the economics of free trade means that investment will flow towards profitability wherever it is, reducing employment opportunities and wages in the country where investment is less profitable, possibly due to higher standards of human and environmental health.[27] Further, the international trade regime embodied in institutions like the World Bank and International Monetary Fund and in organizations such as the World Trade Organization (WTO) and North American Free Trade Area (NAFTA) supersedes the environmental and labor laws of formerly sovereign nations when they restrain trade.[28]

Regulation

Finally, government intervention, including environmental regulation, affects the agricultural sector. Regulatory agencies, including EPA, are increasingly seeking to use collaborative approaches and incentives to complement and enhance regulatory compliance and enforcement. Environmental stewardship can offer opportunities for improving efficiency, engaging in problem solving, and sustaining clean water, air and natural resources. Market interventions such as support for environmentally preferable production in agriculture or payments for conservation practices may make the difference between a farm's staying in business or not.

Organizational Context

The ecological and sociological context of modern agriculture informs the Region's work on agriculture. Within that context, the Region works as Congressional intent and Agency policy mandate.

Congressional mandates

Congress has authorized EPA through several statutes to protect and restore the environment and to preserve the human health which depends on it. These statutes include the Clean Air Act, Clean Water Act, Safe Drinking Water Act, and an alphabet soup of others: FQPA, FFDCA, FIFRA, RCRA, CERCLA, TSCA, and more (see box on next page).

The Clean Air Act, Clean Water Act, and Safe Drinking Water Act regulate the effects of human activities on two environmental Amedia,@ air and water. Other statutes provide for the management of various waste products of household and commercial activities. The scientific expertise and professional skills required in environmental protection work are, to a certain extent, different for each medium. As a result, the organization of the EPA largely reflects the media orientation of the statutes. In contrast, the Food Quality Protection Act and its companion statutes regulate the effects of pesticides and other categories of chemicals, regardless of the environmental media affected. The agency=s organization also reflects these broader, Across-media@ issues.

While this may seem a large delegation of authority to a federal agency, the EPA is limited in what it can do in the global context. Generally, Congress has authorized EPA to implement or oversee specific regulatory programs to address environmental problems in specific media – air, water, and waste – and for specific chemicals – pesticides and specified toxic substances. Congress has generally reserved the authority to effect broad socio-economic policy to other agencies – trade policy to the departments of Commerce and State, energy policy to the Department of Energy, farm policy to the Department of Agriculture – or reserved it largely to itself, as in the case of tax policy. EPA's authorities generally do not extend to these broader socio-economic issues.

Agency policy

Agency policy is formalized and applied to programs in several ways. One of the most direct is through the budget and resource allocations. Another is through the Agency and Regional strategic plans, which set priorities and lay out general goals and objectives that programs must implement. Another is through the promulgation of regulations and dissemination of guidance to implement the statutes. The staff and managers working on agricultural issues participate in developing these policy documents and are ultimately subject to their

Selected Congressional Mandates Affecting Agriculture

Clean Air Act: authorizes states and tribes to develop and implement plans to regulate emissions to air of various pollutants from various sources, under EPA oversight.

Clean Water Act: authorizes EPA, states, and tribes to regulate the discharge into water bodies of pollutants from specific sources, like industrial discharge pipes, and diffuse sources, like storm water runoff, and limit the amounts of pollutants allowed in a water body. *Specific to agriculture: sections 402(p) NPDES permits for concentrated animal feeding operations and storm water runoff, 404 permits (wetlands), and 319 nonpoint source pollution programs.*

Safe Drinking Water Act: protects the quality and sources of drinking water served through public water supply systems

Food Quality Protection Act: enhances two earlier statutes, the Federal Insecticide, Fungicide, and Rodenticide Act and the Federal Food, Drug, and Cosmetics Act, to regulate the use of pesticides and their effects on human health and the environment

Federal Food, Drug, and Cosmetics Act: authorizes EPA to set maximum permissible levels of of pesticide residues in foods and animal feed

Federal Insecticide, Fungicide, and Rodenticide Act: authorizes EPA to regulate the sale, distribution, and use of pesticides through registration of pesticides for specific uses constraints.

U.S. EPA=s Strategic Plan

Congress has required all federal agencies, under the Government Performance and Results Act (GPRA), to develop strategic plans with broad goals and objectives for agency performance, and to measure and report on agency performance on these objectives. Agency programs must contribute to achieving the agency=s strategic goals.

Strategic goals

The agency=s goals are organized according to the three primary environmental media, air, water, and land, with the addition of a goal for over-arching; Across-media@ efforts and one for ensuring compliance with EPA regulations (see sidebar).

Objectives

The Strategic Plan establishes objectives for agency actions under each goal. Several of these goals apply to agriculture. Under Goal 1, they include cleaning the air that people breathe, protecting the stratospheric ozone layer, and reducing greenhouse gases that cause climate change. Emissions from agriculture can affect all of these goals.

Objectives under Goal 2 include protecting human health (through drinking water protection) and protecting water quality across entire watersheds.

Under Goal 4, objectives include managing the risks to workers and consumers from pesticides, as well as overarching objectives for protecting community and ecosystem health which can apply to agricultural communities and to ecosystems that interact with agriculture.

Under Goal 5, objectives include providing both assistance with and incentives for compliance with environmental regulation, as well as monitoring and enforcement of compliance. These objectives continue to be key parts of the Region's agriculture strategy.

Targets

GPRA requires federal agencies to set specific numerical targets for their strategic objectives. Agency strategic targets relevant to agriculture include reductions in many of the emissions to air from agriculture, including nitrogen oxides, volatile organic compounds, and ozone depleting and greenhouse gases. Targets for watershed protection specifically address levels of phosphorus contamination in farmland streams. Targets for managing pesticide risks include reductions in pesticide residues on foods eaten by children and an increase in acreage treated with lower-risk pesticides.

Annual performance goals and measures

GPRA also requires federal agencies to develop, as part of the annual budget development process, annual plans for implementing the strategic plan. The annual plans contain annual performance goals and specific measures for assessing progress toward those goals. Several are relevant for agriculture. Examples for air include the cumulative percentage increase in the number of people who live in areas with ambient concentrations of ozone or fine particulates below the national standard. For water, an example would be water bodies identified in 2000 as not meeting water quality standards that now meet them. Examples for communities include two pesticides measures: the percentage of acre-treatments of reduced-risk pesticides, and detections of pesticide residues on a core set of nineteen foods eaten by children.

Pacific Southwest Region Strategic Plan

The Pacific Southwest Region's strategic plan parallels the agency-wide plan. For air pollution efforts, the Regional strategy specifies the San Joaquin Valley as a

U.S. EPA's Strategic Goals

Goal 1
Clean Air and Global Climate Change

Goal 2
Clean and Safe Water

Goal 3
Land Preservation and Restoration

Goal 4
Healthy Communities and Ecosystems

Goal 5
Compliance and Stewardship

geographic priority and agriculture in the San Joaquin Valley as a major challenge. Key work includes working with the state and local government and other stake holders to reduce emissions of VOCs, NOx and particulates. For water pollution efforts, the plan specifies California dairies, especially those in the San Joaquin Valley, as a priority. For community and ecosystem health efforts, a priority is to work with universities, commodity groups, and other stakeholders to promote adoption of new agricultural and marketing practices that reduce the use of pesticides and improve the quality of soil as well as water and air in farming areas.

The Agriculture Strategy

EPA's Pacific Southwest Region established its agriculture strategy to address environmental and public health concerns as mandated by Congress, and to implement the goals and objectives of the Agency-wide Strategic Plan and of the Regional strategic plan as they apply to agriculture in the Pacific Southwest.

Mission and Objectives

The Region=s mission on agriculture is to collaborate with and coordinate efforts of federal, state, tribal, and private partners to implement the federal regulations related to agriculture and to attain measurable improvements in the environmental and public health effects of agricultural activities, through outreach and education, supporting environmental stewardship efforts, funding, compliance assistance, inspections, and enforcement. In keeping with the Pacific Southwest Region=s strategic plan, the Region will focus its agriculture efforts on the significant environmental problems in the San Joaquin Valley, while supporting our state and local regulatory partners in Arizona, Hawaii, Nevada as well as tribal and Pacific island governments as they manage agriculture-related programs.

The Region has defined several strategic objectives for its operations, consistent with the Agency and Pacific Southwest Region strategic plans.

Clean Air: To reduce agriculture=s contribution to non-attainment of Clean Air Act standards for particulate matter and for volatile organic compounds and nitrogen oxides that are precursors to ground-level ozone pollution.

Clean Water: To reduce the impairment of water bodies due to agriculture.

Healthy Communities: To reduce the impacts of pesticides on farm workers and farm communities and to assure that farm workers have access to adequate drinking water.

Healthy Ecosystems: To reduce the environmental side-effects of pesticide use.

Organizational Structure

The Regional agriculture team comprises managers and staff from the three divisions B Air, Water, and Communities and Ecosystems (CED) B whose responsibilities include issues affecting agriculture. The Associate Director for Agriculture of the Communities and Ecosystems Division manages the program and serves as Advisor to the Regional Administrator on agriculture issues.

Associate directors from each of the three divisions provide critical leadership. A small Agriculture Program staff within CED monitors, facilitates, and reports on efforts on agriculture issues within all three divisions, and coordinates efforts with other Regions and headquarters offices within

EPA and among federal, state, tribal, and local agencies, agricultural stakeholders, and non-governmental organizations.

Implementation

The Agriculture Program's coordinating staff works with the Regional agriculture team to plan, fund, implement, and evaluate projects. Other activities include developing and implementing strategies to improve collaboration and communication with agriculture and involved agencies as well as providing technical, financial and research assistance. The next section briefly describes the Region's strategies for achieving its goals and objectives. The Region 9 Agriculture Operating Plan describes the strategies in more detail as well as the specific projects under each strategic goal.

Strategies for achieving results

The Region employs four basic strategies intended to promote an environmentally sustainable agricultural industry:

1. Collaboration and funding
2. Regulation and policy development
3. Communication and information management
4. Environmental stewardship

Collaboration and funding

Region 9 recognizes that agriculture provides significant economic benefit to the region and that sustainable agriculture can provide significant environmental benefit as well.[29] The Region also realizes that the industry faces economic as well as environmental challenges. For this reason, the Region uses collaborative and incentive-based approaches to reach environmental goals wherever feasible. The Region collaborates on information sharing, priority setting, funding, and joint projects with a range of stakeholders, including:

- USDA agencies including the Natural Resources Conservation Service, the Farm Services Administration, Rural Development, Cooperative *State* Research Education and Extension Service;
- State, local and tribal environmental and agricultural agencies including the CA State Water Resources Control Board and its nine regional water quality control boards, Department of Food and Agriculture, Air Resources Board, local Air Districts, Department of Pesticides Regulation, and others;
- California Association of Resource Conservation Districts and its 103 resource conservation districts;
- Non-governmental organizations with environmental and agricultural missions, including the Community Alliance with Family Farmers, the Natural Resources Defense Council, Sustainable Conservation, Pesticide Action Network, Environmental Defense and others;
- Commodity and producer support organizations including the California Farm Bureau Federation, Nisei Farmers League, California Cotton Ginners and Growers, California Minor Crops Council, Western United Dairymen, the Almond Board of California, and the California Tree Fruit Agreement
- Universities and other academic institutions

Regulation and policy

The Region will also pursue regulatory approaches to achieve compliance. In the coming years, these efforts could include:

Air Programs

- Develop emission reduction credit protocols for agricultural sources in order to provide appropriate incentives for growers to reduce emissions;

- Work with stakeholders to characterize and reduce emissions of VOCs, NOx, and particulate from crop and animal agriculture by incorporating appropriate practices into the Ozone and particulate SIPs and into implementation rules; and
- Implement flexible conservation management practices for control of particulate.

Water Programs

- Provide technical, financial and programmatic guidance and support to states as they develop and implement Total Maximum Daily Loads (TMDLs) related to agricultural activities (e.g., San Joaquin River diazinon and chlorpyrifos);
- Work closely with states to implement the revised CAFO rule (2007) and provide technical assistance, as needed, to the Central Valley Regional Water Quality Control Board as they move toward adoption of its CAFO WDR general permit for dairies in 2006; and
- Provide assistance to the Central Valley Regional Board as it implements the Irrigated Lands Conditional Waiver Program.
- Assist the State Water Resources Control Board as it revises the statewide Rangelands Water Quality Management Plan for consistency with the agriculture waiver program.

Pesticides Program

- Support a strong, fair, predictable, consistent state enforcement presence;
- Work with our state regulatory partners to strengthen the protection of agricultural workers; and
- As appropriate based on national efforts, ensure the protection of endangered species from the effect of pesticides.

Agriculture Program

The Agriculture Program contributes its knowledge of stakeholders and its experience on the ground to the development and implementation of agency policy on current issues as they arise, including:

- Pesticide drift

Potential Performance Measures Applicable to Pacific Southwest Agriculture

Clean Air

Ambient concentrations of ozone (1-hour and 8-hour standards) (e.g., in the San Joaquin Valley)

Ambient levels of particulate matter (e.g., in the San Joaquin Valley)

Asthma morbidity and mortality (e.g., in the San Joaquin Valley)

Clean Water

Surface waters impaired by agriculture (stream miles and lake acres) (e.g., in San Joaquin/Tulare watershed)

Levels of nitrogen, phosphorus, and pesticides *in streams impacted by agriculture* (e.g., in San Joaquin/Tulare watershed)

Healthy Communities

Ambient levels of pesticides in air

Number of cases of farm worker illness due to pesticide incidents

Number of off-farm pesticide drift incidents

Healthy Ecosystems

Percentage of acre-treatments with reduced-risk pesticides for the following commodities: stone fruits, wine grapes, almonds, and walnuts

Number of acres of stone fruits, wine grapes, almonds, and walnuts with reduced-risk pesticides or other more sustainable, environmentally sound practices in use

Invertebrate and fish indices of biotic integrity in streams in the San Joaquin / Tulare watershed

- NPDES permit for pesticides
- Biotechnology
- Fumigants and VOCs

Performance measurement

Like any governmental or private-sector entity, U.S. EPA collects information for program management decision-making and reports program accomplishments to ensure that agency personnel are implementing management direction and priorities. Historically, program management has focused on tracking program activities and milestone events. In recent years, however, federal agency management efforts have shifted from tracking activities, or outputs, toward measuring results, or outcomes, of program activities. The Region is researching measures, including those identified in the national and regional strategic plans (see box on page 12), to track the effectiveness of efforts on the environmental effects of agriculture, especially in the San Joaquin Valley of California.

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Appendix: Project Selection

Informed by knowledge of global socio-environmental issues, the Region works where its authorities and its concerns coincide, in the area of agri-environmental issues. To choose specific projects to address these issues, the Region evaluates several factors, including:

- the contribution of agricultural practices to urgent human health and environmental issues
- the intensity of agricultural activity by geographic area
- the intensity of agricultural activity by crop
- the receptivity of stakeholders to change, and hence the likelihood of success

(NOTE: Projects funded through the Clean Water Act are primarily the decision of the State Water Resources Control Board which has the delegated authority for grants under the 319 nonpoint source pollution control program. Funding decisions are guided by priorities such as waters listed as impaired (i.e., 303(d), watershed-based plans, and TMDL implementation.)

Environmental Issues with Significant Agricultural Sources

Agriculture contributes to a number of significant environmental problems. The key issues identified by the Region 9 programs include:

Air

- Particulate matter: Most of California's San Joaquin Valley is a non-attainment area for particulate matter under the Clean Air Act. Similarly, the South Coast of California and the Maricopa Valley outside Phoenix, Arizona, both have serious problems with particulate matter. Agricultural burning, bare fallowing, plowing, harvesting, and diesel engines are major contributors to dust formation in rural areas.
- Ground-level ozone: Volatile organic compounds (VOCs) from agricultural pesticides and dairies, and nitrogen oxides (NOx) from farm machinery exhaust, are major contributors to ozone formation. In the San Joaquin Valley, pesticides account for 9 percent and dairies 16 percent of the reactive organic gases that contribute to ozone formation, while agricultural burning adds another 3 percent. [30]
- Stratospheric ozone depletion: The soil fumigant pesticide methyl bromide is responsible for 5 to 10% of the reduction in Earth's stratospheric ozone, and California agriculture is the world's largest user of methyl bromide.[31] Most nations of the world, including the United States, have agreed to phase out this chemical, but "critical use" exemptions have kept it in use on strawberries and other crops.

Water

- Surface water pollution: Agriculture is the nation's leading source of pollution for ground, surface, and coastal waters.[32] Pollutants include pesticides, nutrients, fertilizers, silt, and salts in irrigation drainage and livestock production. In California, agriculture is responsible for the impairment of 69% of the river miles due to nonpoint source pollution. Agriculture is the leading contributor to non-point source pollution in four of the state’s nine hydrologic basins[33] and a major contributor in four of the remaining five basins. Concentrations of pesticides, especially diazinon, regularly exceed water quality standards in all major rivers of California's Central Valley.[34]

- Water supply allocation: The Bay-Delta is in decline from decades of competing demands, no longer functioning as a healthy ecosystem or as a reliable water supply. EPA is part of a collaborative effort known as the CALFED Bay-Delta Program with 23 other state and federal agencies to improve water supplies in California and the health of the Delta watershed.
- Wetlands: Vineyard conversion and ag lands being converted to urban development is resulting in a major loss of wetlands.

Pesticides

- Total pesticide use: California is the leading state for pesticide use and uses 20% of the nation’s pesticides.35 More than 200 million pounds of active ingredient36 are applied each year. Fresno County alone receives 40 million pounds – 40 pounds per capita – each year.
- Use of high-risk pesticides: Use of the most toxic materials is also rising. Between 1991 and 1998, the total volume of pesticide use rose 40%, intensity of pesticide use (pounds applied/acre) rose 51%, use of the most toxic materials rose by 27%, and use of carcinogens rose 127%. And agriculture releases three times as many reproductive and developmental toxins as industry.37
- Farm worker health: Such heavy use of highly toxic materials creates significant human health concerns. Pesticides cause acute illness in an estimated 7.5% of the agricultural labor force each year.38
- Farm community health: Numerous communities, including MacFarland, Lompoc, and Watsonville, have raised concerns to the Regional office about pesticide drift into communities and schools. Environmental assessments of these communities indicate high incidences of illness and the potential for chronic exposure to pesticides. Existing regulatory programs do not effectively address community impacts nor do they provide adequate incentives for growers to move beyond compliance to a more proactive stewardship role.
- Pesticide drift into surface water, which has the potential to harm aquatic ecosystems, including endangered species

Intensity of Agriculture by Geographic Area

California is the leading farm state, with $25 billion in farm gate sales accounting for 12% of the nation's total farm economy. Eight of the US's top 10 agricultural counties are in California, each producing over $1 billion annually in farm gate receipts. California produces more than one-half of the nation's fruits and vegetables; leads the nation in production of 85 commodities, including dairy, produce, eggs, and nursery crops; and is the world’s most diverse agricultural economy, with over 350 crop and livestock commodities, many not grown elsewhere. California's Central Valley is the most ethnically diverse rural area in the world, and California employs 25% of the total US hired agricultural labor force, far more than any other state.[39] California alone accounts for 20% of all US farm exports.[40]

Within California, the San Joaquin Valley leads the state in economic value of agriculture, in farm acreage, and in employment of farmworkers. The eight counties of the San Joaquin Valley include six of the seven leading agricultural counties in the state (Table 1). As a result, the Region concentrates its efforts on the San Joaquin Valley.

Table 1: California's Counties with the Most Valuable Agricultural Production
(counties in the San Joaquin Valley are shown in **bold**)

County	Value of Agricultural Production (1000s)
Fresno	**4,052,767**
Tulare	**3,294,660**
Monterey	3,288,468
Kern	**2,477,526**
Merced	**1,918,230**
San Joaquin	**1,494,693**
Stanislaus	**1,454,928**
San Diego	1,351,059
Kings	**1,136,966**
Ventura	1,117,567
Imperial	1,073,472
Riverside	1,067,367
Santa Barbara	858,071
Madera	**760,246**
San Bernardino	645,885

Source: California Agricultural Statistics 2003. California Department of Food and Agriculture. Sacramento, CA, October 2004, ftp://www.nass.usda.gov/pub/nass/ca/AgStats/2003cas-all.pdf

Intensity of Agriculture by Commodity

Commercial agricultural production, research, processing, distribution, marketing, and politics are organized by crop. More than 350 crops are grown in Region 9. Since it is not possible to work simultaneously on such a large number, we identified priority crops based on economic value (Table 2) and acreage (Table 3). In recent years the Region has worked on and funded projects in eleven of the twenty most valuable agricultural commodities in the state, covering plants and animals; tree and row crops; and food, feed, and fiber crops.

Table 2: California's Most Valuable Agricultural Crops and Commodities (crops the Region has worked on in recent years are indicated in **bold)**

Rank	Crop / Commodity	Economic Value ($1,000,000)
1	**milk and cream**	**4,029**
2	nursery	2,437
3	**grapes, all**	**2,298**
4	**lettuce, all**	**1,734**
5	**almonds**	**1,600**
6	cattle and calves	1,556
7	**strawberries**	**1,119**
8	flowers	985
9	**tomatoes, all**	**901**
10	hay, all	842
11	**cotton, all (lint and seed)**	**761**
12	broccoli	603
13	chickens, all	537
14	oranges, all	483
15	**carrots, all**	**468**
16	**stone fruits** (peach, plum, nectarine)	**455**
17	**rice**	373
18	avocadoes	316
19	**walnuts**	**342**
20	eggs, chicken	282

Source: **California Agricultural Statistics, 2003**. California Department of Food and Agriculture. Sacramento, CA, October 2004, ftp://www.nass.usda.gov/pub/nass/ca/AgStats/2003cas-all.pdf

Table 3: California Crops Grown Over the Largest Acreage (crops the Region has worked on in recent years are indicated in **bold**)

Rank	Crop / Commodity	Acreage (1,000 acres)	
1	Hay, alfalfa	1,570	
2	Grapes, all	819	
	raisin		255
	table		85
	wine		**479**
3	**Cotton**	**694**	
4	**Almonds**	**550**	
5	**Rice**	**507**	
6	Wheat, all	485	
7	Tomatoes, all	311	
	Processing		**274**
	Fresh market		37
8	**Lettuce, all**	232	
9	**Walnuts**	213	
10	Oranges, all	195	
11	Corn, grain	170	
12	**Stone fruits**	**140**	
	Peaches		**68**
	Plums		**36**
	nectarines		**36**
13	Broccoli	125	
14	Oil crops	107	
15	Pistachio	88	
16	Beans, dry	75	
17	**Carrots**	**71**	
18	Melons, cantaloupe and honeydew	70	
19	Avocados	60	
20	Barley	58	

Note: For certain agricultural commodities (e.g., milk and cream, nursery crops, cattle and calves, cut flowers, chickens, and eggs), acreage is not a useful measure. Therefore, these agricultural commodities do not appear in this table.

Source: **California Agricultural Statistics 2003**. California Department of Food and Agriculture. Sacramento, CA, October 2004, ftp://www.nass.usda.gov/pub/nass/ca/AgStats/2003cas-all.pdf

Stakeholder ability

Two additional criteria are critical in deciding how the will spend its resources. The Program's non-regulatory activities to promote a more sustainable future for agriculture must rely on the abilities and willingness of our partners.

Producers of many crops in CA are organized into industry, trade, and marketing associations. Many of these associations have state charters and strong ties to University of California Cooperative Extension (http://www.cdfa.ca.gov/mkt/mkt/mktbrds.html). Through these commodity organizations, growers are more able to participate as partners in EPA Region 9 efforts. The Region works with the Almond Board of California, the Nisei Farmers League, the California Farm Bureau Federation, and the Lodi-Woodbridge Winegrape Commission, for example. Growers of commodities that are less well organized are harder to reach. In addition, growers and their representative organizations must be willing to work with the Region. Working with willing and able partners, the Region creates models whose success encourages others to follow.

Result: Region 9's Focus on Agriculture

Agriculture, broadly defined, includes production of food, feed, and fiber using both plants and animals. The many and various environmental effects of this entire field require some focusing of program efforts. Continual, iterative planning has narrowed the focus of the Region's on-the-ground and grant-making work on agriculture to:

- land-based farming activities that contribute to environmental and regulatory issues,
- the San Joaquin Valley where these issues are especially acute,
- crops with the highest value and acreage, and
- stakeholders who are willing to engage with us.

Notable results of this focus are projects on reducing the use of organophosphate pesticides on dormant almond orchards, and on assessing available technologies for managing dairy manure. Also notable are the results from grants under the West Coast Diesel Collaborative. Due to resource constraints, the Regional agriculture team has not addressed, and currently has no plans to address, the environmental effects of forestry, grazing *(note: re grazing, Water Division is working w/ the SWRCB as work gets underway to revise its Rangelands Water Quality Management Plan)*, and aquaculture, though these industries are significant in Region 9.

The Region also works to address market imperfections and to shape policy on and regulation of agricultural technologies. This includes efforts to use a Regional grants program to direct Food Quality Protection Act funds towards helping growers transition away from high-risk pesticides toward more sustainable agricultural practices. It also includes efforts to support market-based incentives for sustainable production through third-party certification, and to influence national policy on funding for integrated pest management, on the interface between pesticides and air and water regulations, and on agricultural biotechnology.

Notes

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[1] Total land area: Central Intelligence Agency World Factbook: http://www.cia.gov/cia/publications/factbook/geos/us.html#Intro; Land in agriculture: USDA National Agricultural Statistics Service *2002 Census of Agriculture*: http://www.nass.usda.gov/census/census02/volume1/us/st99_1_009_010.pdf

[2] USDA Economic Research Service, State fact sheets, http://www.ers.usda.gov/StateFacts/, data from USDA National Agricultural Statistics Service *2002 Census of Agriculture*

3 USDA Economic Research Service, Agricultural Outlook: Statistical Indicators, table 34, Cash Receipts from Farm Marketing, by State, www.ers.usda.gov/publications/agoutlook/aotables, updated May 6, 2005

[4] The Great Valley Center, *The State of the Great Central Valley of California: Assessing the Region Via Indicators: The Economy, 1999-2004*, p. 28, states that the San Joaquin Valley accounts for 88% of the Central Valley=s 57% of California production, or about half of the California total of $30 billion. If the San Joaquin Valley were a state, it would rank second behind Texas and just ahead of Iowa and the rest of California in value of agricultural production. http://www.greatvalley.org/publications/general_program_area.aspx?pId=State+of+the+Great+Central+Valley+Indicators+Series

[5] USDA National Agricultural Statistics Service, Farm Labor, February 2005, hired workers as of October 10-16, 2004 (p. 7) plus agricultural service workers as of October 2004 (p. 14)

[6] USDA National Agricultural Statistics Service, AQuick Stats@ Agricultural Statistics Database, U.S. and State Data, Dairy, Milk Cows by Size Groups: Operations, 2004, for California (1100 operations with more than 500 head) and USA (3010 operations with more than 500 head)

[7] California Agricultural Statistics Service, *California Agricultural Statistics 2003*. USDA National Agricultural Statistics Service and California Department of Food and Agriculture, Sacramento, CA (October 2004), p. 77. In addition, California produced 43% of the nation=s fruit (p. 37) and nuts and 21% of its milk (p. 61).

[8] California Agricultural Statistics Service, *California Agricultural Statistics 2003*, p. 2.

[9] USDA National Agricultural Statistics Service, Arizona Statistics Office, *Annual Statistics Bulletin*, *2003*, ACommodities Rank by State: General, Field crops, Fruit@, http://www.nass.usda.gov/az/03bul/pdf/pg89.pdf and ACommodities Rank by State: Vegetables, Livestock@, http://www.nass.usda.gov/az/03bul/pdf/pg90.pdf

[10] USDA National Agricultural Statistics Service and Hawaii Agricultural Statistics, Statistics of Hawaii Agriculture web site, http://www.nass.usda.gov/hi/stats/t_of_c.htm as of 6/7/05, pages 1-18, *Hawaii Agriculture 2003*, p. 2

[11] Seed crops are now third after pineapple and sugar cane in value of production (2003). USDA National Agricultural Statistics Service and Hawaii Agricultural Statistics, Statistics of Hawaii Agriculture web site, Diversified Agriculture Ranking table, http://www.nass.usda.gov/hi/stats/stat-13.htm as of 6/7/05

[12] USDA National Agricultural Statistics Service and Nevada Agricultural Statistics Service,

Reports, Nevada Agricultural Statistics 2003-2004, General, p. 10 (Utilization of Land in Farms and Ranches, Nevada 2002) and p. 13 (Cash Receipts from Farm Marketings, Nevada 2003), http://www.nass.usda.gov/nv/General.pdf

[13] San Joaquin Valley Unified Air Pollution Control Board, *2003 PM_{10} Plan*, Table 4-8, lists several of these as Asignificant source categories within the district=s regulatory authority@; agricultural equipment and agricultural pesticides are listed in Table 4-7 of sources not under the district=s authority. Table 3-12 indicates that dairy farming is the largest source (60 percent of the total) of ammonia, a $PM_{2.5}$ precursor, with poultry and beef also significant sources.

[14] U.S. EPA Methane web site, ASources and Emissions@ page, AHuman-related Sources@ section, http://www.epa.gov/methane/sources.html#anthropogenic as of 6/1/05, and National Research Council, *Air Emissions from Animal Feeding Operations:Current Knowledge, Future Needs*, p. 45-6, which describes several mechanisms through which animal feeding operations contribute ammonia and other nitrogen compounds, VOCs, hydrogen sulfide, and particulate matter to air pollution.

[15] U.S. EPA Ozone Depletion Rules and Regulations web site, AMethyl Bromide Questions and Answers@ page, http://www.epa.gov/spdpublc/mbr/qa.html, especially the section AWhy has EPA taken action on a pesticide under the Clean Air Act,@ as of 6/1/05

[16] Ralph Heimlich, *Agricultural and Environmental Indicators, 2003*, USDA Economic Research Service, Agricultural Handbook No. AH722, February 2003, http://www.ers.usda.gov/publications/arei/ah722/ as of 6/1/05. Section 2.3, AWater Quality Impacts of Agriculture,@ cites findings from three seminal sources:

- U.S. Geological Survey, *The Quality of Our Nation=s Waters B Nutrients and Pesticides: U.S. Geological Survey Circular 1225*. This is a report from USGS= National Water Quality Assessment (NAWQA) Program, which includes the San Joaquin/Tulare watershed as one of twenty selected nationwide for the first round of monitoring. Current status on the web: http://water.usgs.gov/nawqa/ .
- U.S. EPA=s Office of Water, 2000, *Atlas of America=s Polluted Waters*, EPA 840-B-00-002, an official list of impaired waterways required under the Clean Water Act section 303(d). 2002 data is on the web at: http://www.epa.gov/owow/tmdl/
- U.S. EPA=s Office of Water, 1998, *National Water Quality Inventory: 1996 Report to Congress*. The current database of 2002 water quality assessment information provided by the states under Clean Water Act section 305(b) is on the web at: http://www.epa.gov/waters/305b/

  Also, U.S. Department of Agriculture, Natural Resource Conservation Service, *Water Quality and Agriculture: Status, Conditions, and Trends*, NRCS Working Paper #16, July 1997, links soil quality conditions to water quality conditions, though the data is dated

[17] Susan Kegley, et al., *Hooked on Poison: Pesticide Use in California 1991-1998*, Pesticide Action Network and Citizens for Pesticide Reform, 2000, http://www.panna.org/resources/documents/hookedAvail.dv.html as of 6/605

[18] California EPA, Department of Pesticide Regulation, *Summary of Pesticide Use Report Data 2003*: http://www.cdpr.ca.gov/docs/pur/pur03rep/03com.htm; and *Summary of Pesticide Use Report Data 1998* (for data back to 1991): http://www.cdpr.ca.gov/docs/pur/pur03rep/03chem.htm

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[19] California data: California EPA, Department of Pesticide Regulation, *Summary of Pesticide Use Report Data 2003*: http://www.cdpr.ca.gov/docs/pur/pur03rep/03com.htm as of 6/4/05; national data: Timothy Kiely, et al., *Pesticide Industry Sales and Usage: 2000 and 2001 Market Estimates*, Biological and Economic Analysis Division, Office of Pesticide Programs, Office of Prevention, Pesticides, and Toxic Substances, U.S. Environmental Protection Agency, Washington, D.C. 20460, May 2004, http://www.epa.gov/oppbead1/pestsales/01pestsales/market_estimates2001.pdf as of 6/4/05

[20] California Department of Water Resources web site, Agricultural Water Use page: http://www.owue.water.ca.gov/agdev/ as of 6/605

[21] The International Institute for Sustainable Development provides concise, non-technical definitions of several of the terms used here: http://www.iisd.org/susprod/principles.htm (as of 9/21/2005)

[22] The consensus of over 1360 scientists and experts working under the auspices of the United Nations on the Millennium Ecosystem Assessment, in *Living Beyond Our Means: Natural Assets and Human Well-Being*, http://www.millenniumassessment.org/en/products.aspx

[23] Mathis Wackernagel, et al., "Tracking the ecological overshoot of the human economy," *Proc. Natl. Acad. Sci.* USA, Vol. 99, Issue 14, pp. 9266-9271, July 9, 2002; also, Donella H. Meadows, et. al., *Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future*, Chelsea Green, 1992

[24] Paul Hawkins, et. al., *Natural Capitalism:Creating the Next Industrial Revolution*, 1999. See also the Rocky Mountain Institute at http://www.rmi.org. In Europe, the Factor Four and Factor Ten movements promise four- and ten-fold increases in resource use efficiency.

[25] Herman Daly and John R. Cobb, Jr., For the common good: redirecting the economy toward community, the environment, and a sustainable future, Beacon Press, 1994, pp. 44 ff

[26] This section is largely taken from A.V. Krebs, "Corporate Takeover of Agriculture," in Andrew Kimbrell, ed., *Fatal Harvest: The Tragedy of Industrial Agriculture*, Foundation for Deep Ecology, 2002, p. 307

[27] Daly and Cobb, op. cit., pp. 209 ff

[28] Debi Barker, "Globalization and Industrial Agriculture," in Andrew Kimbrell, ed., *Fatal Harvest: The Tragedy of Industrial Agriculture*, Foundation for Deep Ecology, 2002, p. 314,

[29] In addition to the aesthetic value of pastoral and cultivated lands, certain farming practices can improve biodiversity in agricultural areas. See Jeanne Clark and Glenn Rollins, eds., *Farming for Wildlife:Voluntary Practices for Attracting Wildlife to Your Farm*, California Department of Fish and Game, 1996. See also Dan Imhoff and Roberto Carra, *Farming with the Wild*, Sierra Club Books, 2003, and Dana L. Jackson and Laura L. Jackson, *The Farm as Natural Habitat: Reconnecting Food Systems with Ecosystems*, Island Press, 2002.

[30] California Air Resources Board, *Almanac Emissions Projection Data (published in 2005), Estimated Annual Average Emissions, San Joaquin Valley Air Basin*, http://www.arb.ca.gov/ei/maps/basins/absjvmap.htm

[31] US EPA Office of Air and Radiation (http://www.epa.gov/docs/ozone/mbr/mbrqa.html); World Meteorological Organization, *Global Ozone Research and Monitoring Project – Report No. 37: Scientific Assessment of Ozone Depletion: 1994*, Geneva, Switzerland.

[32] According to the USDA-Natural Resource Conservation Service, “The 1996 National Water Quality Inventory, which summarizes state surveys of water quality in the United States, indicates that about 40 percent of surveyed U.S. waterbodies are impaired by pollution, with the leading source being polluted runoff. About 70 percent of impaired rivers and streams and 49 percent of lakes are impaired by runoff or discharges from agriculture.” Source: web site (http://rigis2.nhq.nrcs.usda.gov:80/cleanwater/action/c2c.html), Actions to Strengthen Core Clean Water Programs - Strong Polluted Runoff Controls.

[33] Sacramento River, San Joaquin River, Tulare Lake, and Central Coast watersheds

[34] US Geologic Survey, Central Valley Regional Water Quality Control Board, and the CA Department of Pesticide Regulation

[35] Figures on pesticides use come from United States Department of Agriculture, Agricultural Statistics (http://www.usda.gov/nass/pubs/agstats.htm); Aspelin, A.L. and A.H. Grube. 1999. *Pesticides Industry Sales and Usage: 1996 and 1997 Market Estimates*. US EPA Office of Pesticide Programs, Biological and Economic Analysis Division, Washington, DC; Wilhoit, L. *et al.* 1999. *Pesticide Use Analysis and Trends from 1991 to 1996*. California Department of Pesticide Regulation, Sacramento, CA; and Kegley, S. *et al., Hooked on Poison: Pesticide Use in California, 1991-1998*. Pesticide Action Network, San Francisco, 2000.

[36] “Active Ingredient” refers to the registered portion of the pesticide product. The “inert” or “other” ingredients include carriers, spreader-stickers, and other agents to aid in formulation. Many of these other ingredients are quite toxic, and contribute an additional 150 million pounds per year. See: Marquardt, S. *et al.* 1998. *Toxic Secrets: "Inert" Ingredients in Pesticides*. Northwest Coalition for Alternatives to Pesticides, Eugene, OR.

[37] Data for agriculture is reported under the CA Pesticide Use Reporting (PUR) system; data for industry is reported under the Toxics Release Inventory (TRI). An analysis is published in: *Generations at Risk: How Environmental Toxicants May Affect Reproductive Health in California*. Physicians for Social Responsibility and California Public Interest Research Group, San Francisco, 1999..

[38] Coye, M.J. 1985. The health effects of agricultural production: I. Health of agricultural workers. *Journal of Public Health Policy* 6:349-370. U.S. Congress, Office of Technology Assessment, *Neurotoxicity: Identifying and Controlling Poisons of the Nervous System*, OTA-BA-436 (Washington, DC: U.S. Government Printing Office, April 1990), p. 283.

[39] National Agricultural Statistics Service, Agricultural Statistics Board. 2000. *Farm Labor*. US Department of Agriculture, Washington, DC (http://usda.mannlib.cornell.edu/reports/nassr/other/pfl-bb/2000/fmla1100.pdf).

[40] California Department of Food and Agriculture. 2003. *California Agricultural Resource Directory 2002*. California Department of Food and Agriculture, Sacramento, CA. 176 pp.