ORGANIC FARMING RESEARCH FOUNDATION

Organic Farming for HEALTH and PROSPERITY

August 2012

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ORGANIC FARMING FOR HEALTH & PROSPERITY

Introduction

Rising health care costs, unemployment, an economy struggling to recover from the ongoing recession, environmental degradation and the need to address climate change are among the most serious problems facing the United States today. The release of Organic Farming for Health and Prosperity comes as our nation grapples with these urgent needs and offers some solutions to help ease those significant problems.

Organic Farming for Health & Prosperity is a review of North American scientific literature concerning organic farming in the United States and Canada. The report examines the multitude of benefits that organic agriculture can provide and identifies the key ways in which agricultural policies in the United States could support organic farmers.

The scientific literature shows that organic farming practices build soil quality, maintain water quality, support biodiversity, and have potential to mitigate global climate change while supporting an economic bright spot. Organic farming is comprised of an integrated suite of practices that provide these benefits in addition to producing food, fiber and feed. Studies conducted over the past decade have called for the agricultural industry to be responsive to changing climate and environmental conditions. None of these studies, however, has focused primarily on organic farming. **Organic Farming for Health & Prosperity** was drafted to help fill that void.

To compile the report, the authors reviewed the scientific literature for research on organic farming in the United States and Canada since the year 2000. Research papers published in

peer-reviewed academic journals comprised the primary sources of information, along with reports from the US Department of Agriculture and the Rodale Institute. Where peer-reviewed literature on a given topic was non-existent or difficult to find, additional sources, including organizations associated with the United Nations, the Organic Trade Association, and the Organic Center are cited.

When the scientific literature is reviewed as a whole, it's easy to see that organic farming practices are good for human health, economic prosperity, the environment and for slowing climate change. Healthy soil, which organic farming enhances, is the basis of a healthy nation. Despite the obvious benefits, several key challenges have slowed the growth of organic agriculture. Increasing public awareness of the value of organic farming, implementing public policy changes that support organic growers and conducting research to advance the industry are essential in overcoming the challenges of organic agriculture. Additional research is imperative to fill the gaps in the scientific understanding of the benefits of organic farming.

For many of you who are active in the organic industry, this report provides information you can use to educate consumers and retailers and provide people additional reasons, beyond their personal health, to invest in organic. We anticipate that it will provide food for thought for others who are considering getting involved in and/or investing in organic farms and businesses. Another key goal of the report is to educate government officials and policymakers about the myriad of benefits organic provides. We believe it's time that the benefits of organic agriculture are acknowledged by the public at large.

A new unified policy to support organic farmers and the organic food industry is imperative. Over the past decade, modest public resources have been directed toward organic farming in the form

Federal statute defines organic farming as "A production system that is managed in accordance with the (national organic standards) to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity."[1]

of funding for research and data collection, funding to offset certification costs, enforcement of organic standards, and an initiative to ensure fair and equal access to conservation programs for organic farmers. The resources allocated to date, however, are still far short of the investment needed to realize the great potential of organic farming. **Organic Farming for Health & Prosperity** recommends elements of an integrated, unified policy that will further organic agriculture and support the multiple advantages it provides to society.

About Organic Farming

What is organic farming and why is it important? Organic farming is agriculture that makes healthy food, healthy soils, healthy plants and healthy environments a priority along with crop productivity. Organic farmers use biological fertilizer inputs and management practices such as cover cropping and crop rotation to improve soil quality and build soil organic matter. By increasing the amount of organic matter in the soil, as nature does on a forest floor, organic farmers enhance the soil's ability to absorb water, reducing the impacts of droughts and flooding. Improving soil organic matter also helps it to absorb and store carbon and other nutrients needed to grow healthy crops which, in turn, are better able to resist insects and diseases.

Organic foods command premium prices in the United States and safeguards are in place to ensure that consumers are getting the quality products they are paying for. Farmers and food processors must meet strict regulations to gain organic certification and the right to use the phrase "organic" on their packaging and in their marketing. Only agricultural products that are certified as meeting the national organic standards implemented under the U.S. Department of Agriculture's (USDA) National Organic Program qualify.

To gain certification, organic farms and processing facilities must submit an organic system plan each year to a certifying agent. The plan documents all of their production practices, each substance or input that will be used, and their record-keeping practices. A farm's organic system plan is a comprehensive document that describes all aspects of its management including the source of the seeds to be used, proposed crop plantings, livestock management practices, the farm's proximity to potential sources of contamination and steps taken to avoid it and weed and pest control practices. Farmers must document that they maintain accurate records so that each crop can be tracked back to the field where it was grown.

Each certified organic farm and processing facility undergoes an annual inspection to verify that they are meeting the standards. Organic inspectors typically walk the farm with the producer, checking the crops and the outbuildings, ensuring no synthetic herbicides or pesticides are present, and verifying sales paperwork. Organic farmers must demonstrate their growing practices maintain or improve the soil, water, wetlands, woodlands, and wildlife in and around their farms. Organic farmers must show they rotate their crops to build the soil, minimize erosion and enhance biodiversity in and around their fields.

Organic standards specifically prohibit the use of numerous substances including genetically modified organisms (GMOs), food irradiation, synthetic pesticides, antibiotics and hormones in animal production and the application of sewage sludge.

Converting a farm to organic is a multi-year process. To gain organic certification, farmers must prove that no prohibited substances have been used on the farm for at least three years, reducing the chance that the farm has residual contamination of crops, soil or water.

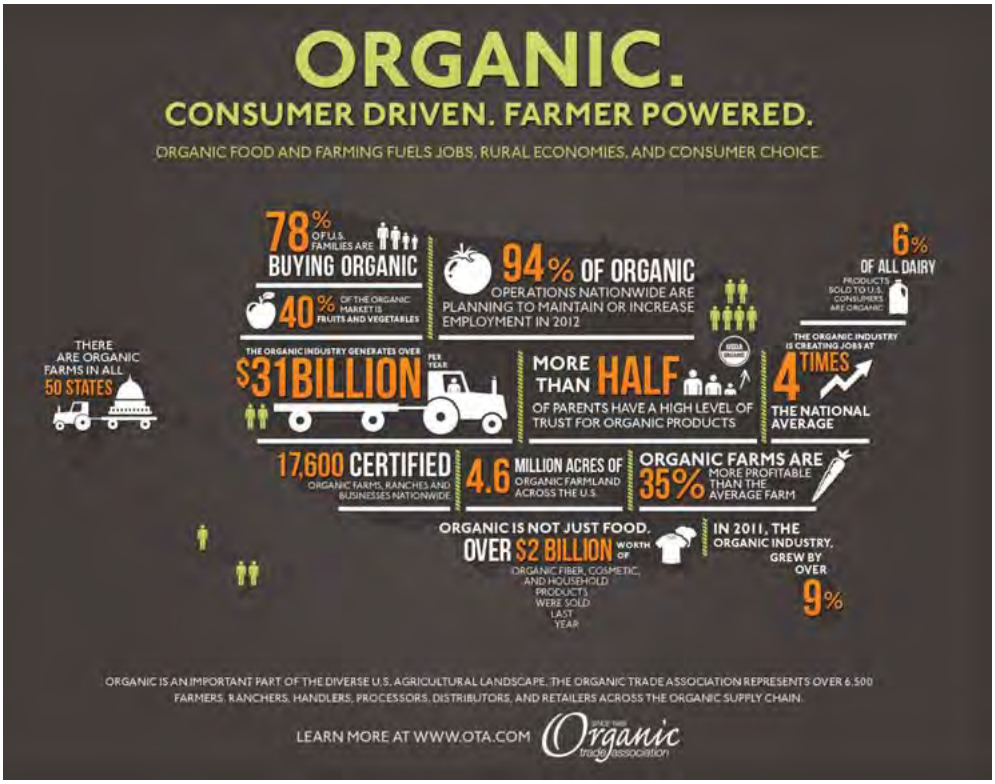
Organic farmers are required to maintain buffer zones between organic farmland and adjacent potential sources of water, chemical or genetic drift to prevent their crops from being contaminated by actions taken on nearby farms. Organic farmers may not sell crops grown in buffer zones as organic.

To obtain organic certification for livestock and poultry production, producers must show that they raise their animals in ways that are compatible with the animals' natural needs and behaviors. Producers must provide all animals with outdoor access for freedom of movement. All ruminants must be grazed on pasture during the grazing season so that their diet is comprised of a minimum 30% pasture. This is important because grazing on grass and having access to sunshine and fresh air enhances the health and longevity of organically raised dairy cows and improves the quality of their milk.[2]

Organic livestock production prohibits the use of animal byproducts in feed and bans the use of hormones and antibiotics. Withholding medical treatment to a sick animal in order to maintain its organic status is illegal. Any animal to which antibiotics have been administered cannot be sold as organic, nor can its products.

Organic production continues to be one of the fastest growing sectors of the U.S. food system. Sales of organic food and non-food products were $31.5 billion in 2011, a 9.5% increase from 2010 sales.[3] In contrast, sales of comparable non-organic products increased only 4.7% in 2011.[4] Prior to the economic downturn, the growth of organic food sales showed annual increases averaging 19%.[5] Organic food now represents 4.2% of all food sales in the U.S.[6]

The vital and growing organic sector is supported by the production of over 17,000 certified organic operations[7] farming over 4.1 million acres of land. The most recent data available document that total organic farmgate sales reached $3.16 billion in 2008.[8]



In addition to being economically attractive, certified organic practices have been shown to provide multiple benefits to soil, water and biological diversity **(Table 1).**

Table 1: Select key organic farming practices and their benefits.

Organic Farming Practice	Environmental Benefits
Crop rotation	Enhances soil quality, disrupts weed, insect, and disease life cycles, sequesters carbon and nitrogen, diversifies production (can have market benefits)
Manure, compost, green manure use	Enhances soil quality, sequesters carbon, recycles nutrients, and contributes to productivity
Cover cropping	Enhances soil quality, reduces erosion, sequesters carbon and provides nitrogen, prevents dust (protects air quality), improves soil nutrients, contributes to productivity
Avoidance of synthetic fertilizers	Avoids contamination of surface and ground waters, enhances soil quality, sequesters carbon, mitigates salinization (in many cases)
Avoidance of synthetic pesticides	Enhances biodiversity, improves water quality, enhances soil quality, prevents disruption of pollinators, reduces costs of chemical inputs
Planting habitat corridors, borders, and/or insectaries	Enhances biodiversity, supports biological pest management, provides wildlife habitat
Buffer areas	Improves water quality, enhances biodiversity, prevents wind erosion

Who Benefits from Organic Farming?

The benefits of organic farming are widespread and important to multiple sectors of society. Organic foods can help protect what's most valuable to people--their health. Eating a healthy diet rich in antioxidants, vitamins and minerals is a solid investment in preventative care. Preventing disease is much more cost efficient than treating disease. Organic foods can play an important role in keeping people healthy.

In addition to the health benefits, the organic industry is important in many other ways.

For investors, the organic agricultural sector is one of the few sectors with consistent growth over the last decade. During the current economic downturn, the growth of the organic industry has outpaced the food industry as a whole.

Organic products are increasingly important to consumers who are committed to reducing their carbon footprints and their impacts on the environment. More and more people are making their purchasing decisions based, at least partially, on environmental considerations.

For families, organic products are important in protecting and enhancing the health of their children. Young bodies in particular are more susceptible to the impacts of pesticides, fungicides and other synthetic chemicals used in non-organically grown fruits and vegetables. So many parents are willing to pay a premium for organic products that the term "gatekeeper moms" has become part of the industry lexicon.

For educators, the many economic, health and environmental benefits of organic farming offer opportunities to integrate organic farming practices into their agricultural programs to attract students. Demand for organic foods and materials such as cotton for clothing is strong and projected to increase in the near term. It is imperative that future farmers be trained in organic practices.

For environmental advocates, organic farming provides numerous benefits to the environment. Because they use diversified cropping systems and don't use synthetic pesticides, organic farms support biodiversity. Organic farming practices are also proven to be good for soil quality, water quality and retention and slowing climate change because they build organic matter in the soil. Organic matter helps hold water in the soil, reducing runoff, and sequesters carbon.

For ocean advocates, organic farming has great potential to reduce the "dead zone" that forms each year in the Gulf of Mexico. Organic farming reduces the amount of fertilizer that leaches into ground and surface waters. These nutrients, most of which arise from non-organic farming practices, stimulate uncontrolled microbial growth which depletes the oxygen in larger bodies of water (hypoxia), causing die-offs of other aquatic organisms.

For clean water advocates, organic farming practices protect water quality by using biological forms of fertilizers that release nutrients slowly, reducing nitrate leaching into ground and surface waters.

Many climate change scientists and policy experts recognize that organic farming helps mitigate the threat of global warming by sequestering carbon and reducing greenhouse gas emissions from energy-intensive chemical fertilizers.

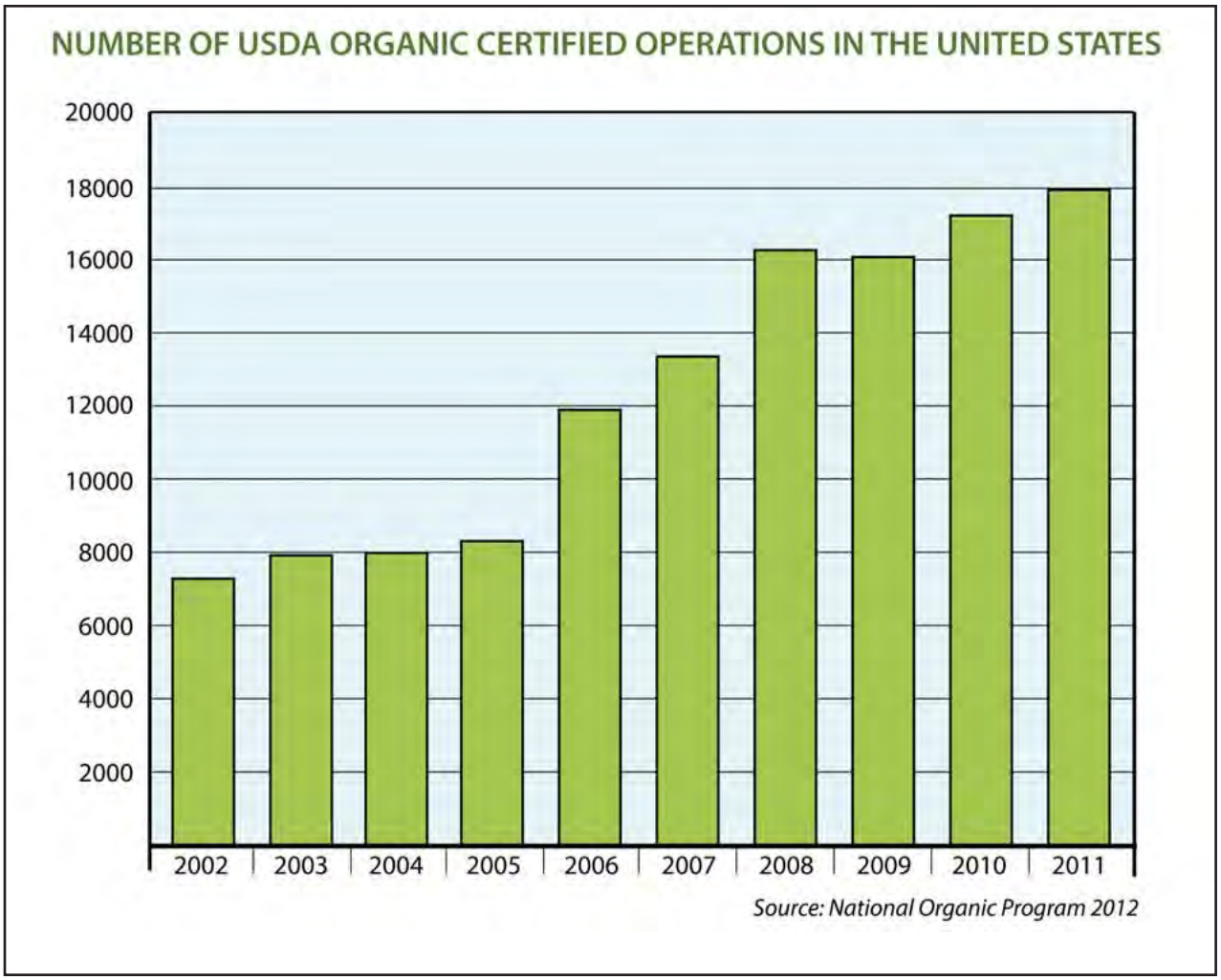
For farmers, organic farming is profitable because organic foods are in demand, and as a result of the price premiums they receive.[9] The organic industry has grown from $3.6 billion in 1997[10] to $31.5 billion in 2011.[11] In 2008, organic farmers reported average sales per farm being $82,868 more than the sales documented from all farms in the 2007 Census.[12]

For communities, organic agriculture provides economic benefits by expanding employment opportunities within the industry. The latest data indicate that 78% of organic farmers planned to maintain or increase their organic production over the next five years.[13]

By the end of 2011, 17,281 farms and processing facilities in the United States were certified to the USDA organic standards.[14] This represents a 140% increase in the number of certified organic enterprises since 2002, when the federal organic standards were implemented.

For consumers, sharing the rich flavors of foods grown without the use of chemicals, there is evidence that some organic foods have higher levels of certain vitamins, antioxidants, and flavonoids, though much more research is needed in this important area of human health.

All of these elements come together as we seek to protect our health, the health of our families, the prosperity of communities and our environment.



WHAT NEEDS TO BE DONE

It's time the many benefits of organic agriculture are acknowledged by more members of the public, lawmakers, businesses, and all aspects of society. A new unified policy to support organic farmers and the organic food industry is needed. Over the past decade, modest public resources have been directed toward organic farming to fund research and data collection, offset small percentages of certification costs, enforce organic standards and ensure fair access to conservation programs for farmers. The resources allocated to date, however, are a small fraction of the investment needed to realize organic farming's tremendous potential. **Organic Farming for Health & Prosperity** recommends elements of an integrated, unified policy to promote organic agriculture and support the multiple advantages it provides.

Now is the time to change our country's current agricultural policies which do relatively little to support organic farmers, and, in some cases, work against their interests. The Farm Bill is due to be reconfigured and reauthorized before the end of 2012. As the primary instrument of agricultural policy in the United States, the 2012 Farm Bill presents a unique opportunity to legislate in favor of the growth of organic agriculture, to better meet organic consumer demand and economic competitive positioning.

Increasing the role of organic farming presents a three-fold challenge that Organic Farming Research Foundation is committed to meeting: increasing public awareness of the value of organic farming, building organic champions in Congress and federal agencies and conducting research to arrive at necessary technological advances. If the nation is to have a sustainable food supply well into the future, organic farming must become the leading form of agriculture. In addition to the demonstrated benefits to soil and water, organic farming has proven benefits to human health, to the nation's economic prosperity and to the health of the planet. A review of the research finds:

- Organic Farming Improves Soil and Water Quality
- Organic Farming Enhances Biodiversity and Pollinator Health
- Organic Farming Sequesters More Carbon, Slowing Climate Change
- Organic Farming Reduces Toxic Chemical Exposure
- Organic Food Can Feed the World
- Organic is a Vital Sector in the US Economy
- Organic Farming Increases Farmers' Sales and Profits
- Organic Farming Strengthens Job Growth in the Agricultural Sector

Currently there are more than 17,000 certified organic farmers in the United States and demand for organic foods is rising. Despite modest growth in the number of U.S. organic farmers, serious organic supply shortages have emerged in many food sectors over the last decade and additional organic farmers are needed to meet projected market demand.[15] We can, and should, work to ensure our nation's needs are met and that more people can access healthy food grown in sustainable ways while protecting the environment.

Despite the benefits, significant obstacles remain. **Organic Farming for Health & Prosperity** has identified six policy recommendations for removing some of these obstacles by implementing a wide range of relatively low-cost or no-cost changes to the current agricultural system. These modifications include adopting new insurance options to better serve organic farmers, increased funding for organic farming research, reforming regulations, adopting new market incentives, providing assistance to farmers transitioning to organic farming and expanding environmental markets.

Findings: Organic Farming Systems Benefit the Environment, Human Health, and National Prosperity

The research is clear: Organic farming provides numerous benefits for people and the planet. Although our findings show that more money needs to be allocated for organic research, here's what we do know:

"A nation that destroys its soil, destroys itself."

- Franklin D. Roosevelt

Organic Farming Improves Soil and Water Quality

Soil scientists and cultural historians have made a convincing case that civilizations rise or fall based on how they manage their soil.[16] Unfortunately, history is marked by human failure to properly manage soil. When native vegetation in prairie or forest ecosystems is removed and the soils cultivated, there is an immediate decline in the amount of organic matter in the soil due to increased erosion and stimulation of microbial activity. [17]

Any discussion of farming must include both the availability and quality of water. Farming relies on access to adequate supplies of clean water. And farming practices in turn directly impact the health and quality of our waterways and oceans.

Why is Soil Organic Matter Important?

Soil organic matter is defined as "waste, residue and metabolites from plants, animals, and microbes" (Soil and Water Conservation Society 2000). Soil scientists have identified many functions performed by soil organic matter including energy transfer between micro-organisms, nutrient cycling, and influencing soil structure *(Grandy and Robertson 2007; Marriott and Wander 2006).*

The quality and quantity of organic matter that accumulates is influenced by fertilizer source (see Marriott and Wander 2006, Drinkwater et al. 1998). The organic practices of using crop rotations and biological sources of fertilizer build soil organic matter which holds both water and nutrients in the soil *(see e.g. Snapp et al. 2010, Kong et al. 2007).*

The ability of soil to accumulate soil organic matter is a direct reflection of its ability to sequester carbon. Increases in soil organic carbon under organic management have significant implications for the potential of organic farming to help mitigate global climate change.

Organic farming practices can improve soil and water quality. Crucial soil functions such as water-holding capacity, soil microbial activity, and nutrient cycling are strongly influenced by the structure of the soil, particularly the degree to which it forms soil aggregates.[18] Without aggregate formation, soil erodes easily via wind or rain as happened in the Great Plains during the historic Dust Bowl.

Aggregates and the pore spaces in between them are key components of the soil microbial habitat. The size of aggregates affects soil aeration and drainage.

Excessive tillage and the use of synthetic materials--including fertilizers, pesticides, and fumigants--destroy soil structure and interfere with microbial and root exudates that help hold soil particles together. Additionally, use of synthetic nitrogen fertilizers has been implicated in reducing the amount of organic carbon and nitrogen that is sequestered by the soil.[19]

Declines in soil quality can be reversed by careful management and implementation of soil-building practices such as those used by organic farmers. Crop rotation, growing cover crops, and using composted and raw animal manures are common organic practices that build soil quality, enhance microbial activity, and cycle the nutrients needed to produce high quality crops and forages. Those practices also improve the health of organic crops. There is a small but telling body of research in the United States that suggests that improved soil quality increases the ability of crops to withstand or repel insect attack[20] and plant disease.[21]

Organic Farming Builds Soil Organic Matter

A large body of organic soil quality data comes from long-term systems comparison trials across the U.S., including studies in Pennsylvania, Michigan, California, Iowa, North Carolina, Maryland, Wisconsin, Washington, and Minnesota. These studies found that the most characteristic changes under organic management were increased levels of soil organic matter and increased microbial activity, even when the soil was subjected to routine tillage.[22] A study that analyzed samples from nine U.S. farming systems trials found that organic management increased particulate organic matter carbon by 30% and particulate organic matter nitrogen by 40% compared to non-organic controls. [23]

Increases in soil organic matter under organic management were also found in shorter-term studies including a two-year corn-tomato rotation in Maryland and Virginia,[24] a two-year study of strawberry-vegetable production in California,[25] and a three-year study on various horticultural crops grown in North Carolina.[26]

Organic Farming Reduces Nitrate Leaching into Waterways

One of the most widely known impacts of agriculture on water quality is fertilizer leaching into groundwater and runoff, causing off-site hypoxia including the well-known "dead zone" which forms each year in the Gulf of Mexico.[27] Both nitrogen and phosphorus stimulate algal growth and contribute to hypoxia when they pollute waters downstream. Only about 50% of applied conventional fertilizers are taken up by crops; approximately 30-40% is leached into ground and surface waters and the rest is lost into the atmosphere.[28]

Organic farming practices build soil organic matter which retains nutrients in the soil longer, releasing them slowly over time. Slow nutrient release allows nitrogen to be absorbed by crops before leaching below the root zone. Long-term organic management has been found in numerous studies to decrease nitrate leaching from soils.[29] The most recent data, from a 12-year

study in Michigan, shows that fields under organic management had half the annual nitrate leaching losses than fields under non-organic management.[30]

A modeling study that compared nitrogen exports into Lake Michigan under different scenarios found organic farming to be the only land management scenario that would reduce, rather than increase, nitrogen loading into the water.[31]

Researchers at Washington State University found that, after nine years of organic management, nitrogen losses to groundwater and to the atmosphere were far lower in organic orchards than non-organic orchards.[32] Annual nitrate leaching from non-organic plots was 4.4–5.6 times greater than in organic plots. In this study, organically farmed soils also exhibited higher levels of organic matter and greater microbial activity.[33]

Organically managed soils are not immune to nitrate leaching. Cover crop incorporation, animal manure, and compost applications must be carefully timed with crop uptake and soil biological activity to avoid losses from the system.[34] Evanylo et al. found that compost, poultry litter and inorganic fertilizer in an organic vegetable system leached comparable levels of nitrate past the tillage zone.[35] Compost N was not released in time for sweet corn uptake and would have posed a leaching risk without planting a winter rye "scavenger" crop to take up the excess N.[36] Some of the Rodale data document nitrate leaching under organic management.[37] This is clearly an area that requires more research.

Organic Farming Contributes to Better Water Quality

As agriculture is dependent upon water availability, agricultural practices in turn impact water quality. Research has shown that organic farming contributes to cleaner water by using biological fertilizers that release nutrients slowly, build soil organic matter, increase soil water-holding capacity and reduce leaching of nitrates into groundwater.

Ground and surface waters are too often contaminated by pesticides, fertilizers and animal wastes that are not absorbed by plants or soil. In the United States, 64% of measured lake acres and 44% of stream miles are impaired; they no longer support one or more of their designated uses such as swimming or fishing.[38] The synthetic herbicides, pesticides, fungicides and fertilizers used in non-organic farming also seep into drinking water supplies, posing a variety of threats to human health.

Organic farming does not contaminate water to the degree that non-organic practices do because certified organic farmers do not use synthetic pesticides or highly soluble synthetic fertilizers. Under federal law, organic farmers must utilize "production practices (that) maintain or improve the natural resources of the operation, including soil and water quality."[39] No other farmers in the U.S. are held to this standard.

Organic Farming Increases the Ability of Soil to Hold Water for Crop Use

Water availability is a particular concern around the globe as rainfall patterns have become increasingly unpredictable and groundwater use accelerates.[40] Scarcity of clean, usable water is likely to become the largest problem facing global agricultural production in the near future.

Organic agriculture has an advantage in this regard: many of the long-term systems studies that documented increased soil organic matter under organic management also consistently measured greater water holding capacity in organically managed soils.[41]

In studying water found in drainage tiles installed to drain excess water from fields, University of Minnesota researchers discovered that organic farming reduced the amount of water lost in drainage tiles by 41% and reduced nitrate-nitrogen levels in the water by 60%.[42]

Similarly, a 3-year study in Virginia investigating compost, poultry litter, and inorganic fertilizer effects on soil and water quality found that a high rate of compost increased runoff concentrations of nitrogen and phosphorus but reduced overall amount of nutrients transported because of reduction in runoff volume.[43]

As President Franklin Roosevelt so wisely said, a nation that destroys its soil destroys itself. Isn't it time we begin rebuilding our nation by rebuilding our soil through organic farming?[44]

ORGANIC FARMING ENHANCES BIODIVERSITY AND POLLINATOR HEALTH

Biological diversity is critical for the health of an environment.

In agriculture, both above- and below-ground diverse biological communities are important in providing genetic diversity for crops and livestock and maintaining well-functioning, productive agroecosystems. "Ecosystem services" refers to a multitude of functions that are provided by well-structured ecosystems. These include atmospheric and climate regulation, water purification and cycling, soil formation and nutrient fixation and cycling.[45] Collectively, ecosystem services and the resource base that supports them has been estimated to be worth on average $33 trillion annually.[46] The value of pollination and control of crop insect pests provided by native insects in the U.S. was estimated to be worth at least $10.6 billion per year.[47]

Certified organic farmers in the United States are required to "conserve biodiversity" on their farms.[48] Because of their reliance on diversified cropping systems, organic farms support larger populations of beneficial organisms such as songbirds and pollinators than non-organic farms. Organic farms support diverse populations of native bees that pollinate crops, balanced populations of beneficial insects that help keep crop pests under control, and an array of soil macro- and microorganisms that decompose dead and waste materials and recycle nutrients.

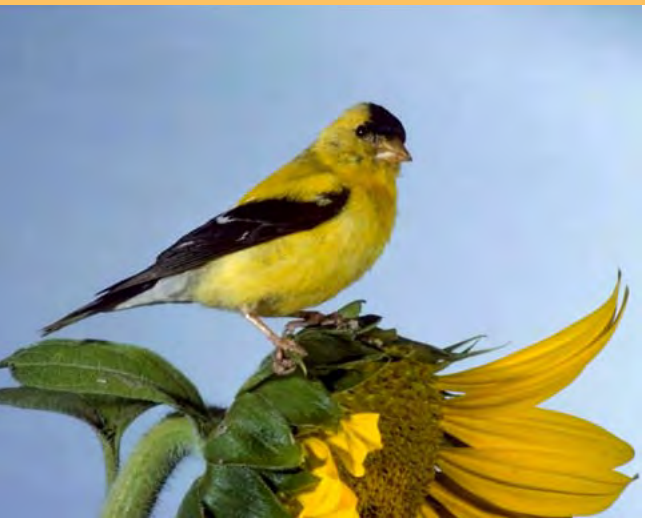
Organic farming supports diverse insect populations largely by prohibiting the use of synthetic pesticides. While certain pesticides derived from natural sources are allowed in certified organic production, growers are required to utilize conservation practices before they resort to using those materials. Additionally, any pesticides used in organic agriculture must be shown to "not be harmful to human health or the environment." [49]

Organic Farming Enhances Pollinator Populations

Ongoing work to quantify the contribution of pollinator services to agriculture is being conducted by researchers at the University of California - Berkeley. Highly complex pollinator relationships revealed in one study found that native bee populations supported 50-100% of the pollination needs for a watermelon crop on organic farms and none of the pollination needs on non-organic farms, which required supplemental pollination from honey bees.[50] The study also noted that the proximity of a field to natural habitat was a factor in influencing native pollinator services, regardless of whether the field was organically or non-organically managed.

A Canadian study showed that organic canola fields in Northern Alberta, Canada, were found to have greater abundance of native bee communities than non-organic fields, which in turn had more native bees than fields planted to GMO canola.[51]

Organic Farming Enhances Bird and Beneficial Spider Populations



A two-year study in Nebraska found that fields on organic farms had both more birds and more bird species than were found on non-organic farms,[52] while Florida research found that the practice of intercropping sunflower into organic vegetable fields increased "incidence, abundance, and foraging activity" by insect-eating native birds.[53]

A study of apple orchards in Washington comparing synthetic, broad-spectrum pesticides with organic management showed the total arboreal and understory spider populations were significantly higher in the organic orchards.[54] The authors conclude "spider populations may be severely reduced by even a small number of synthetic, broad-spectrum insecticide applications and the time required for recovery may be lengthy."[55]

Organic Farming Enhances Natural Enemy Populations

One important organic strategy for managing crop pests is to enhance populations of non-pest insects, or "natural enemies," that prey on crop pests. Numerous studies have focused on utilizing floral hedgerows or corridors on the edges of or within organic fields. One study in an organic vineyard in California found that flowering corridors, planted with locally adapted species with sequential flowering periods, can increase biodiversity by attracting an abundant diversity of natural enemies.[56]

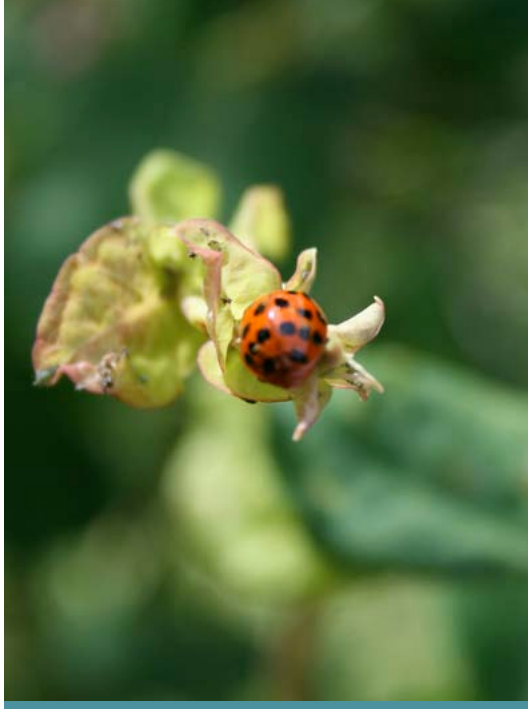
The California Sustainable Winegrowing Alliance assessed the existence of biodiversity and habitat protection in five vineyards in Mendocino and Sonoma counties in 2007. Four of the five sites were certified organic and all had habitat corridors or riparian vegetation. None of the vineyards that relied on vegetation management experienced major pest damage, and all had abundant populations of beneficial insects.[57]

A study of insect community structure and crop damage on organic and non-organic fresh market tomato farms in California found that there was no significant difference in fruit or leaf damage between the farming systems.[58] There was higher natural enemy abundance and greater species richness of all groups of insects on organic than non-organic farms, meaning that crop pests would encounter more potential predators on organic than on non-organic farms.[59]

A paper published in 2010 found that natural enemy species were distributed evenly across an organic landscape, as opposed to being numerically dominated by any one species.[60] The researchers also conducted a meta-analysis of the literature and found that most scientific evidence shows a significantly greater evenness in organic than in non-organic fields.[61] They conducted an experiment that manipulated levels of evenness in the field and found that increasing natural enemy evenness "triggered a powerful trophic cascade beneficial to plants and harmful to herbivores [pests]". Even distribution of both pest and natural enemy species was correlated with larger plant size and potato tuber yield. The authors point to the need for more studies comparing "pest-control intensity and effects of natural enemy evenness in organic and non-organic fields."[62]

Most of the work documenting the impacts of organic farming on various animal species to date has been published in Europe. Hole et al. conducted a qualitative review of the European literature comparing biodiversity in organic and non-organic farming systems.[63] Most of the studies indicated that species abundance and richness was higher on organic than on non-organic farms for a wide range of species.

More than just the birds and the bees benefit from organic farming. When the health of an environment is improved, all living beings benefit.



Organically Resilient

Organic farming practices that improve soil structure, water-holding capacity, and nutrient cycling will be more resilient in the face of climatic extremes. Maintaining vegetative cover throughout the year--whether under pasture, forage, or cover crops--is key. Iowa State researchers, for example, found that perennial crops absorbed 5-7 times the precipitation as corn or soybeans during the first hour of rainfall (Bharati et al. 2002). Researchers at the Rodale Farming Systems Trial found that the organic plots were productive even in years of extreme drought *(Lotter et al. 2009).*

ORGANIC FARMING SEQUESTERS MORE CARBON, SLOWING CLIMATE CHANGE

Scientists have documented that human activity is responsible for unprecedented levels of greenhouse gases in the atmosphere that trap heat and contribute to global climate change.[64] Emissions of carbon dioxide (CO2), nitrous oxide (N2O), and methane (CH4)--the three main greenhouse gases released by humans--have increased more than 70% in the last 30 years.[65]

Scientists are expressing a sense of urgency about the need to mitigate release of greenhouse gases before catastrophic changes occur in the world's environment.[66] Global climate change is already increasing the frequency and intensity of droughts, floods, heat waves, and major storms.[67] The destabilized climate is affecting crop production and water availability, causing hunger, malnutrition, and social unrest worldwide.

Evidence shows that, not only will organic farms fare better under climate change, the practice of organic farming slows the impact of climate change.

Organic Farming Stores Carbon

While there are ultimately physical limits to the amount of carbon that can be stored in the soil, organic farming systems--particularly those with lengthy, diversified rotations[68] and those that integrate crop and livestock production[69] --can play a significant role in helping capture carbon. The world's soils, if managed carefully, could capture an estimated 5 - 15% of global emissions released by burning fossil fuels, or 0.4-1.2 billion tons of carbon per year.[70]

Time and again, field studies show that organic farming stores carbon in the soil even when routine tillage is utilized for weed control.[71]

Organic Farming Can Reduce Total Greenhouse Gas Emissions

Meaningful estimates of greenhouse gas emissions from any given agricultural system are difficult to achieve: it is a technical challenge to take direct measurements of emissions from the field, and an accurate accounting of emissions must consider both direct and indirect sources of emissions. (Direct emissions arise from the farming practices themselves, while indirect sources are the amount of greenhouse gases generated in manufacture of inputs used on the farm.) Despite the multiple factors that must be considered when generating accurate greenhouse gas budgets for any given system, recent studies are documenting that net release of greenhouse gases is negative from organically-managed soils.[73]

The Intergovernmental Panel on Climate Change has offered recommendations for adapting agriculture to mitigate climate change by increasing soil carbon storage which include many practices routinely used by organic farmers:

- **Reduced reliance on synthetic fertilizers and pesticides**
- **Using legumes and perennials in crop rotations**
- **Using catch or cover crops**[72]

Table 2 presents soil carbon (C), nitrous oxide (N2O) flux, energy use, and emissions per unit of yield data from the long-term cropping systems trial conducted by the Agricultural Research Service of USDA in Beltsville, Maryland. These factors were integrated into a single measurement, the global warming potential. Global warming potential is calculated by adding together all sources of emissions and sequestrations from each system. Of the three systems studied, organic is the only one that had a negative value for global warming potential, indicating that it had a net uptake of greenhouse gases.[74] This is mostly due to the fact that organic farming built more soil organic matter than non-organic farming did even when the organic farmland was routinely tilled.[75]

Table 2. Global warming potential (GWP) of three cropping systems[76]

	Δ soil C[a, b]	N_2O flux[a, c]	Energy use[a, d]	Total GWP[a]	Greenhouse gas intensity intensity grain)[e]
No till	0	303	807	1110	330
Chisel till	1080	406	862	2348	153
Organic	-1953	540	344	-1069	-207

[a] kg CO_2 ha^{-1} y^{-1} equivalents
[b] Average carbon change rates over 11 years.
[c] N_2O data were measured in 2008.
[d] Energy use is for a typical year using published values and field records.
[e] kg CO_2 Mg $grain^{-1}$ equivalents

De Gryze et al. constructed a model based on field data to compare the greenhouse gas contribution of various agricultural management systems. They found that cover cropping increases annual N2O emissions whether standard or "conservation" tillage is used; however, the findings echo the Beltsville data and indicate that systems which accumulate soil carbon, such as cover cropped and organic systems, more than outweigh the slight increase in N2O, resulting in net sequestration by the organic system.[77]

Another method for calculating the global warming potential of agricultural systems is a life-cycle assessment which considers energy demand from field preparation to farmgate sales. A Canadian life-cycle study of canola, corn, soy, and wheat grown with a legume green manure found that emissions which contribute to global warming were reduced 23% by using organic practices and emissions of ozone-depleting chemicals declined 83% by using organic practices.[78] Most of these differences were due to the high energy demand and emissions associated with production of synthetic fertilizers used in the non-organic system.

The Organic Center has developed a comprehensive "carbon calculator" that takes all factors of dairy production into consideration when calculating a particular system's carbon footprint. Depending on cow breed and numerous management details, the data show that, per unit of production, organic pasture-based dairy emits only 77-80% of the methane emitted by non-organic dairies.[79]

Organic Farming has Lower Energy Use

Some studies have found that organic agriculture has lower net energy use and increased energy efficiency than non-organic farming.[80] A recent analysis of 17 years of field crop data from Michigan showed that the organic system had lower fossil fuel inputs than the conventional system; however, because of lower yields in the organic system, energy

efficiency was intermediate between low-till and conventional till.[81] The Canadian life-cycle study estimated that organic crop production consumes, on average, 39% of the energy utilized by non-organic production.[82]

Global warming is one of the biggest threats to life on earth, and organic farming has been shown to effectively mitigate climate change by increasing carbon sequestration in the soil, reducing greenhouse gas release and consuming less fossil fuel.

ORGANIC FARMING REDUCES TOXIC CHEMICAL EXPOSURE

One of the main reasons organic farming is good for human health is because organic growers do not apply toxic synthetic pesticides, fungicides, or herbicides to their crops. In addition, organic farming practices do not contribute to the development of antibiotic-resistant strains of pathogens because antibiotic use is prohibited in organic livestock production.

"If you want to learn about the health of a population, look at the air they breathe, the water they drink, and the places where they live."

Hippocrates, the Father of Medicine, in the Fifth Century B.C.

Lower Pesticide Residues Found in Organic Foods

While the official position of governmental regulatory agencies is that there are acceptable levels of pesticide exposure below which there is no reason for concern, many people choose to try to reduce their pesticide exposure by eating organic foods. Studies show that they are making the right choice: a 2002 assessment of pesticide residue data on organic and conventional fresh fruits and

vegetables found that organic produce had significantly lower pesticide residues than conventional produce or produce marketed as grown using integrated pest management.[83] This study also found that about half of the occurrence of residues found on organic produce was at a very low rate and "consistent with unavoidable contamination because of drift, persistent residues in the soil, or contaminated irrigation water supplies."[84]

Pesticide residues in foods can find their way into our bodies and can be detected in our bodily fluids. Scientific evidence shows that eating organic foods can decrease the levels of pesticide metabolites detected in children's urine. A 2003 study found that "children fed predominantly organic produce and juice had only one-sixth the level of pesticide byproducts in their urine compared with children who ate conventionally farmed foods."[85] A follow-up study found that metabolites in children's urine indicating exposure to malathion and chlorpyrifos decreased from detectable to non-detectable levels "immediately after the introduction of organic diets."[86]

Exposure to chemicals commonly used in non-organic agriculture has been linked to many types of cancer including those affecting the brain, breast, colon, lung, ovarian, pancreas, kidney, testicles, and stomach, as well as cancer of the central nervous system, according to the U.S. Dept. of Health and Human Services President's Cancer Panel 2010 report.[87] The President's Cancer Panel examined the impact of environmental factors and the use of synthetic chemicals on cancer risks before reporting its findings. Written in collaboration with the National Institutes of Health and the National Cancer Institute, the report recommends that American consumers eat food grown without pesticides and synthetic fertilizers.[88]

Organic Farming Reduces Pesticide Exposure to Farm Workers and Their Families

The President's Cancer Panel report summarizes the large body of literature documenting the negative impacts the exposure to synthetic pesticides has had on non-organic farm workers and their families. Problems include an increased incidence of certain types of cancers by farm workers and their spouses and an increased incidence of leukemia in children living in agricultural areas.[89]

Organic Food is More Nutritious Than Non-Organic Food

Studies are showing that certain crops when grown organically--including apples, tomatoes, strawberries, and blueberries—have higher levels of certain minerals and phytonutrients than their non-organic counterparts. Additionally, some studies show that cows grazed on pasture, as organic farmers are required to do, produce milk with higher conjugated linoleic acid content.[90]

- A long-term study conducted by researchers at University of California, Davis, examined the differences in the flavonoid content of organically and non-organically grown tomatoes. The results of the 10-year study showed that the levels of quercetin, the major flavonoid found in tomatoes, was 79% higher in organic tomatoes than in non-organic. Levels of kaempferol were 97% higher in the organic tomatoes.[91]

- A carefully controlled study conducted by Agricultural Research Service scientists found that organic highbush blueberries had significantly higher levels of fructose, glucose, malic acid, phenolics, anthocyanins and antioxidant activity than fruit grown non-organically.[92]

- A study conducted by Washington State University researchers compared the differences between strawberries grown organically and non-organically. During the two-year study, researchers compared 13 different strawberry varieties. The organic strawberries had 8.5% high total antioxidant activity, 9.7% more ascorbic acid and 10.5% more phenolic compounds than non-organic strawberries. In addition, the organically grown strawberries had a longer shelf life.[93]

More nutritionally dense than their non-organic counterparts, organic foods provide an extra boost of vitamins and minerals along with richer flavors.

ORGANIC FOOD CAN FEED THE WORLD

Skeptics of organic farming often argue that large-scale organic practices are impractical. Claiming that organic farming produces low yields, critics argue that organic agriculture cannot produce enough food to meet the world's current needs, much less to feed a population projected to reach 9 billion in the next 20 years. Could we better feed the world with healthful organic food were we to make greater investments in organic agriculture? Scientific evidence suggests the answer is yes.

"It is time to put to rest the debate about whether or not organic agriculture can make a substantial contribution to the food supply. It can, both locally and globally."

Badgley et al. 2007[94]

No one had made a serious attempt to answer the question until 2007, when a paper was published that analyzed organic yield data from around the world.[95] Drawing on data from 91 sources in 53 countries and 12 U.S. states, the authors calculated the ratio of organic vs. conventional yields for ten different categories of foods in both developed and developing countries. The data indicated that organic farming is producing higher yields than the "non-intensive" agriculture typical of food production in developing countries.

The authors went further and also estimated the amount of biologically available nitrogen (N) potentially available for global organic production based on the amount of N that could be fixed by green-manured legumes planted in between regular cropping periods. They calculated that this biologically fixed nitrogen would total 140 million metric tons, well over the 2001 global input of 82 million metric tons of synthetic nitrogen.[96]

After crunching all the numbers, the authors concluded that "organic agriculture has the potential to contribute quite substantially to the global food supply, while reducing the detrimental environmental impacts of conventional agriculture."[97]

While Badgley et al.'s conclusions have been criticized by some scientists on a variety of minor points, their analysis is an excellent attempt to use a systems analysis to determine the production potential of organic farming. More analyses of this type are needed.

Organic Yield Data from Studies in the U.S.

For a variety of reasons, gross generalizations about organic yields do not necessarily represent the productive capability of organic systems accurately. Public investment in understanding organic farming systems has been almost nil compared to the huge amount of money and effort spent to study optimal application rates and timing for synthetic inputs such as fertilizers, pesticides, and, more recently, GMO crops. Organic farmers have pioneered complex farming methods that do not use synthetic chemicals with virtually no public support. In this context, organic yields are extremely competitive with conventional yields.

Productivity of organic and non-organic crops can vary greatly depending on climate and soil type. Organic crop failures do occur, often when unseasonal rains interfere with timely field operations to manage weeds.[98] Long-term research in Wisconsin showed that when wet weather prevented timely field operations, weeds decreased organic corn and soy yields to 74% of those found under non-organic management; however, in years when timely weed management was conducted, organic yields were 99% of non-organic yields.[99]

Many growers initially see reduced yields during the transition from non-organic to organic farming until the system rebounds from chemical use. A 22-year study done by the Rodale Institute that compared non-organic and organic corn and soybean crop rotations found that organic corn production was lower than non-organic during the initial 5-year transition period while organic soy yields were comparable in all but one year.[100] However, after the adjustment period, organic corn yields were similar to non-organic yields. The study also showed that organically-grown crops were significantly more productive than their non-organic counterparts during periods of drought.[101]

Researchers at Iowa State University were able to avoid the "transition effect." Organic and non-organic feed corn and soybean yields were equivalent during the three-year transition period while organic yields exceeded non-organic yields in the fourth year.[102]

A significant source of data on organic yields is long-term farming systems trials. Most of these studies have found slightly lower yields in organic than conventional production systems for some crops, equivalent yields for other crops, and greater yields for yet others.

- The University of California--Davis Sustainable Agriculture Farming Systems Project found that, after 11 years, crop yields were mostly similar between organic, low-input, and non-organic systems.[103] Organic bean and safflower yields were consistently higher than non-organic.
- A five-year study of apples grown in Washington State showed that average yields from organic, non-organic, and integrated orchards did not differ.[104]
- After 6 years of a comparison study in Minnesota, organic corn yields were 91-93% of non-organic corn yields while organic soybean yields were 81-84% those of non-organic soybeans.[105]
- A ten-year comparison study conducted by the Agricultural Research Service at Beltsville, MD, found that yields of organic corn averaged 59-76% of non-organic corn yields, organic soybeans averaged 81% of non-organic yields and organic wheat yielded the same as non-organic wheat.[106] The investigators conducted multiple regression analysis to determine which factors contributed to reduced organic yields. For corn, reduced yields of organic corn were caused by low nitrogen levels and competition from weeds. For soybeans, weed competition accounted for 100% of the difference between organic and non-organic yields.[107] These findings beg the need for more research to discover effective weed and nitrogen management strategies.

With so much at stake, it is now more important than ever for our nation to invest in a healthier form of agriculture in order to feed a healthier population.

ORGANIC IS A VITAL SECTOR IN THE U.S. ECONOMY

Organic farming has spawned a vital industry. Organic product sales in 2011 catapulted to $31.5 billion, demonstrating growth of 9.5% over 2010 sales.[108] Prior to the recent economic downturn, organic food sales averaged a 19% growth rate between 1997-2006.[109] Organic food processors, wholesalers, and retailers all benefit economically from organic foods and the sector provides jobs for thousands of people.

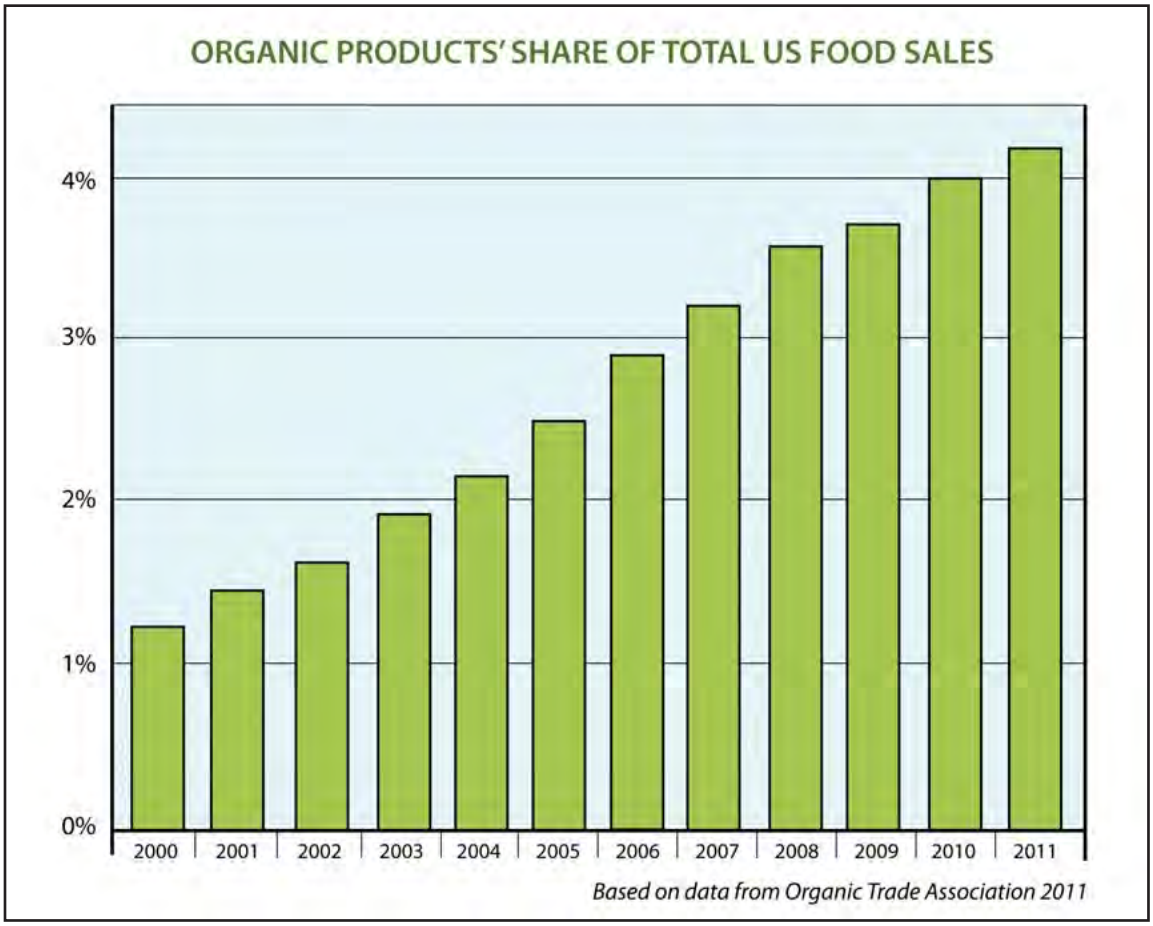
Where once organic foods were sold primarily in health food stores and at farmer's markets, today they can be found in major retail chains, including Wal-Mart, Costco and Target. Many supermarket chains, like Safeway, carry organic foods and products and their own organic brands. Organic products are becoming ubiquitous in the United States. A 2010 consumer survey conducted by the Hartman Group showed that, despite the economic downturn, 75% of consumers in the United States had purchased an organic product that year.[110]

The demand for organic products has moved some of the country's largest brands into the green and organic market place. Several large food processors have augmented their product lines by acquiring organic companies, including General Mills, Kellogg, Dean Foods, Kraft, Nestlé and Pepsi.[111]

The popularity of organic products has captured investors, who are experts at analyzing consumer trends. The investment community is acting on the public's desire for foods and products that protect their health and that of their families. This was illustrated in March, 2012, when Annie's Inc., makers

of 125 organic products sold in more than 25,000 stores in the United States and Canada, saw its initial public offering on Wall Street soar 89% on the first day.[112]

Organic farming presents great opportunity for communities to hire people, provide jobs and deliver healthy food. The growth in the organic industry provides our nation with a unique opportunity where demand is outpacing supply. How we thoughtfully build infrastructure to meet consumer demand for organic in areas of research, education and policy will shape our ability to sustain a viable and prosperous country.



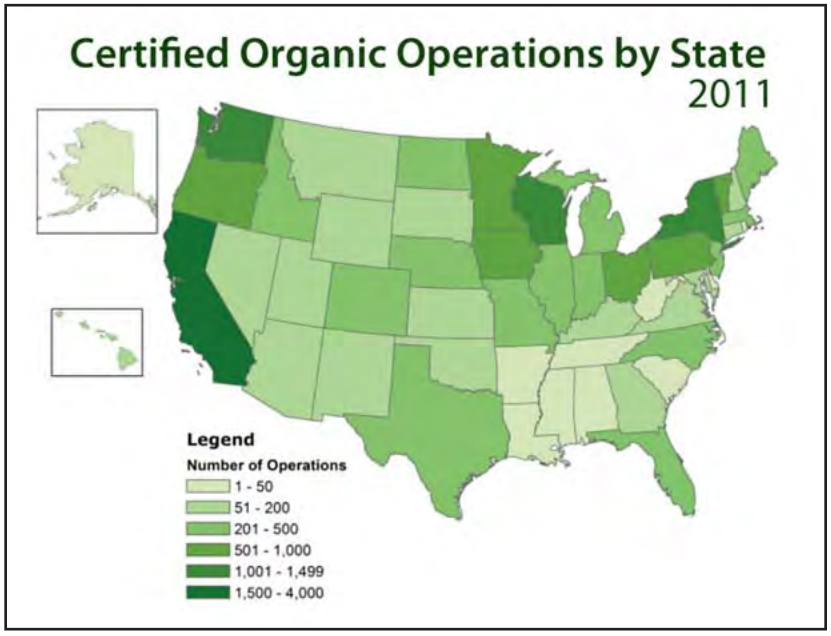
ORGANIC FARMING INCREASE FARMERS' SALES AND PROFITS

Census data from the USDA indicates that, while U.S. organic farms on average have higher production expenses, they have higher sales and higher operating profits than the average for all U.S. farms, creating real opportunity for rural economic livelihood.

The few existing studies on the economics of organic farming show that organic farming can be profitable. The USDA's 2008 Organic Production Survey showed the average sales per organic farm was $82,868 more than the sales documented from all farms in the 2007 Census.[113] Organic farms also reported having higher production costs than non-organic farms, averaging $171,978 per farm compared with the all-farm average of $109,359.[114] Based on these values, the average organic farm realized $45,697 in profits while the average non-organic farm gained $25,448 in profits.

A significant factor in the profitability of organic farms is the price premium commanded by organic crops and processed products. The organic premium—or difference in price between an organic product and its non-organic counterpart—is based largely on marketplace supply and demand and partially on the higher production costs in organic compared with non-organic farming.[115]

Many studies show that the organic premium is necessary in order for organic returns to be competitive with returns from non-organic farming. For example, eighteen years of data from a cropping systems trial at the University of Minnesota showed that, without the price premium, the non-organic system was more profitable than the organic system.[116] When organic crops received the full price premium, a four-year organic rotation showed a net return of $1,329 compared to the return to the four-year non-organic rotation of $675.[117] Even if the organic crops were sold at half of the price premium, the net return to organic was $994.[118]



Many studies indicate that higher organic profits are made despite higher costs of production and somewhat lower yields because of the price premium. USDA data indicate that organic soybean producers earn higher profits even in years when yields are slightly lower largely because of the higher market prices received for organic food-grade soybeans.[119] USDA data for dairy operations indicate that average operating and capital costs are higher for organic dairies but the prices farmers receive are higher as well.[120] The profitability of organic dairy farms in Pennsylvania was highly dependent on the higher prices farmers received for their organic milk.[121]

Net returns to an organic grain system in the mid-Atlantic region were "almost always substantially greater" with the organic premium than for the non-organic system, while returns to organic were generally lower when crops were sold at the conventional price.[122] A number of other studies indicate that the organic premium is required for organic returns to be competitive with non-organic.[123]

The three-year transition period required to convert a non-organic farm into organic often presents a significant cost for farmers. However, some research shows crops grown during the transition period are profitable. A study in Pennsylvania showed that transitional grain cropping yielded positive economic returns when tillage was reduced and a high-value crop was included in the rotation.[124]

Since owners of 78% of the organic farms in the United States report they plan to maintain or increase organic production levels over the next five years,[125] the organic sector will continue to play a contributing role in revitalizing America's rural economy. Understanding the profitability of commercial organic farms and the trade-offs between providing ecosystem services such as soil sequestration and producing high yields is essential. Profitable farms enhance local economies (both rural and urban), not only through the increased income of the farmer but through increased job opportunities.

ORGANIC FARMING STRENGTHENS JOB GROWTH IN THE AGRICULTURAL SECTOR

The organic industry has been one bright spot during the current recession. While many industries have shed employees, organic farming has been hiring workers, adding farmers and increasing revenues. The organic industry has grown from $3.6 billion in 1997 to $31.5 billion in 2011, according to the Organic Trade Association.[126] Even in 2010, during one of the greatest economic downturns in the United States, organic sales increased by nearly 8%.[127]

Organic farms benefit their communities by providing jobs: in the U.S., 53% of organic farms hire labor in comparison to 22% for the entire sector.[128] There are two main reasons for this:

- Specialization in labor-intensive fruit and vegetable production: many small- and medium-sized organic farms specialize in growing high-value crops such as fruits and vegetables which typically require more hand labor than field crops. Fruits and vegetables account for 35% of organic farm-level sales, while, for the agricultural sector as a whole, only 11% of farm-level sales are of fruits and vegetables.[129]

- Substitution of labor for herbicides and pesticides: organic farms rely on management-intensive practices including planting and incorporating cover crops, hand- or mechanical tillage, and planting flowering hedgerows or corridors to attract beneficial insects and birds that can control crop pests.

A recent survey of organic and non-organic farmers in Georgia, North Carolina, South Carolina, Alabama, and Mississippi found that organic farms employ an average of 61 year-round employees compared with 28 year-round employees hired on non-organic farms.[130] This study also found that the number of man-hours required for each type of on-farm enterprise was also much greater on organic versus non-organic farms except for pasture management.[131]

An earlier study of organic and non-organic production in New Jersey found that, depending on crop, organic farms required 7 – 33% more labor.[132]

Almost no peer-reviewed data on employment in the organic manufacturing sector has been published; however, a recent report commissioned by the Organic Trade Association suggests that production and manufacturing of organic products results in 21% more jobs than the manufacture of equivalent non-organic products, due largely to the larger labor requirements on organic farms, smaller organic farm size, and reliance on the organic certification industry.[133]

These numbers show that organic farmers and manufacturers are growing more than just healthy foods. They're creating job opportunities and fulfilling a critical need at this juncture of our nation's history.

Summary of the Findings

Organic Farming for Health and Prosperity has identified several ways that organic farming is good for human health, economic prosperity and the environment. The increase of organic farmers and acreage, through low- or no-cost changes to the current agricultural system outlined below, will support a thriving economy, people and planet.

POLICIES TO SUPPORT ORGANIC EXPANSION

Improving agriculture is not merely a technological challenge. We must also be creative in how we structure policies to support the types of agriculture that will reliably produce crops, livestock, and fiber in the future while maintaining natural resources.[134]

National agriculture policy is a major driver of practices in the United States and the means by which the government encourages, or discourages, certain activities. Encouragement includes tax breaks, regulations that favor certain practices, and subsidies, which affect supply, nutrition and food access in America. Our government must remove obstacles limiting the growth of the healthful organic food and a positive economic paradigm.

One of the key ways to support organic agriculture is through the Farm Bill –the legislation that is the primary driver of agricultural policy in the United States. Policy initiatives can be created, or modified, to reward organic farming or break down barriers for organic farmers. A unified set of policies that invests in the urgent need for organic research, builds an appropriate farm safety-net for organic farmers, helps meet market demand, provides transition assistance, and reward organic agriculture's environmental benefits must be established, as it has been established for decades in non-organic agriculture.

The clear and compelling evidence on how to improve human health and achieve a healthy economy and environment must guide the development of 21st century policies. Policies must create a food and farming system that provides enhanced societal benefits in the production of food, fiber and fuel. Key policy recommendations are made below that both facilitate the expansion of organic agriculture and leverage the multiple benefits it provides.

Seeds of Health and Prosperity

Organic farmers are required to use certified organic seed "when commercially available" and need diverse, resilient, and locally-adapted seed. Policies have been developed and could be implemented to reinvigorate publicly funded plant and animal breeding capacity to meet changing consumer demand for more healthy and nutritious foods. Increasing the availability of seed that is adapted to local growing conditions and carries a wide range of desired traits would benefit farmers. Diversity in seeds will help restore genetic diversity on farms as well as provide farmers with greater cropping choices.

Priority 1: Increase Funding for Organic Farming Research

We strongly recommend significantly increasing funding for organic research, education, and extension activities at the intramural and extramural agencies of the USDA. Policymakers should expand organic research by:

- Increasing funding for the Organic Agriculture Research and Extension Initiative.
- Expanding and fully implementing the Agricultural Research Service's organic research agenda and funding its full implementation.
- Expanding and fully implementing the National Agricultural Research, Extension, Education, and Economics Advisory Board's recommendations on organic agriculture research
- Building on the success of the first Organic Production Survey by including it regularly in the U.S. Census of Agriculture.
- Building on the Economic Research Service's successful organic economic reports to ensure continued economic analysis of issues and trends in the organic sector.
- Creating set-asides for organic research within competitive grants programs such as the Agriculture and Food Research Initiative administered by the National Institute of Food and Agriculture.
- Increasing funding and coordination among USDA research agencies for developing seeds, varieties, and livestock breeds appropriate for organic farming systems and making the results publicly available.
- Creating an interdepartmental task force led by the White House Office of Science and Technology Policy to examine opportunities to integrate organic research in USDA and other federal agencies.

Priority 2: Provide Fair and Appropriate Insurance Options for Risk Management

A farmers' success in producing food is directly correlated to their risk management and operational efficiency. In efforts to build sustainable business operations for organic farmers, the following recommendations are set forth:

- Develop appropriate crop insurance options for diversified operations, including the expansion of whole farm revenue insurance to all locations and raising the annual income limit.
- Eliminate the existing organic premium surcharge and create an organic premium discount that would reward risk reduction from maintaining a diverse cropping system.
- Base insurance payouts on organic prices for organic products, not on non-organic prices. Organic input costs and organic land prices should be recognized.
- Extend relevant disaster assistance to cover lost organic crops at organic prices, not non-organic prices.
- Provide coverage for contamination from genetically modified organism (GMO) and pesticide drift damage to organic farms.
- Extend relevant coverage to grazed forage, double crops, and cover crops.

Government Procurement of Organic

Federal, state, and local government programs procure vast quantities of food for use by the military, schools, universities, agencies, and Indian reservations. For example, Food Distribution on Indian Reservations is a U.S. Department of Agriculture program that supplies a monthly selection of 70 foods to 85,000 low-income individuals living on Indian reservations who do not have easy access to grocery stores as an alternative to supplemental nutrition assistance program (SNAP) benefits. In 2011, this program received $60 million in funding. Policy reforms could be enacted to allow, encourage, or even require a certain percentage of organic foods be included in these government purchases. One model might be the Federal BioPreferred Procurement Preference Program, which requires all federal agencies and their contractors to preferentially purchase biobased products (i.e., those made from renewable biological resources) when available.

This means common sense regulations including:

- Regulating pesticides more strictly to reduce risk of pesticide drift to organic farms;
- Regulating GMOs more strictly to reduce risk of genetic and pesticide contamination;
- Placing the liability for pollen drift on manufacturers and patent holders;
- Shifting the burden of providing buffers to GMO and pesticide users;
- Coordination between the National Organic Program regulations and existing and new regulations impacting agriculture, such as food safety regulations.

To do this, the USDA must expand its data collection efforts on organic, including timely and accurate organic price collection and reporting.

GMO regulation and liability

USDA bans the use of genetically modified organisms (GMOs) in organic production systems, which provides a critical assurance of organic integrity to consumers. Access to non-GMO seeds and protection from GMO contamination by pollen drift or commingling is essential to the success of the organic sector. Since the widespread release of GMO crops, risk avoidance practices by producers and genetic testing by handlers have increased the cost of growing and processing organic food.[135] Tighter regulation of GMO approval, strengthened monitoring and enforcement systems to ensure compliance, shifting responsibility for buffers to the users

of pesticides and GMOs, including coverage for GMO contamination in crop insurance, and placing liability for genetic contamination squarely on the manufacturer/patent holder could limit those problems. Funding for research on contamination potential and a national GMO reporting system is essential.

Priority 3: Promote Government Procurement of Organic Food

This means allowing access to organic food by:

- Lifting prohibitions on the purchase of organic food in the Woman, Infants and Children (WIC) program.
- Allowing Supplemental Nutrition Assistance Program (SNAP) recipients to buy organic foods at farmers' markets and elsewhere
- Allowing government procurement of organic food in military, schools and Native American Food Service and Assistance Programs.

It also means maintaining and strengthening consumer confidence in the organic label by ensuring adequate funding for the National Organic Program to perform oversight, enforcement and regulatory functions.

Priority 4: Create a Robust Organic Transition Assistance Program

Organic Transition Assistance

Obtaining organic certification involves a high level of planning, development, and time. Farmlands that were previously non-organic are required to go through a three-year transition period to ensure that previously used prohibited substances are no longer in the soil. During the transition period, the products cannot be marketed as organic, yields are typically lower, and profitability is likely to be lower.

In order to help beginning and transitioning farmers cross the chasm to organic sustainability and profitability, we put forth the following recommendations:

- Provide planning assistance to meet the requirements of an organic system plan.
- Offer business and marketing guidance to identify, engage and sustain complex sales and distribution channels.
- Provide current information and education about organic standards and prohibited materials.
- Provide annual payments during the three-year transition period that reflect income lost during change in system from non-organic to organic.
- Coordinate with the Environmental Quality Incentives Program Organic Initiative and provisions of the Conservation Stewardship Program that provide assistance for implementing conservation practices in organic systems.
- Fund research to address the unique challenges during transition to organic production.

- Collect and report data on the number and characteristics of farmers who are transitioning to organic systems.

- Identify and follow products produced by transitioning farmers through the supply chain.

The European Union provides an excellent model of supporting farmer transition. Countries in the EU provide annual payments during the three-year conversion period to farmers as incentive to convert to organic and continue this support after the transition.[136] In the U.S. there are several policy models for annual payments to farmers to reward a particular land use, particularly the Conservation Reserve and the Biomass Crop Assistance Programs.

Priority 5: Create Environmental Markets

There are many motivations for a farmer to choose organic production. Some farmers are deeply motivated by environmental protection. We believe this 'greater good' of our people and planets' health should also be economically rewarded and make the following recommendations:

- Ensure organic farmers are rewarded through participation in market-based systems that pay farmers who provide ecosystem services benefiting the wider society.

- Make use of the water quality markets that can be created as a result of the Clean Water Act in certain watersheds or river basins.

- Make use of the USDA's Office of Environmental Market's infrastructure as a clearinghouse for agriculture environmental credits in managing nutrients, wetlands, and carbon.

Environmental Markets

One way to reflect the overall benefits of organic farming in the marketplace is to include organic agriculture within an environmental market. Most studies regarding agriculture's potential role in an environmental market do not consider organic agriculture. They focus on "sustainable" practices such as water quality management, habitat protection, and the reduction of pesticides and fertilizers. Additional research needs to be conducted to accurately measure and compare the benefits of organic versus non-organic farming.

Since the first market for sulfur dioxide reductions from coal power plants successfully reduced acid rain, environmental markets have been a powerful tool to enable wetland restoration, water quality improvements, habitat restoration, and greenhouse gas reductions. There is growing interest by the USDA, Congress, and others in creating similar market-based systems of payments to farmers who provide ecosystem services to society.

Farmers and other land owners using good practices to prevent pollution would be permitted to sell environmental credits, which could be bought by polluters to offset a unit of environmental damage under market rules set by a government agency. The environmental market would reward growers who have improved the environment with their practices and allow certified organic farmers to make money by selling eligible credits. This system would achieve pollution reductions at lower costs to society.

Environmental markets depend on placing an economic value on credits and performance. Ecologists and economists need to collaborate to establish valuation rules that recognize organic farming systems provide multiple benefits to natural resources by managing the land in a sustainable manner.

An example is the mechanism to create water quality markets in certain watersheds and river basins established by the Clean Water Act and not yet put into practice. Where a pollution trading system has been established, facilities that need discharge permits may be able to buy credits from farmers who have already reduced their pollution runoff by using certain best management practices, thus enabling the treatment facilities to avoid more costly improvements. The USDA Office of Environmental Markets provides infrastructure, as yet underutilized, as a clearinghouse for agriculture environmental credits in return for carefully managing nutrients, wetlands, and carbon.

Priority 6: Improve Conservation Programs

- Improve and fund existing conservation programs, such as the Conservation Stewardship Program and the Environmental Quality Incentives Program, to serve and reward the environmental benefits of organic systems more appropriately.

- Defend the Environmental Quality Incentives Program from cuts, defend the Organic Initiative, and modify rules and practices to make it more useful for organic farmers. Increase training of NRCS staff and outreach to farmers.

Environmental Stewardship Programs

In the United States, the **Conservation Stewardship Program (CSP)** provides payment to farmers for implementing conservation practices on their farms. CSP is a popular "working lands" environmental stewardship program that is coming up for renewal in the 2012 Farm Bill.

CSP is specifically designed to provide comprehensive conservation assistance to whole working farms to help support existing

and newly added conservation efforts. It is the first program where farmers earn annual payments for their performance—for how they farm instead of what they farm. The breadth of goals encompassed by CSP are unmatched by any other policy. They include improving soil, water and air quality; increased biodiversity with wildlife and pollinator habitat; reducing greenhouse gas emissions and sequestering carbon in the soil; and conserving water and energy use. Even though organic farms are not given special treatment, their farming practices are acknowledged in the program. To the extent that organic farms provide environmental benefits by virtue of required practices for certification--including non-chemical control of pests and weeds, resource-conserving crop rotations, and planting cover crops and buffers--they will score well. To the extent that organic certification is silent on a resource concern, for example on energy efficiency or air quality, the organic farmer will have an equal opportunity to address that resource as any other farmer.

While similar programs could be used to benefit organic growers and neighboring municipalities, there are numerous challenges in creating effective environmental markets. High transaction costs, challenges in measuring environmental impacts and the need to set socially efficient prices are some of the current barriers to developing a well functioning market. These constraints may necessitate a governmental regulatory framework to be overcome.[137]

Appendix A

Organic Research Priorities

While there is a strong and growing body of scientific literature on organic agriculture in the United States, further research is urgently needed to fill gaps in information. In 2007, Organic Farming Research Foundation published the *National Organic Research Agenda* outlining an array of research needs identified by organic farmers and researchers.[138] Many of the research priorities identified are even more relevant today with the increase in organic market demand and lack of investment in organic infrastructure.

A number of long-term trials have been conducted to investigate the transition from non-organic to organic management of field crops and to study the performance of increasingly mature organic systems. The literature on organic horticultural and specialty crop production is much more limited and is greatly needed by a majority of organic growers.

The creation of the federal Organic Research and Extension Initiative in 2002 has funded dozens of projects around the country, greatly increasing the amount of organic research being conducted in the United States. Though more organic research is being conducted, many questions remain open about how best to optimize organic farming systems.

We propose investment in the following five urgent research priorities.

Research Priority 1: Study the Human Health Benefits of Consuming Organic Food

There is a great need for research on the human health benefits of consuming organic foods compared to non-organic food diets. The conversation needs to be expanded beyond the argument over "is organic more nutritious or not" and encompass full analysis of different agriculture and food systems, their environmental impacts, and their impacts on public health. A great deal of work has yet to be done to identify how farmers in general can implement practices which increase the nutritional content of food.[139]

Looking beyond nutritional content, analysis is needed to quantify the pesticide reduction potential that can be achieved through widespread adoption of organic management systems and the corresponding impacts on water quality, biodiversity, pollinator survival, farmworker health, public health, market opportunities/profitability, budgetary savings, and societal change.

Research Priority 2: Better Understanding of the Economics of Organic Farming and the Potential for Environmental Markets

There is very little information available on the labor requirements and employment potential of organic farming. There is evidence that organic farming builds community and provides societal benefits including the jobs created by thriving farms, vibrant farmers markets and food co-ops, and prosperous processors. The local and organic food movements have emerged as powerful forces in the marketplace and in communities. These issues are ripe for in-depth investigation by economists, social scientists, rural sociologists, and others.

Expanding the studies of yields and profitability to a wider range of organic crops is also a need.

Environmental markets depend on placing an economic value on credits and performance, a difficult interdisciplinary task requiring ecologists and economists to collaborate. Valuation rules should recognize the multiple functions of natural resources and how organic farming systems provide multiple services by managing the land in a sustainable manner. Ideally, organic interests must be engaged in the creation of the environmental market in order to clearly articulate how and why certified organic farms are high performers. Thus far, valuation systems are evolving and are the current focus of much research that may bear fruit in the near term.

Research Priority 3: Conduct Transdisciplinary Systems Research

Organic systems are complex. Organic management is based on the integrated functioning of soil, plant, and water ecosystems. In a mature organic system, the whole is greater than the sum of its parts. As one example, cover crop species and management (planting date, incorporation strategy) strongly impact weed competition and nutrient availability to the crop.[140] Cover crops also interact with other fertilizer inputs such as compost in a variety of ways. Soil quality resulting from cover cropping can also enhance crop ability to withstand insect predation or disease pressure. All of these

variables are likely to influence the nutrient content of the crop, as well.

In order to fully discern how an organic farm functions, scientists from multiple disciplines are needed to collaborate using a systems approach to study what works on organic farms, what doesn't and why. Shennan[141] provides a rigorous theoretical framework from which to approach managing biological interactions to best support crop production and environmental health.

Making a transdisciplinary effort, soil scientists need to join forces with weed scientists, plant pathologists, entomologists, agronomists, horticultural scientists, food scientists and other disciplines to fully understand how organic systems function as integrated wholes.

Research needs identified by the scientific papers cited in this report include:

- A ten-year comparison study conducted by the Agricultural Research Service at Beltsville, MD, points to the need for more research into delivering nutrients to organic crops when they need them and effective weed management strategies.[142]

- There is a wide body of literature describing the complex ecological interactions underlying the biological control of crop pests. We have only scratched the surface of evidence that organic practices support more biological diversity than do non-organic practices. Organic practices support the natural suppression of pest populations. This presents a great future research opportunity.

- Crowder et al. point to the need for more studies comparing "pest-control intensity and effects of natural enemy evenness in organic and non-organic fields."[143]

- A small body of research in the United States suggests that improved soil quality may be able to influence the ability of crops to withstand or repel insect attack[144] and plant disease.[145] This is an area where soil scientists and plant pathologists could collaborate on research and generate extremely useful information for all farmers.

Weed Management is the Top Challenge for Organic Farmers

A multitude of surveys and research results have shown that weed management is the number one production issue for organic farmers. Research reports indicate that weeds are the single factor most responsible for lower yields in organic plots.[147] Weed management methods that use herbicide-resistant transgenic crops or regimes of herbicide application focus on only one aspect of the problem: killing the weed. The efficacy of such strategies is challenged, however, as weeds develop resistance to herbicides.

Developing integrated weed management strategies that are not reliant on synthetic herbicides will be useful to both organic and non-organic farmers. The book *Ecological Management of Agricultural Weeds*[147] outlines a comprehensive research agenda for managing weeds using practices rather than inputs. A recent paper presents a conceptual model that similarly situates weed management in an ecological framework and shows promise for guiding useful weed management research in the future.[148] An Agricultural Research Service scientist in South Dakota has argued for increasing field crop rotation length to nine years, using both perennial forages and annual crops and including periods of no-till management in order to break up weed cycles and improve soil quality.[149] All of these concepts must be put to the test in field studies.

Environmental Effects of the Widespread Adoption of Genetically Modified Organism (GMO) crops

Scientists are documenting GMOs ending up in places that were not anticipated and therefore not studied, highlighting the fact that the real impacts of GMOs are not yet understood. Long after harvest, the insecticidal protein introduced into GMO corn to make it insect-resistant was found in 23% of waterways draining from agricultural fields in Indiana.[150] This unstudied side effect of widespread adoption of GMO crops reveals a deep knowledge deficit: what effect does exposure to this transgenic protein have on stream organisms? This and other unanticipated effects of widespread planting of GMO crops need to be seriously investigated to provide a basis for realistic risk assessment of the impacts of GMO crops.

Organic Livestock Management Systems

One of the least studied areas continues to be organic livestock management systems. There is a need for an increased understanding of organic-compatible ways to manage animal and herd health.

Organic livestock management systems have clear benefits: evidence suggests that grazing can play a role in increasing carbon sequestration.[151] Additionally, reintegrating crop and livestock systems can tighten nutrient cycling within agroecosystems and reduce accumulation of wastes that pose environmental risks to water supplies from confined animal production operations.

Research Priority 4: Developing Climate-Friendly Farms

Few studies have examined to what degree crop and range lands can absorb atmospheric carbon releases.[152] Policymakers and scientists must "work aggressively" to identify and promote the most effective ways to sequester carbon.[153] While there is a broader body of international literature on this topic, more research needs to be conducted in the United States.

One of the most challenging shifts that both organic and non-organic farmers are facing is the need to find ways to decrease reliance on fossil fuels. The more that organic farmers explore options such as solar, wind, on-site biofuels including algae,

and technologies like using anaerobic digesters, the closer they will be to fully meeting the food production challenges of the near future. A related need is to continue developing reduced tillage systems that require less fossil fuel to operate.

The Tri Societies' Greenhouse Gas Working Group has identified increasing nitrogen-use efficiency of cropping systems as the most effective method for reducing N2O emissions from agriculture.[154]

More research is needed on CO2, N2O and CH4 flux from cropland and range land and integration of the data to determine the overall effect of agricultural management on greenhouse gas releases.[155] Organic farmers have a related and ongoing need for information on how to better integrate nutrient release from biological fertilizer sources with crop uptake throughout the year.

All farmers, whether they utilize organic or non-organic methods, will need to contend with changing rainfall and weather patterns, reduced availability of fossil fuels and reduced access to energy-intensive nutrient sources such as cheap nitrogen in the very near future. Improving efficient water use of cropping systems is becoming increasingly necessary. Responding to this challenge will require plant breeders to develop crop varieties that are highly productive with less irrigation and will require researchers to develop management systems that produce under very dry conditions.

A related research need is gaining a better understanding of how to manage periods of both flooding and drought in crop production.

Because world phosphorus reserves are finite, pressure is increasing to find ways to improve crop absorption of this nutrient and to recycle available sources. Data suggest that certain clover and alfalfa species have properties that markedly enhance phosphorus cycling.[156] Buckwheat has also long been thought by organic farmers to make phosphorus more readily available to subsequent crops, a notion that is supported by some evidence.[157] This is another topic that would benefit from increased study.

Research Priority 5: Assessing the Environmental Impacts of Organic Farming

While a great deal of research has been conducted on the impact of non-organic farming systems on the environment, there are very little data available on the positive impacts of organic farming. How does organic farming impact water quality? Based on current research, it appears that organic farming plays a significant role in reducing off-site hypoxia because of lower rates of nitrate leaching from organic systems. However, this issue has not yet been systematically explored.

Some scientists have called for a thorough study of the environmental and health impacts of the botanical and mineral-based pesticides allowed for use in organic farming.[158] This information will be helpful for farmers to continue to improve organic management practices and to make a stronger case in favor of organic farming.

Much more work is needed in the U.S on the impacts of organic agriculture on supporting biodiversity. Greater understanding is needed of the mechanisms underlying biological control of pests, diseases, and weeds in organic systems and how these contribute to biodiversity. Another area in which hardly any research has been done is how organic farming affects wildlife.

Additional Research Needs

There is a close link between food systems and resource protection. Organic management is the best defined, regulated, and recognized agricultural production system in the United States. Analysis is needed to quantify the environmental benefits that can be achieved through widespread adoption of organic management systems and the corresponding

impacts on water quality, biodiversity, pollinator survival, farm worker health, public health, market opportunities/profitability, budgetary savings, and societal change.

With further investment into research and the support of insightful policymakers, organic farming will realize its full potential in providing the nation with a safe, abundant, nutritious, and environmentally sound food supply.

The Organic Farming Path Forward

Organic farming is critical to the success of this country and meeting our nation's most urgent needs. When we imagine an America in which organic farming is the leading form of agriculture, we can see a more prosperous, healthy, and environmentally healthy country. Organic farming increases the number of jobs in the agricultural sector, increases agricultural profitability, improves the health of soil and water, and reduces damage from global climate change.

The many benefits of organic farming are important to multiple sectors of society: farming, business, major employers, government policy makers, health professionals, universities, municipal governments, environmental advocates, and individuals.

As the leading national non-profit champion of the American organic family farmer, Organic Farming Research Foundation (OFRF) is building the infrastructure to ensure the success of organic farmers. Organic farms in the United States have, on average, higher sales, higher production expenses, and higher operating profits than the average for all U.S. farms, creating real opportunities for rural economic livelihoods. Organic farms bring economic benefits to their communities by providing increased employment opportunities, as well as health benefits to farmers and their families, consumers of organic foods, and the environment.

Increasing the role of organic farming presents a three-fold challenge: increasing public awareness of the value of organic farming, implementing policy changes that ensure organic farming meets the rapidly growing consumer demand, and conducting research to arrive at necessary technological advances.

The demand for organic foods is growing. OFRF promotes policies that help organic farmers to fully meet current and near-term market demand and to expand the number of organic farmers so that, within a generation, organic farming becomes the leading form of agriculture.

It is time that the many benefits of organic agriculture are acknowledged by the public and by more policymakers. A new unified policy to support organic farmers and the organic food industry is needed. The government should increase research that is responsive to organic farmers' needs, integrate organic programs into every federally funded university, and create farm safety net and transition assistance programs that work for organic growers.

Over the past decade, modest public resources have been directed toward organic farming. However, the resources allocated to date are still far disproportionate to the investment needed to realize the great potential of organic farming. **Organic Farming for Health & Prosperity** recommends elements of an integrated, unified policy that will further organic agriculture and support the multiple advantages it provides to society.

The research leads overwhelmingly to the conclusion that an America in which organic farming is the leading form of agriculture is a more prosperous America, a healthier America, and an environmentally healthier America.

Removing the barriers for organic farmers can help make America stronger and healthier. By building a broad and deep base of organic supporters and increasing the number of champions for organic farmers in Congress and federal agencies, these goals will be achieved.

When an organic farmer succeeds
we all thrive

Appendix B

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About OFRF

Organic Farming Research Foundation (OFRF) is the only national non-profit champion of the American organic family farmer. Founded in 1990, OFRF promotes organic champions in Congress, integrates organic farming in agricultural universities, provides research that is responsive to organic farmers' needs, and partners with organizations to secure the connection between organic farming and a healthy planet. Headquartered in Santa Cruz, California, with offices in Washington, D.C., OFRF knows that when an organic farmer succeeds, we all thrive.

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