The Health-Based Rationale for Hospital Purchase of Sustainable Food

HEALTH-BASED MISSION

Increasingly clinicians who work in hospitals and leading health systems and institutions have been encouraging the leaders and staff at U.S. hospitals to broaden their health-based missions to become role models focused on prevention and community health in addition to providing medical care.

Clinician engagement

Many medical professionals believe that supporting sustainable food systems through hospital purchase of local and sustainably produced foods is a key strategy for promoting and achieving overall improvements in individual and community health. Since 2007, the following professional groups have adopted resolutions that recognize the unique role that hospitals and health practitioners can play in support of sustainable food systems:

- California Medical Association (CMA) (2007)[1]
- American Public Health Association (APHA) (2007)[2]
- American Nurses Association (ANA) (2008)[3]
- Minnesota Academy of Family Practitioners (MAFP) (2008)[4]
- American Medical Association (AMA) (2009)[5]

For instance, the ANA resolution "encourages health care institutions to institute food preference policies to purchase and serve nutritional foods grown according to organic or other methods that support and emphasize sustainable food purchasing, local food systems, renewable resources, ecological diversity, and fair labor practices,"[6] and the stated objective of the AMA Sustainable Food resolution is "to address how medical schools, hospitals, and other health care facilities can model and encourage healthy eating in a manner that supports environmentally sustainable agricultural and food system practices."[7]

In 2007, the Academy for Nutrition and Dietetics (AND) [formerly the American Dietetic Association (ADA)] adopted a position statement "to encourage environmentally responsible practices that conserve natural resources, minimize the quantity of waste generated, and support the ecological sustainability of the food system."[8] This position statement includes information, resources, and specific action-oriented strategies to guide dietitians and technicians in food decision making and professional practice.[9]

Action-oriented strategies for dietitians in food management include the purchase of foods produced with fewer agricultural inputs (e.g., certified organic, grass-fed, or range-fed meats, pastured poultry), purchase of foods direct from local growers (i.e., farm-to-institution) and reduced reliance on imported foods.[10] Since most dietitians work in hospitals, nursing homes and other health care institutions

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2105 First Avenue South Minneapolis, Minnesota 55404 USA iatp.org
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and many of these sustainably raised foods are more expensive than conventionally produced food, support from hospital management will likely be needed for dietitians to implement these procurement focused strategies.

In August 2012, staff at the Division of Nutrition, Physical Activity and Obesity (DNPAO) at the Centers for Disease Control and Prevention (CDC) convened a meeting of healthy hospital researchers and practitioners to discuss the ways in which hospitals can be role models in work site wellness with respect to healthy food and beverage access and promotion among other things.[11] The panel's full recommendations are presented in a report entitled "Healthy Hospital Choices." The food specific recommendations are as follows:

- Hospitals and public health practitioners can collaborate to establish healthy food/beverage standards and measures addressing employee, community and environmental health for hospital venues.
- Hospitals can support food and beverage environmental change strategies (e.g., access, pricing, product placement and menu labeling strategies).
- Public health practitioners can help develop a publicly available healthy food and beverage environment scan toolkit.

Also in 2010, the AND, ANA, American Planning Association (APA) and APHA developed and endorsed a set of shared food system principles to "support socially, economically, and ecologically sustainable food systems that promote health—the current and future health of individuals, communities, and the natural environment."[12] In the *Principles of a Healthy, Sustainable Food System,* the authors agree on a shared definition of a healthy, sustainable food system around the key themes of health, sustainability, resilience, fairness, economics, and transparency (see below). The coalition partners plan to coordinate with other health, nutrition, and planning-related organizations to advocate for improved food systems.[13]

Principles of a Healthy, Sustainable Food System

Definition of a healthy, sustainable food system:

Health promoting

- Supports the physical and mental health of all farmers, workers, and eaters
- Accounts for the public health impacts across the entire lifecycle of how food is produced, processed, packaged, labeled, distributed, marketed, consumed and disposed

Sustainable

- Conserves, protects, and regenerates natural resources, landscapes, and biodiversity
- Meets our current food and nutrition needs without compromising the ability of the system to meet the needs of future generations

Resilient

- Thrives in the face of challenges, such as unpredictable climate, increased pest resistance, and declining, increasingly expensive water and energy supplies

Diverse in

- Size and scale: includes a diverse range of food production, transformation, distribution, marketing, consumption, and disposal practices, occurring at diverse scales, from local and regional to national and global
- Geography: considers geographic differences in natural resources, climate, customs, and heritage
- Culture: appreciates and supports a diversity of cultures, socio-demographics, and lifestyles
- Choice: provides a variety of health-promoting food choices for all

Fair

- Supports fair and just communities and conditions for all farmers, workers, and eaters
- Provides equitable physical access to affordable food that is health promoting and culturally appropriate

Economically balanced

- Provides economic opportunities that are balanced across geographic regions of the country and at different scales of activity, from local to global, for a diverse range of food system stakeholders
- Affords farmers and workers in all sectors of the system a living wage

Transparent

- Provides opportunities for farmers, workers, and eaters to gain the knowledge necessary to understand how food is produced, transformed, distributed, marketed, consumed and disposed
- Empowers farmers, workers and eaters to actively participate in decision making in all sectors of the system.

Hospital models for healthy food

More than 450 hospitals, health systems and long-term care facilities (at least 8 percent of U.S. registered hospitals) across 37 states and the District of Columbia have already committed to purchasing more local, sustainable food by signing the Health Care Without Harm (HCWH) Healthy Food in Health Care (HFHC) Pledge and/or are participating in the Healthy Hospital Initiative (HHI) Healthy Food Challenge.

Pledge signatories have committed to taking the following steps:

- Work with local farmers, community-based organizations and food suppliers to increase the availability of locally sourced food.
- Encourage our vendors and/or food management companies to supply us with food that is, among other attributes, produced without synthetic pesticides and hormones or antibiotics given to animals in the absence of diagnosed disease and which supports farmer health and welfare, and ecologically protective and restorative agriculture.
- Increase our offering of fruit and vegetables, nutritionally dense and minimally processed, unrefined foods and reduce unhealthy (trans and saturated) fats and sweetened foods.
- Implement a stepwise program to identify and adopt sustainable food procurement. Begin where fewer barriers exist and immediate steps can be taken.
- Communicate to our group purchasing organizations (GPO) our interest in foods that are identified as local and/or third-party certified.
- Educate and communicate within our system and to our patients and community about our nutritious, socially just and ecological sustainable food healthy food practices and procedures.
- Minimize or beneficially reuse food waste and support the use of food packaging and products which are ecologically protective.
- Develop a program to promote and source from producers and processors which uphold the dignity of family, farmers, workers and their communities and support sustainable and humane agriculture systems.[14]

Participants in the HHI Healthy Food Challenge must have signed the HFHC Pledge or formally adopted a sustainable food policy and commit to achieving one or more of the following:

- Decrease amount of meat purchased by 20 percent within three years from baseline.
- Increase the percentage of healthy beverage purchases by 20 percent of total beverage purchases annually over baseline year OR achieve healthy beverage purchases of 80 percent of total beverage purchases for use throughout the hospital (patient, retail, vending and catering) within three years.
- Increase the percentage of local and/or sustainable food purchases by 20 percent annually over baseline year OR achieve local and/or sustainable food purchases of 15 percent of total food dollar purchases, within three years.[15]

PATIENT SATISFACTION

A patient's hospital food experience can influence a hospital's Press Ganey and other patient satisfaction scores, including the new Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). While the HCAHPS survey does not include food specific questions, according to FoodService Director's 2012 Hospital Census Report "a patient's experience with food greatly affects certain categories, such as the overall hospital experience."[16] As of October 2012, patient satisfaction scores have become even more important, because they will be factored into how much Medicare and Medicaid reimbursement hospitals receive.[17,18]

Serving more local, sustainable foods to patients can have a positive impact on patient satisfaction. In 2006, prior to creating their Plow to Plate® initiative and making changes such as using fresh, local ingredients whenever possible, New Milford (Conn.) Hospital had low Press Ganey scores for their inpatient food service—in the 30th percentile nationally.[19] As of 2012, New Milford Hospital's Press Ganey scores for dining services ranked in the high nineties.[20]

FOOD SERVICE EMPLOYEE SATISFACTION

Hospitals have also reported improvement in satisfaction among food service employees after starting to serve more fresh, local, sustainable foods. For instance Pam Oldham, co-director of food and nutrition services for Mercy Medical in Cedar Rapids, Iowa, reported that, despite some initial challenges due to additional food prep instead of opening packages, cafeteria patrons noticed employee efforts and "employees felt proud of what they were producing."[21]

POSITIVE IMAGE

There are now many examples of hospitals getting positive local, national and sometimes even international press attention for providing fresh, local, sustainable food to patients and staff as well as attracting more business from their local communities due to these improvements. Some recent examples include:

- 9 Hospitals With Food That's Worth Eating, The Daily Meal (December 2012)[22]
- The Ins and Outs of Hospital Food, Gloucester Times (September 2012)[23]
- Watertown Regional hospital chef is starting from scratch, JSOnline Milwaukee-Wisconsin Journal Sentinel (August 2012)[24]
- Sustainable nutrition services offered at Hudson Hospital, Hudson Star-Observer (June 2012)[25]
- Hospital Food So Fresh, Even The Healthy Come To Dine, The Salt (May 2012)[26]

Hospitals and hospital food service staff, especially chefs, are also receiving recognition and awards for this work. For example:

- New Milford Hospital (Conn.) received a 2009 Spirit of Planetree Award in the "Nutritional and Nurturing Aspects of Food" category, the Glynwood Center Harvest Award for "Good Food for Health" in 2010 and a 2012 Gold Level Connecticut Quality Innovation Award (CQIA) Innovation Prize for its success at building and sustaining a healthy dining experience for its patients, employees and the community.
- Holly Emmons, food service manager at Union Hospital (Md.) won a Smart, Green and Growing Buy Local Agricultural Challenge Award from Maryland's governor in 2011.
- Fletcher Allen Health Care (Vt.) won a HFHC Sustainable Food Procurement Award in 2011 and 2013.
- John Muir Medical Center (Concord, Calif.) won two HFHC awards in 2011, a Sustainable Food Procurement Award and a Food Climate Health Connection Award.

"New Milford Hospital's award recognizes its healthful culinary achievements following a six-year journey that has helped the community hospital achieve patient satisfaction scores among the nation's best for overall meals and quality of food.

Specifically among its inpatient population, the hospital reached the 98th percentile nationally for overall meal satisfaction (up from 51 percent) and currently ranks in the 99th percentile for quality of food throughout the United States (compared to the previous 38 percent).

Additionally, the hospital has continually increased satisfaction among staff, physicians and local community members who visit its café, generating a 25 percent increase in sales between 2009 and 2011.

"Food is central to our community's health and well-being. When our patients and employees had concerns years ago, we decided to make food service a top priority," stated Deborah Weymouth, senior vice president and executive director, in a news release. "We committed to develop a culture rooted in the belief that a healthful, sustainable food system and exceptional customer service are integral to the patient experience."[27]

MARKET SHIFTING POTENTIAL

Hospitals spend a significant amount of money each year to produce food and beverage items for their food service operations—patient food, retail (cafeterias, cafes, etc.) and catering. Since most hospitals currently spend very little, if any, of this money on sustainably produced food, local or otherwise, dedicating even a small portion of every hospital's annual food purchases to sourcing local, sustainable food, can positively affect human and environmental health and contribute to the economic health of the communities in which the food is produced, especially when hospital dollars are used to purchase directly from small and mid-scale farmers in their community.[28,29,30] See the IATP report *Connecting Sustainable Farmers to Hospitals—A Hospital-Focused Report* for more on the health care market for sustainable foods.

FOOD- AND FOOD SYSTEM-RELATED HEALTH IMPACTS

Overview

Food-related health effects can be immediate or longer term. Food allergies can be life-threatening and ingestion of food-borne or waterborne pathogens sickens millions of people and results in thousands of deaths each year in the U.S.[31] The way food is produced, processed, packaged, delivered and purchased can also negatively impact the health and well-being of individual farmers and farm workers, meat handlers, and communities downwind and downstream. Illnesses also may result from long-term dietary exposure to one, some or many of a wide variety of heavy metals and synthetic chemicals commonly used in food production, processing and packaging. Chronic diseases, such as heart disease, cancer and diabetes, also often food-related, account for 75 percent of U.S. health spending.[32] Like Type-2 diabetes and many forms of cancer and heart disease, most food- and food system-related illnesses are preventable.

Low prices, convenience, and product uniformity have been the primary benefits of the portion of the U.S. food system, commonly referred to as "conventional" agricultural. Menu planning and food budgets of all U.S. hospitals reflect these benefits.

But industrial scale food production is based on a range of often unhealthy and unsustainable practices that result in costs not reflected in these low prices—contaminated crops, meat and animal waste; degraded air, water and soil quality; increased greenhouse gas emissions; declining health and inferior nutrition; and increased and unnecessary on and off-farm exposure to chemical toxicants, antibiotic-resistant bacteria, and exogenous hormones, all of which may contribute to otherwise preventable illness and disease.

Four strains of antibiotic-resistant salmonella sicken meat eaters in 2011

April 2011. Twelve people were sickened in 10 states and three hospitalized by Jennie-O Turkey Store turkey burgers contaminated with Salmonella Hadar; 54,960 pounds of turkey burgers were recalled.

August 2011. Salmonella Heidelberg sickened 136 people in 34 states and one death was reported; 36 million pounds of ground turkey were recalled by Cargill Meat Solutions.

November 2011. Chicken livers tainted with Salmonella Heidelberg sickened 179 people in six states; Schreiber Processing Corp. recalls chicken livers.

December 2011. Twenty people from seven states were infected with Salmonella Typhimurium, including seven who were hospitalized; Hannaford, a Scarborough, Maine-based grocery chain, recalled an undetermined amount of fresh ground beef products.[33,34]

These costs are primarily borne by farmers, their families and employees, processing plant workers, natural resources and rural communities downwind and downstream, and secondarily by consumers and the global community.

The industrialization of agricultural methods also has contributed to crop and food animal production being highly concentrated in various parts of the country, with less and less agricultural diversity found regionally and locally. This geographical concentration in production leads to regional concentration of agriculturally-related waste products, air and water pollutants.[35,36,37] It has also made long-distance transportation of food items routine, whether by ship, tractor-trailer or plane, contributing to air quality issues and greenhouse gas concentrations that further threaten human and ecological health.

Going from a diverse agricultural landscape with lots of small and mid-scale farms producing a heterogeneous mix of crops and food animals to a small number of very large farms growing significant amounts of one or two types of crops or food animals has also made food animals and crops more vulnerable to disease, led to significant loss of soil, and resulted in thousands of mid-scale farms going out of business in Minnesota, Wisconsin, and rural communities throughout the U.S. According to the Census of Agriculture, there were 2.2 million farms in the U.S. in 2007, and of these farms, 125,000 produced 75 percent of the value of U.S. agricultural production; most earned a million or more in sales.[38] As farms have gone out of business so have processing facilities, with many of the remaining facilities dedicated to serving the very large-scale producers or being owned outright by multi-national conglomerates.

The demise of these farms has been a boon for land speculators who have begun to buy up U.S. farm land as a hedge against the predicted effects of climate change. Thus, industrial-scale food production, which is highly fossil-fuel dependent, has contributed to climate change overall and the transfer of U.S. agricultural lands from farmers to investors who then rent the land to new farmers.

Climate change is predicted to have varying effects on the agricultural landscape, some areas of the world may benefit while other previously thriving agricultural communities may suffer. By the end of the century, it is predicted that

summers in the Upper Midwest may be comparable to those in present-day Texas and Oklahoma.[39] Heavy rainfall events are expected to be two to three times more frequent than in the past, causing increased flooding.[40] More water shortages and periods of drought are also predicted as a consequence of increased evaporation from warmer summers. While effects will vary across the U.S., it is clear that industrial-scale food production has made U.S. food production increasingly vulnerable to both flooding and drought, while decreasing the resilience of the overall food system and inhibiting our capacity to adapt.

Fortunately, use of sustainable agricultural methods, such as those used in organic farming, can lead to beneficial improvements in soil and water quality and rural community economics;[41] reduced energy consumption, atmospheric greenhouse gas concentrations and build resilience to extreme weather events associated with climate change,[42] as well as reduce unnecessary exposure to potentially harmful substances; and in some instances, has been shown to enhance the nutritional quality of certain foods, such as milk and beef.[43] Buying products from small and mid-scale producers can help to re-diversify U.S. agricultural production, especially in the Upper Midwest, and to keep more of hospital's food dollars in the local economy and circulating longer than they do when they go to larger-scale farms here or elsewhere.[44,45,46]

Antibiotics

Status quo

Antibiotics are administered for nontherapeutic purposes in large-scale farming operations where beef cattle, chickens, hogs, turkeys and farmed fish and shellfish[47] are raised in crowded, stressful and often unsanitary conditions. The U.S. Food and Drug Administration (FDA) has established withdrawal periods to help ensure that no residues are left in the meat prior to slaughter, but residues are not the most concerning public health issue. More concerning is that the enormous, routine, and largely unnecessary addition of antibiotics to animal feed spurs the formation and spread of bacterial resistance from the farm to human populations.

"According to the [FDA], 80% of all antimicrobials sold in this country—nearly 30 million pounds per year—are used in food animals. Ninety percent of those are added to animal feed or their drinking water at nontherapeutic dosages for what are nontherapeutic purposes, such as promoting growth. The overuse of antibiotics is a primary driver in the formation and spread of antibiotic resistance. The extensive use of antibiotics in animal feed, therefore, promotes resistance, resulting in the spread of more drug-resistant bacteria on meat, in waterways and among farmers and veterinarians.

There is both a human and financial toll to antibiotic overuse. In the [U.S.] alone, an estimated 900,000 cases of antibiotic-resistant infection occur annually; methicillin-resistant Staphylococcus aureus [MRSA] alone is responsible for 18,650 deaths and 94,000 cases of infection. Antibiotic-resistant infection also results in longer hospitalizations, which cost the U.S. health care system $20 billion a year. Lost productivity and other societal costs add another $35 billion to the annual cost."[48]

"More resistant infections mean more patients now receive antibiotics previously held in reserve that may be less potent or convenient, or inherently more toxic—like vancomycin."[49]

Company policies on antibiotics use, when they exist, can be vague and difficult for the lay person to decipher. A few examples are included below. Most indicate that they comply with legally mandated withdraw periods before slaughter and otherwise follow the law, but little else. Others indicate that antibiotics likely are being used routinely to compensate for poor husbandry conditions—prevent disease or transmission of disease (and possibly given to promote growth even though that is not their stated purpose)—and not just to treat sick animals.

- **PILGRIM'S PRIDE**—"We use antibiotics only as instructed by our federally accredited and licensed poultry veterinarians. The antibiotics are used in strict accordance with FDA and USDA guidelines, leaving our products free of harmful residues—a fact verified by on-site USDA sampling."[50]

- **HORMEL FOOD CORPORATION**—"Licensed veterinarians prescribe only approved medications and dosage levels to properly treat, control and prevent illness in animals. All medications are regulated by the FDA, which evaluates any potential negative effects on human health and the environment and any impact on resistance."[51]

- **TYSON**—"FDA-approved antibiotics and antimicrobials may sometimes be used by Tyson Foods for the well-being of our chickens"[52]

Methicillin-resistant Staphylococcus aureus (MRSA) cases at two large-scale poultry operations

July 2008

"At least 8 employees from the Pilgrim's Pride Hatchery are on a leave of absence right now. Several of them confirmed to Today's THV they have a form of community acquired or CA-MRSA....employee[s] have been sick on and off for about a year....'Everyone in the hatchery has had it, but none of their family members has had this and that tells you right there it's at the hatchery....' Vickie Smith says. Smith is speaking on behalf of friends who are currently employed at the Batesville Pilgrim's Pride hatchery. Together she says all three of them have had CA-MRSA 23-times. Smith adds, 'They complain about the pain. If they bump it they almost cry because it's so painful and they say it feels like their heart is beating with the mosquito like sore.' 'There are 32 people in the building and thirty have had it multiple times.' This employee wants to remain anonymous. He says he had CA-MRSA in February and April. He continues, 'You go in everyday and you don't know if you're going to get to work the next day. There have been people take off five weeks at a time and that's five weeks without any income.' Pilgrim's Pride spokesperson Ray Atkinson says, 'We discovered the first cases a year ago. Since then we've added hand washing stations and sterilized suits for employees. Unfortunately, we're continuing to see a number of cases and we've hired experts in MRSA research and we're cleaning the facility weekly.'"[53]

August 2009

"About two years ago, dozens of workers at a large chicken hatchery in Arkansas began experiencing mysterious skin rashes, with painful lumps scattered over their hands, arms and legs. 'They hurt real bad,' says Joyce Long, 47, a 30-year veteran of the hatchery, where until recently, workers handled eggs and chicks with bare hands. 'When we went to the doctor and got cultured, he told us we had the worst kind of sickness—a superbug.' Its name, she learned, was MRSA, or methicillin-resistant Staphylococcus aureus....

Soon, co-workers at the nearby processing plant, where each day hundreds of thousands of chicken carcasses are prepped for sale, began finding the lumps. Dean Reeves, an 11-year plant employee, went to emergency room with an excruciating bump on her thigh that she thought was a spider bite. It wasn't: She, too, had contracted MRSA. Since November 2007, Reeves, 50, and her husband, Bill, 46, who also works at the processing facility, have experienced relapses every single month. Even the safety glasses, gloves, and smocks workers wear—along with additional cleaning of the plant's equipment instituted by its owner—aren't enough to protect them from the pathogen, says Bill. 'We work so fast we often stick ourselves with scissors or knives, and get blood slung on us from head to foot,' he explains. When a large swelling appeared over one of his eyes, he was told he might go blind; if the MRSA infection progressed to his brain, he'd die."[54]

The alternative

Farmers who use organic or other sustainable production methods generally eschew the routine use of antibiotics. Instead, animals are given more space, are allowed to express their natural behaviors; waste is less concentrated, less contaminated, and removed more frequently from housing; and sick animals are sequestered, treated and often sold separately. Some farmers are audited annually by an independent, third-party organization to assure consumers that they have engaged in these and other similar practices. Farms that pass audits are allowed to use the applicable certification program's logo/eco-label when marketing their products. The following eco-labels demonstrate that meaningful limits have been placed on the use of antibiotics in meat and poultry: American Grassfed Certified, Animal Welfare Approved, Certified Humane Raised & Handled, Food Alliance Certified, USDA Organic, and USDA Process Verified Never Ever 3. The new Aquaculture Stewardship Council (ASC) Certified label can be used to verify that antibiotics were not used for prophylactic purposes in farmed fish.

In the absence of one of these third-party eco-labels, hospitals can use the following USDA-allowed label claims to identify meat and poultry products that were produced without use of antibiotics—"Raised Without Antibiotics" and "No Antibiotics Added." Since producers making these claims are not subject to an independent audit, they are not as reliable as the eco-labels listed above, but companies tend to watch closely what their competitors say, and report what they believe to be false claims.

When purchasing directly from a farm that has not sought approval to carry one of the above-listed eco-labels, hospitals should ask the farmer or rancher if they give their animals antibiotics, if yes, what for and how often. Many farmers now have websites where they will list this type of information. Someone from the hospital can also visit the farm, if deemed necessary; ask to see records of any antibiotics given to treat illness in the current flock or herd and/or to be shown any bags or containers the feed is delivered in to assure that they do not contain antibiotics.

Further Reading

Antibiotics, Animal Agriculture and MRSA: A New Threat, www.iatp.org/files/421_2_107139.pdf.

Buying Better Chicken: A Resource to buying chicken Raised without Antibiotics and Arsenic for Schools, Hospitals and Other Purchasers, www.iatp.org/files/Buying%20Better%20Chicken042011.pdf.

No Time to Lose: Science Supporting Public Health Action to Reduce Antibiotic Overuse in Food Animal, www.iatp.org/documents/no-time-to-lose.

Our Unhealthy Food System: Why physicians' voices are critically needed, www.minnesotamedicine.com/PastIssues/December2012/ourunhealthyfoodsystem.aspx.

Chemical toxicants

Status quo

Many types of chemicals factor into conventional agricultural production. Some are used intentionally to speed growth in food animals, kill pests and weeds, and boost crop yields, while others are used to manufacture synthetic fertilizer. These chemicals are also found in human and animal waste-based fertilizers, including both sewage sludge and manure from cattle, hog, and poultry concentrated animal feeding operations (CAFOs), which can be laden with antibiotics and arsenic.

Pesticides

As of 2007, the latest year for which there is data, it was estimated that 684 million pounds of conventional pesticide active ingredients were used in U.S. agriculture.[55] This represented 80 percent of the 857 million pounds of pesticides used for all purposes in that year. Agricultural pesticides have been linked to a range of chronic health effects including cancer, neurologic and endocrine (hormone) system disorders, birth defects and other chronic diseases.

FARM WORKERS AND RURAL FAMILIES

Though more attention is often paid to the health impacts of eating foods containing pesticides residues, farmers and farm workers have the greatest exposure to pesticides and face greater pesticide-related health threats, including both acute poisonings and long-term health effects such as cancer and Parkinson's Disease.[56,57] They are often the ones to mix or apply pesticides. They plant, weed, prune, harvest and process crops, and they often live in or near treated fields. They may also expose their family members by inadvertently carrying pesticides home from the field on their clothing and skin.[58]

FETUSES AND CHILDREN

Fetuses and children are especially vulnerable to the acute and chronic health effects of pesticides. Fetal exposure can lead to birth defects, developmental delays and autism. The children of farmers and farm workers can be exposed to agricultural pesticides brought home on the clothes and shoes of their parents, in household dust and in drinking contaminated water and food. Also, as many as 500,000 children work as hired labor in fields and orchards.[60]

For children not living in rural communities, food is a significant source of exposure to high toxicity organochlorines, such as dichlorodiphenyltrichloroethane (DDT), a banned insecticide that still persists in the environment, and organophosphate insecticides including chlorpyrifos and methyl parathion.[61] The average American child between the ages of six and eleven carries unacceptable levels of both chlorpyrifos and methyl parathion.[62] Both are neurotoxins and suspected endocrine disruptors.[63,64]

Between seven and nine million pounds of chlorpyrifos were used to treat crops in 2007, making it the most commonly used conventional insecticide active ingredient in U.S. agriculture.[65] In California, where the greatest data on agricultural use of pesticides has been collected, chlorpyrifos is used on almost every type of produce including: nuts, vegetables such as broccoli, cabbage and cauliflower, fruits such as citrus, grapes for wine, table and raisins and strawberries, beans and wheat.[66] In 2009, the highest volumes were applied to almonds, walnuts, oranges, grapes and broccoli.[67] The highest volumes of methyl parathion were applied to walnuts, potatoes, onions, leaf lettuce and dried beans.[68]

Concerns about the role of pesticides in causing both acute and chronic health effects in children led the American Academy of Pediatrics (AAP) to adopt a position statement in 2012 on pesticide exposure in children. In it they encouraged pediatricians to advocate for increased use of integrated pest management (IPM) practices and for government to adopt policies to encourage farmers to use IPM.[69] Through IPM pest damage is managed by the most economical means, and with the least possible hazard to people, property and the environment.[70]

ALL AMERICANS

Most Americans are exposed to multiple agricultural pesticides through consumption of contaminated food. The USDA conducts routine nationwide testing of washed ready-to-eat produce, beef, grains, milk, pork, poultry and water.[71] Funding level usually determines the number of commodities tested each year. As of 2005, funding only allowed for testing of 20 agricultural commodities.[72] The

Food workers among the most affected

Of the 20 million workers employed throughout the U.S. food chain, nearly 3 million are involved in producing the raw products (growing, raising and harvesting) and another 1.3 million are engaged in processing. The remainder is involved in distribution, retail and service. Most of the 20 million are front-line workers. These and the other illuminating statistics that follow are based largely on the results of a survey of more than 600 food chain workers, nearly half of whom worked on farms and in processing plants, and are reported in *The Hands that Feed Us*, published in 2012.[59]

Key survey results for farm workers:

- 54 percent reported being exposed to toxic chemicals and another 10 percent did not know if they had been exposed.
- 16 percent reported being asked by their employers to do something that would put themselves at risk, including working in the rain, working in the dark, working in sub-freezing temperatures, jumping over ditches, spraying without proper training and picking during or right after spraying.
- 23 percent reported that there were 10 to 20 minors in their workplace, ages 12-17.

Key survey results for processing plant workers:

- 65 percent reported experiencing injuries or illnesses on the job, and among those workers, the most frequently reported injuries were: cuts (37.8 percent of injured processing workers), repetitive motion injuries (34.6 percent), slips and falls (26.8 percent), and back injuries (25.2 percent).
- Processing plant workers are often exposed to extreme cold temperatures intended to preserve food safety, but which result in regular illness.

Key survey results all food workers:

- More than 86 percent of workers surveyed reported earning low or poverty wages.
- Food system workers use food stamps at double the rate of the rest of the U.S. workforce.
- Due to a lack of sick days provided by employers, more than half (53 percent) of the workers surveyed reported picking, processing, selling, cooking and serving food while sick, an average of at least three days per year.
- Due to a lack of employer-provided health benefits, more than one third of all workers surveyed (34.8 percent) report using the emergency room for primary health care. In addition, 80 percent of these workers are unable to pay for such care.

Environmental Working Group (EWG) reviews this data to develop its list of the foods most commonly contaminated with pesticides. In their latest review, conducted in 2012 EWG found that 68 percent of tested food samples had detectable pesticide residues after they had been washed or peeled.[73] Though DDT has not been used since 1972, 99 percent of Americans have tested positive for DDT degradants; 93 percent for metabolites of chlorpyrifos.[74] These are just two of the many active pesticide ingredients found by USDA and FDA scientists in produce.

Nearly half of fresh fruit, two-thirds of canned fruit and approximately one-third of fruit juice consumed in the U.S. are imported.[75] According to The Organic Center, on average, pesticide risks are over three times higher for imported produce than produce grown in the U.S.[76] More information on the types of pesticide residues found on food and their documented health effects can be found on the Pesticide Action Network website, www.panna.org.

NATURAL RESOURCES

The environmental impacts of agricultural pesticide use include:

- Soil contamination
- Water and air pollution
- Loss of biodiversity and elimination of key species (e.g., bees)
- Pest resistance, resulting in the need for increased application of pesticides or formulation of alternate pesticides

No scrubbing to safety

Though washing and peeling produce before eating may help to reduce pesticide exposure, they do not remove all residues or other contaminants such as those found in sewage sludge. Residues from many pesticides could still be found on produce samples that government scientists washed and peeled prior to testing. Also, some pesticides, as well as some contaminants in sewage sludge (see below) are taken up by a plant's roots and distributed throughout the plant, so no amount of washing will remove them. According to Pesticide Action Network, at least one analysis has shown that "systemic insecticides account for about 60 percent of dietary risk in domestic crops. Included in this class of pesticides are genetically engineered crops like Bt corn, which express an endotoxin that is likewise impossible to wash off. The average ear of U.S.-grown corn likely has three different systemic insecticides coursing through its tissue."[77]

Arsenic-based feed additives and pesticides

Until very recently arsenic compounds were widely used in poultry and approved for use in hog feed. While initially approved to help control parasites, for decades arsenicals have been added to feed to speed weight gain and to create the appearance of a healthier color. In her blog "Food for Thought," Carole Morrison, veteran contract chicken farmer for an international corporation writes, "Mostly unknown to the outside world, arsenic is a routine feed additive for industrially produced chickens no matter if cocci [bacteria] is present or not or diagnosed by a veterinarian…"[78]

In December 2009, IATP and the Center for Food Safety (CFS) requested via a formal Citizen Petition (FDA-2009-P-0594) that FDA among other steps "immediately suspend the approval of all new animal drug applications (NADAs) for arsenic-containing compounds used as feed additives for food animals." FDA responded in June 2010 by saying that it needed more time to study the issue.

In 2011, following the completion of an FDA study that detected inorganic arsenic at higher levels in the livers of chickens treated with 3-Nitro than untreated chickens, Alpharma, the maker of 3-Nitro (also known roxarsone) agreed to suspend sale of its product.[79] Prior to this suspension roxarsone was the most commonly used arsenic feed additive in the U.S.[80]

In 2012, Maryland became the first state to ban the sale or use of any chicken feed containing roxarsone. The law went into effect in January 2013, but it only affects the sale or use of one type of arsenical used in one type of animal—chicken (ranking 33rd in the nation, Maryland does not have a lot of commercial hog production)[81]. The Maryland law also contains a provision that would lift the ban if, after studying the issue, the FDA finds the product is safe to use in poultry.[82,83] According to the Baltimore Sun, no timeline for review has been established.

Then, in May 2013, attorneys at CFS filed a lawsuit on behalf of CFS, IATP and seven other U.S. food safety, agriculture, public health, and environmental groups to compel FDA to respond to the groups' three year-old petition. See more at http://www.iatp.org/documents/fda-ignores-toxic-arsenic-in-animal-feed. In September 2013, after receiving letters from the FDA requesting additional information about the presence of arsenic in animal tissue, two other major feed manufacturers announced they would withdraw their arsenical products from the market. Zoetis requested that the FDA withdraw approval of roxarsone and carbarsone on September 19, and Fleming Laboratories, Inc. requested that FDA withdrawal approval of arsanilic acid on September 26. See more at http://www.iatp.org/blog/201310/big-win-to-eliminate-toxic-arsenic-in-meat.

Unfortunately, FDA recently denied the CFS and IATP request to withdrawal approval of nitarsone—the last major arsenic-containing compound still used as a feed additive for food animals, pending consideration of additional information that FDA expects to be available at the end of the first quarter of 2014.

Arsenic use in food animals is a concern because it results in arsenic residues in meat, as well as arsenic contamination of manure, agricultural lands and water supplies.

> Inorganic arsenic causes cancer. Adult cancers may form decades after in-womb exposure to arsenic because it re-programs some genes responsible for proper hormone function. Recent research shows arsenic affects at least 187 different genes, about a quarter of which impact how estrogen or other steroid hormones work in the body. Arsenic now appears to also interfere with thyroid function, essential for normal brain development as well as adult function. Researchers see arsenic-related hormone effects even at exposures below 1parts per billion (ppb), or more than 10 times lower than the legal limit for arsenic in drinking water…[84]

Not long after the first arsenic-based additive was approved for use in poultry and swine feed, the extensive use of lead-arsenate insecticides on fruit trees, especially on apple orchards, was winding down and eventually banned in the U.S. in the 1980s.[85] However, since heavy metals persist in the environment, residues still contaminate soils wherever apples were grown between the 1890's and the 1950's, including Wisconsin and Minnesota. According to the Wisconsin Department of Health Services the longer a property was an orchard, the higher the soil pesticide concentration.[86] Crops produced from soils contaminated from previous treatment with lead-arsenate or naturally occurring arsenate may contain these contaminants. Many other countries also used lead-arsenate insecticides including China, which was still allowing use until at least the year 2000.[87] According to the Consumer Reports, China is now the world's major exporter of apple juice concentrate and provided two-thirds of the U.S. apple juice supply as recently as 2011.[88]

Sewage sludge, also known as biosolids

Since the early 1990's, when ocean dumping of sewage was banned, sewage sludge, the semi-solid to solid matter left over following municipal wastewater treatment, has been rebranded as "biosolids" and used as fertilizer by farmers, ranchers and landscape contractors. Sewage sludge is also used for home use under a variety of brand names, e.g., Milorganite® made from Milwaukee's treated sewage. Sewage sludge commonly contains nutrient-rich fecal matter along with bacteria, viruses, parasites, heavy metals, pharmaceuticals and other chemical contaminants—many known to cause health effects.

Though legal, the benefits touted by municipalities and states across the U.S., the use of sewage sludge as fertilizer for food production increases the risk of exposure to sludge contaminants and their associated health effects for consumers and people in the vicinity of application sites. For more than two decades, this latter claim has been hotly debated in rural communities where sewage sludge is spread, but a new study published in Environmental Health Perspectives on March 12, 2013, found that sewage sludge may be causing illness in people up to a mile from where the sludge is spread on land.[89]

The study involved residents from North Carolina, South Carolina and Virginia who live near fields where sludge is applied as a soil amendment. Epidemiology researchers from the Gillings School of Global Public Health at The University of North Carolina in Chapel Hill conducted the study in which more than half of the participants reported acute symptoms such as burning eyes, diarrhea, nausea and vomiting after sludge had been applied to nearby fields. According to the press release, people who live near fields sprayed with waste from industrial swine operations have reported similar symptoms.

Because some of these contaminants are highly persistent, repeated applications of sewage sludge to the same piece of land can increase soil contaminant levels and possibly food contaminant levels for centuries to come. When used for agricultural purposes the sludge can be applied to land used to raise crops for both human and animal consumption or it may be applied to pastureland used to graze cattle, sheep, goats, etc. Use of sewage sludge-based fertilizer is prohibited in production of organic food.

Off-farm toxicants

Also, though not discussed here, between the farm and final purchase of food and beverage items, other chemicals such as food dyes and preservatives are often added, some of which have been shown to have deleterious effects. Chemicals can also leach from food packaging. For more information on the incidence and health effects of these chemicals, see the "Further Reading" list in this section.

The alternative

Farmers who use organic or other sustainable production methods, such as integrated pest management (IPM), generally avoid use of arsenic-based and synthetic pesticides and sewage sludge. While IPM takes a least toxic approach, pesticides may still be used as a last resort. In contrast, certified organic food production applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals.

In addition to the USDA Organic standards, the standards for several other third-party certified eco-labels place meaningful limits on the use of pesticides in crop production and/or on and around food animals, in feed and to grow feed crops including: American Grassfed Certified, Animal Welfare Approved, Certified Humane Raised & Handled, Certified Naturally Grown, Fair Trade USA, Fairtrade International, Food Alliance Certified, Protected Harvest, Rainforest Alliance Certified, Salmon Safe and Wisconsin Healthy Grown Potatoes.

There is currently no meaningful USDA or FDA allowed label claim related to agricultural use of pesticides. Many small-and mid-scale farms essentially follow organic standards without seeking certification, but farmers should be asked to describe their approach to insect, rodent, mold and weed management as applicable to their operations. Also, though not a third-party certification, a growing number of farmers are becoming peer-certified to meet a new standard called "Certified Naturally Grown."

Further Reading

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Driving Down Pesticide Risks, www.organic-center.org/reportfiles/DRIfinal11-1[1].pdf

Fields of Poison 2002 California Farmworkers and Pesticides, www.panna.org/sites/default/files/FieldsOfPoison.pdf

Feeding Arsenic to Poultry: Is this Good Medicine? www.noharm.org/lib/downloads/food/Feeding_Arsenic_to_Poultry.pdf

The Hands that Feed Us: Challenges and Opportunities for Workers along the Food Chain, www.foodchainworkers.org/wp-content/uploads/2012/06/Hands-That-Feed-Us-Report.pdf

Not So Sweet: Missing Mercury and High Fructose Corn Syrup, www.iatp.org/files/421_2_105026.pdf

Organic Essentials: A comprehensive guide for identifying safe and nutritious food, www.organic-center.org/reportfiles/TOC_PocketGuide_2011.pdf

Potential Health Impacts of Certain Persistent and Other Chemicals Detected in Sludge, www.iatp.org/files/421_2_104204.pdf

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Smart Guide to Food Dyes: Buying Foods That Can Help Learning, www.iatp.org/files/421_2_105204.pdf

Smart Guide on Sludge Use in Food Production, www.iatp.org/files/421_2_104203.pdf

Smart Plastics Guide: Healthier Food Uses of Plastics, www.iatp.org/files/421_2_102202.pdf

2012 Shopper's Guide to Pesticides in Produce, www.ewg.org/foodnews

Still Poisoning the Well: Atrazine Continues to Contaminate Surface Water and Drinking Water in the United States, www.nrdc.org/health/atrazine/files/atrazine10.pdf

What's on my food? www.whatsonmyfood.org/index.jsp

Hormones

Exogenous hormones–those originating outside the body–are approved for use in cattle and sheep raised for meat production to speed up growth, in dairy cattle to boost milk production[90] and in fish-farming to spur reproduction.[91] It is illegal to use hormones in poultry and hog production.

Status quo

Beef

Hormones routinely given to U.S. beef cattle to spur faster growth end up in the meat, and ultimately, our bodies. The Food and Drug Administration (FDA) banned one synthetic estrogen, DES, as an animal growth promoter in 1979. But at least three natural steroids and three synthetic surrogates remain in widespread use as growth hormones by U.S. and Canadian beef cattle producers. One of them, trenbolone acetate, is thought to have 8–10 times greater anabolic activity than testosterone. A 2004 congressional investigation also revealed that the U.S. veal industry had been giving trenbolone implants to more than 90 percent of veal calves; an illegal practice the industry admitted had been commonplace for decades.

Though illegal in Europe since 1988, the U.S. government's position is that hormone residues in beef from adult cattle pose no threat to human health. This safety presumption, however, rests mostly on outdated research concerning the ability of estrogen (estradiol) to mutate genes. The latest research suggests instead that harm from early life exposure to hormones and hormone-disrupting chemicals could stem not from their ability to change the genes, but rather their ability to change the crucial protein environment surrounding the genes called the epigenome. It is this protein environment that determines, in part, at which points in one's life particular genes will be turned on and off. By changing this environment, hormone exposure early in life may basically re-program the body's resilience, reproduction and metabolism later in life…[92]

Dairy cattle

rBGH (recombinant bovine growth hormone, also known as rBST) is a genetically engineered growth hormone injected into dairy cows to increase milk production. rBGH is unnecessary to produce milk. Though declared "safe" by the FDA, food safety officials in many other countries—including Canada, Japan, Australia, New Zealand and all 25 nations of the European Union—have refused to approve its use. Concerns with use of rBGH revolve around its known adverse impacts on dairy cows (including increased mastitis infections needing antibiotic use) and the potential harm to humans. Increased antibiotic use in food animals contributes to antibiotic resistance transmitted to humans. rBGH use also increases levels of a hormonal growth factor called IGF-1 in cows and

in cow's milk. Increased IGF-1 levels in humans have been implicated in higher rates of colon, breast and prostate cancer. As yet, the science is insufficient to assure the safety of drinking milk from cows given rBGH because it is unknown whether doing so will also increase IGF-1 levels in the human bloodstream.[93]

Aquaculture

In captivity, most fish do not reproduce successfully. Fish hatchery operators inject hormones into male and female fish so that they breed. Chorionic gonadotropin, a human hormone, can be injected into fish destined for human consumption. Luteinizing hormone releasing hormone (LHRH) can also be used to induce spawning, but while the offspring can go to market, the parent fish cannot. When humans use chorionic gonadotropin as a fertility drug (or for other uses), it can increase the risk of multiple pregnancy, premature puberty, and ovarian enlargement and cysts. The highest legal cumulative dose of chorionic gonadotropin in fish destined for human consumption is 25 ml. However, FDA does not test fish for residues of the hormone, nor does it take any other regulatory action to enforce this limit.[94]

The alternative

Farmers who use organic or other sustainable production methods generally eschew the routine use of added hormones.

Verification of claims via an audit by an independent third party is currently the best way to know if a beef, bison, or dairy product supplier is placing meaningful restrictions on hormone use. The standards for the following eco-labels prohibit use of synthetic hormones, including rBGH/rBST in dairy cattle, in addition to placing meaningful restrictions on antibiotic use as noted above: American Grassfed Certified, Animal Welfare Approved, Certified Humane Raised & Handled, Food Alliance Certified, USDA Organic and USDA Process Verified Never Ever 3. The applicable eco-label should be present on product packaging.

In the absence of one of these third-party eco-labels, hospitals should look for beef, veal and sheep (lamb) products labeled "No hormones added" and dairy products labeled as produced without rBGH/rBST.

When purchasing directly from a farm, ask the farmer or rancher if they administer hormones when raising their beef, bison, or dairy cattle. Many farmers now have websites where they will list this type of information.

Further Reading

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IATP Smart Guide to Minnesota Dairy Without rBGH, www.iatp.org/files/421_2_105184.pdf

HCWH Purchasing Guide to Sourcing Dairy Products Produced Without rBGH, www.noharm.org/lib/downloads/food/Purchasing_Non-rBGH_Dairy.pdf

HCWH Position Statement on rBGH, www.noharm.org/lib/downloads/food/HCWH_Position_on_rBGH.pdf

Genetic engineering

Status quo

As of December 2011, it is estimated that 95 percent of the U.S. commercial sugar beet crop, 94 percent of the U.S. commercial soybean crop, 90 percent of the U.S. commercial rapeseed (canola) crop, 88 percent of the U.S. commercial corn crop, most of the papaya grown in Hawaii and 25,000 acres of zucchini and yellow summer squash (~45,000 acres were planted in squash, all varieties, in 201295) were produced from genetically engineered (GE) seeds or plants.[96]

Common food ingredients that may also have been derived from these or other GE crops include: amino acids, aspartame, ascorbic acid, sodium ascorbate, vitamin C, citric acid, sodium citrate, ethanol, flavorings ("natural" and "artificial"), high-fructose corn syrup, hydrolyzed vegetable protein, lactic acid, maltodextrins, molasses, monosodium glutamate, sucrose, textured vegetable protein (TVP), xanthan gum, vitamins and yeast products.[97] These ingredients are commonly found in multi-ingredient processed food items, most of which fall into the Grocery category, but also in juice, drink mixes, sodas, processed eggs, flavored milk and most other dairy products including many ice cream products. In addition, most conventionally raised beef and dairy cattle, chickens (laying hens and broilers), turkeys and hogs are fed a diet containing GE corn and/or GE soy beans.

No GE food animals are in commercial production, though FDA is currently deciding whether to approve a genetically engineered variety of salmon (AquAdvantage® Salmon) developed by AquaBounty Technologies.[98] This biotechnology company is also working to develop similar varieties of tilapia and trout.[99] The corporate office of AquaBounty Technologies is in Massachusetts. Aqua Bounty Farms is on Prince Edward Island in Canada.

According to HCWH, GE-related health concerns include allergies, antibiotic resistance and toxins, especially for hospital patients who may be more vulnerable to possible problems from GE crops than the general public.[100] Also, studies have shown that weeds have developed resistance to herbicides used with GE corn and soybeans and have led farmers to use higher application rates of and/or more toxic herbicides.[101] For instance, widespread use of genetically engineered Roundup Ready soybeans and corn and the herbicide glyphosate (brand name Roundup) has led to increased use of atrazine, 2,4-D and other leading herbicides on glyphosate-resistant weeds.[102]

The alternative

Farmers who use organic or other sustainable production methods generally avoid use of GE crops and animals.[103] In addition to USDA Organic standards, which prohibit the use of GE crops and livestock, the following eco-labels can be used to identify foods produced without GE ingredients: ASC Certified, Certified Naturally Grown, Food Alliance Certified and Non-GMO Project Verified. In the absence of one of these eco-labels, hospitals should look for foods, mainly processed foods or beverages, carrying the following statement: "No genetically engineered ingredients." Before purchasing yellow squash and zucchini from a local farm consider asking whether they use GE seeds. Some mid to larger-scale diversified farms grow crops for a variety of markets including wholesale, so it is possible that they may be using GE seeds.

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Cereal Crimes: How "Natural" Claims Deceive Consumers and Undermine the Organic Label—A Look Down the Cereal and Granola Aisle, www.cornucopia.org/cereal-scorecard/docs/Cornucopia_Cereal_Report.pdf

HCWH Position Statement on Genetically Engineered Food, www.noharm.org/lib/downloads/food/Genetic_Engineered_Food_Stmnt.pdf

HCWH Purchaser's Guide to Sourcing Food Without Genetically Engineered Ingredients, www.noharm.org/lib/downloads/food/Purchasing_Non-GMO_Food.pdf

Scrambled Eggs Separating Factory Farm Egg Production from Authentic Organic Agriculture, www.cornucopia.org/egg-report/scrambledeggs.pdf

Concentration of production and market share

Industrialization of agricultural methods has also contributed to crop and food animal production being highly concentrated in certain parts of the country. This geographical concentration in production leads to regional concentration of agriculturally related air and water pollutants, such that some communities are disproportionately affected. Tables 1.1 and 1.2 contain information on the top producing states for food animals and crops.

Table 1.1—Regional Concentration of Eggs, Milk and Food Animal Production

Food animal	Top producing states in 2007
Cattle and calves	>50 percent of total sales from five states—Tex., Kan., Neb., Iowa and Colo.[104]
Milk and other dairy products	>50 percent of total sales from five states—Calif., Wis., N.Y., Pa. and Idaho[105]
Pork	>50 percent of total sales from three states—Iowa, N.C. and Minn.[106]
Poultry and egg production (combined)	>50 percent of total sales from six states—Ga., N.C., Ark., Ala., Miss. and Tex.[107]
Broilers (chickens for meat)	The top five broiler-producing states are Ga., Ark., Ala., Miss., and N.C.[108]
Chicken eggs	The top five egg-producing states are Iowa, Ohio, Pa., Ind., and Tex.[109]
Turkeys	The top five turkey-producing states are Minn., N.C., Missouri, Ark., and Virginia[110]

Table 1.2—Regional Concentration of Crop Production

Crop	Top producing states in 2007
Fruits, nuts and berries	89 percent of total sales from six states—Calif. (59.4 percent), Fla., Wash., Ore., Mich. and N.Y.[111]
Grains, oilseeds and pulse crops	49 percent of total sales from five states—Ill., Iowa, Neb., Minn. and Ind.[112]
Vegetables, potatoes and melons	Top five states in acres harvested for fresh market—Calif., Fl., Idaho, Ariz. and Ga. (Calif. alone accounted for 30 percent)[113] Top five states in acres harvested for processing—Calif., Wash., Wis., Minn. and Idaho[114]

Further Reading

Identifying Our Climate Foodprint: Assessing and Reducing the Global Warming Impacts of Food and Agriculture in the U.S., www.iatp.org/files/258_2_105667.pdf

The Changing Climate for Food and Agriculture: A Literature Review, www.iatp.org/files/451_2_104516.pdf

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Written by Marie Kulick, Earth Wise Communications.

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