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Does the adoption of organic food and farming systems solve multiple policy problems? A review of the existing literature

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1. Introduction

> "The organic sector has an excellent record of socially responsible business practice. In all links of the chain, organic production largely meets social requirements in terms of environment, animal welfare and biodiversity, and plays a pioneering role for the entire agri-food complex." *Gabrielle Nuytens-Vaarkamp. Head, Co-ordination Unit on Organic Agriculture, Ministry of Agriculture, Nature Management and Fisheries, the Netherlands.*[1]

The Canadian food and agriculture sector is facing some significant environmental, food safety and financial difficulties. These difficulties are affecting perceptions of Canadian food, both domestically and internationally. These realities explain, in part, the development of the new Agricultural Policy Framework, being implemented by the federal, provincial and territorial governments.

To date, with the possible exception of Quebec, Canadian governments have treated organic food and farming as a niche market to be supported in limited ways. In most of parts of the world, organic has been a niche market, but rapid growth rates this past decade suggest that restricting policy supports on this basis would be misplaced (see Appendix 1). In several European countries, the sector has grown to become a significant percentage of the agrifood economy and rural landscape, with attendant environmental, economic and social benefits.

This paper presents data and analysis to support the position that organic food and farming is more than simply a niche market opportunity. Given relatively low adoption levels to date, the extensive benefits of organic farming systems are not yet very visible. However, there is growing evidence that adoption of such systems produces multiple environmental, social and financial benefits that can solve pressing agricultural and governmental problems in Canada.

This report uses primarily peer reviewed literature and governmental and paragovernmental reports. It is not the product of a thoroughly exhaustive literature review, but does identify the main sources of literature on the themes addressed. It focuses particularly on literature employing an agroecological analytical framework. Agroecology is concerned about the relationships between organisms, and their associated nutrient, energy and water flows. It is concerned about systems and their dynamics. Agroecology believes in multiple causes and multiple effects. This is a relatively new science. Although ecology is over 100 years old, agroecology is perhaps a 50-60 year old discipline, still in many ways on the margins of agricultural science.

Using the agroecological paradigm, four essential system properties of agroecosystems have been determined: productivity (level of output); stability (constancy or persistence of output over time); sustainability (recovery from stress, disruptions); equitability (evenness of distribution among various groups)[2]. Agroecology has identified a number of "laws" of agroecosystem behaviour[3]. These "laws" direct how agroecologists interpret the behaviour of agroecosystems

and the strategies they feel will enhance sustainable production. Resolving problems involves mimicking the functions within natural ecosystems[4]. Put another way, employing production practices that a) promote community stability; b) optimise the rate of turnover and recycling of organic matter and nutrients; c) optimise multiple use of the landscape; d) optimise energy flow efficiency, are most likely to ensure sustainability[5].

Sustainable approaches, consequently, use design and management procedures that work with natural processes to conserve all resources and minimize waste and environmental damage, while maintaining or improving farm profitability. Working with natural soil processes is of particular importance. In this view, sustainable agriculture systems are designed to take maximum advantage of existing soil nutrient and water cycles, energy flows, beneficial soil organisms, and natural pest controls. By capitalizing on existing cycles and flows, environmental damage can be avoided or minimized. Such systems also aim to ensure the humane treatment of animals, the well being of rural communities, and food that is nutritious and uncontaminated with products that might harm human and livestock health[6].

This paper also offers systems comparisons. Many of the studies used for this paper compare, directly or indirectly, organic and conventional farming systems. To produce useful comparisons, it is important to focus on the entire farming system or larger food system dynamics as opposed to examining specific elements outside of their larger operating context. It is also important to compare systems that have common components, including comparable management capacities. Clearly poorly managed organic and conventional systems generate problems. A poorly managed organic system compared to a well managed conventional one may reveal more about the management capacity of the farmer than the way the farming system behaves. We're interested in structural comparisons, so we assume good management in systems being compared[7]. In doing so, we are attempting to analyze how the structure of organic farming offers benefits that are not necessarily associated with conventional farming.

The report is organized by thematic areas and each section has a similar structure:

Context
What do the data say about the benefits of organic food and farming?
How solid is the evidence?

Scale used for assessment:
very solid - A large number of peer-reviewed studies over most farming systems and geographies come to the same conclusion
solid - a modest number of studies covering a representative sampling of systems over some geographies come to the same conclusion
tentative - some preliminary work on a small number of cases reveals similar results, suggesting some interesting possibilities and that more work is worth the investment
weak - very few studies have been conducted

Where is there a pressing need for more information?
What appear to be the weaknesses in the organic system and how might they be addressed?

2. Environment

2a. Adopting organic farming helps governments address pollution problems and their costs.

Context

Agriculture is a significant contributor to water quality problems, both acute ones associated with spills and more chronic ones, such as excess nutrient runoff into streams from regular farm practices. For example, the annual cost of damage to water from agricultural practices in the USA is estimated at $2.6 billion. The cost of pesticide damage to all natural capital in the USA is estimated at $3.70 / kg of active ingredient[8].

What do the data say about the benefits of organic?

- A UK study of the real costs of the British food basket estimated that the external costs of organic farming are one third those of conventional agriculture[9], so investing in organic farming is a good pollution abatement and remediation strategy.
- A Swiss study concluded that it was cheaper to pay organic conversion subsidies to all the farmers surrounding a lake, than to pay for a technological solution to clean up the lake[10].
- European data suggest there are lower levels of pesticide leaching from organic farms into water systems and equivalent or lower nitrate leaching[11].
- It is well established in North American literature that the off-farm benefits of mitigating soil and watercourse degradation far exceed the on-farm costs of soil conservation[12]. The implication is that those benefiting from the mitigation, i.e., society at large, should pay at least some of the on-farm costs of conservation. Since the mid-80s, it's been well-established that organic farming systems can significantly reduce soil erosion relative to conventional operations[13], with semi-arid regions being a possible exception given current challenges to control weeds and generate sufficient residue for soil cover[14].
- An extensive European comparison of organic and conventional farming systems and their environmental impacts found that organic farming was the same or better than conventional on all environmental indicators, except there was some potential for more soil erosion in some cases (although most comparisons were more positive to organic), and some possibilities in some comparisons for more nitrate leaching[15]. The conclusion is that organic farming has a broad positive impact on many indicators.
- Phosphorous losses are lower in organic systems as compared with comparable conventional ones in virtually all studies[16].
- An Atlantic Canada Dairy Sustainability Model investigation concluded that an organic seasonal-grazing dairy system generated 10% less soil erosion and 40% less nitrate leaching compared to the average of all other dairy profiles studied, including low-input and intensive dairy systems[17].

How solid is the evidence?

Solid, with the caveat that non-point source pollution from farms is notoriously difficult to study. There isn't much data specific to Canada.

Examples of initiatives being undertaken

- As with the Swiss study mentioned above, similar strategies to encourage adoption of organic farming are being implemented in Germany and the UK in catchment areas where nitrate leaching has been an issue[18].
- Some Canadian jurisdictions have recognized that it is cheaper to invest in farm pollution prevention than remediation – for example, the Regional Municipalities of Waterloo and Wellington in Ontario are investing heavily in on-farm pollution abatement structures and cropping practices to protect the water supply[19] – but have yet to extend this concept to organic farming adoption.
- Fish kills in PEI streams, associated with mostly "normal" farm applications of endosulfan, carbofuran, mancozeb, chlorothalonil, and azinphos-methyl in potato fields, provide a telling Canadian example of both the costs of failing to act and the benefits of such investments. As a result, the PEI government is undertaking a series of initiatives to support potato farmers particularly by providing per acre payments to support the conversion to IPM and this may set the stage for organic conversion in the future.

Where is there a pressing need for more information?

There is little Canadian data at this point. Canada's capacity to monitor non-point source pollution from agriculture is generally weak, but getting better as the federal government begins to implement data collection and monitoring provisions of the Agricultural Policy Framework.

What appear to be the weaknesses in the organic system and how might they be addressed?

There may be specific farm practices that can outperform organic on some measures, but taken as a package, no current systems outperform organic regarding pollution reduction. In Europe, organic does not do as well in a comparison of impact per output, since outputs are generally lower, but given the major oversupply problem in Europe, this is not a significant limitation[20]. In more extensive farming systems in Canada, the situation is somewhat different (see yield discussion below).

Key to the success of organic farming in this area is properly managing leaching losses following pasture cultivation and green manures, and also minimizing leaching from storage and composting of animal manure in systems without pads[21].

2b. Adopting organic farming can reduce Canada's greenhouse gas emissions

Context

Farming in Canada contributed (with fossil fuel use included) about 13% of total 1996 Canadian greenhouse gas emissions, up 4% from 1986[22]. The main Canadian agriculture emission sources are:

For carbon dioxide (CO_2): breakdown of soil organic carbon, consumption of fossil fuels, use of synthetic pesticides and fertilizers;
For methane (CH_4) : liquid manure tanks, animals;
For nitrous oxide (N_2O): inefficient, ineffective or inappropriate use of nitrogen fertilizers resulting in significant nitrogen release to water and air.

N_2O and CH_4 are priorities for reduction[23], since agricultural soils are now thought to be net CO_2 sinks and emissions from agriculture represent only 1% of Canada's total CO_2 emissions. In contrast, primary agriculture in Canada accounts for 61% and 38% of Canada`s total emissions of N_2O, and CH_4 respectively[24]. Over half of all agricultural GHG emissions are N_2O[25]. 50-75% of annual N_2O emissions occur during the spring, around snow melt and planting. 42% of GHG emissions are associated with the livestock sector[26], particularly, most CH_4 emissions which are associated with animal digestion (almost all of it from beef and dairy) and manure[27] management (also N_2O and CO_2 emissions). The most significant emissions from the cropping sector are associated with synthetic nitrogen fertilizer (12 Mt CO_2eq in 1996).

To reduce these kinds of emissions, the International Panel on Climate Change (IPCC) has concluded that, in general, mitigation practices should: a) enhance sustainable production; b) have additional benefits for farmers, including profitability; and c) generate products that are suitable to consumers[28].

What do the data say about the benefits of organic food and farming?

From a systems perspective, organic farming usually leads to reductions in emissions and meets the IPCC's criteria for success. These farms are generally characterized by complex cropping patterns, with significant use of green manures, intercrops and legumes and reduced reliance on synthetic pesticides and fertilizers, reduced tillage, deep and extensive root masses, and high soil organic matter levels, and good soil tilth. Relative to most conventional farm operations, organic farming reduces soil erosion, stores more C, does not require synthetic N and pesticides (and their associated emissions), eliminates N_2O emissions from non-biological sources, does not permit anaerobic digestion of manure (and the associated methane emissions), often has lower animal stocking rates which contribute to lower methane emissions generally, consumes less energy and water overall, and has higher percentages of farm acreage in perennial crops (including pasture) and shelterbelts[29].

There is some empirical research on organic farming systems that demonstrates greenhouse gas emission reductions, greater adaptive capacity in the face of climate variability and significant carbon sequestration potential. For example:

- a study carried out for the federal German parliament came to the following conclusions when comparing conventional and organic farming systems[30]:

- The organic systems used 65% less energy than the conventional ones. The main differences in fossil fuel consumption were associated with the "operating materials", synthetics pesticides and fertilizers and imported feedstuffs.
- Although conventional operations fixed more carbon in shoots and harvested main crops, the organic systems tended to have much higher root masses. Roots in organic systems had 1.6 times more bound carbon dioxide, most of it associated with legume crops such as alfalfa and red clover). When all biomass generated in ecological systems is contrasted with conventional ones, the above ground production is similar.
- Ecological systems generally have more active soil microflora and detectable increases in the assimilation of carbon dioxide, whereas conventional systems have less carbon dioxide bound up in soil organic matter.

- A Danish study of wholesale national conversion to organic farming found 10-51% reductions in net energy use relative to 1996 conventional agriculture, depending on the scenario of wholesale conversion. Scenarios varied by yields of animal and crop production and extent of self-reliance in animal feed. These reductions in net energy use were associated with significant reductions in greenhouse gas emissions, particularly nitrous oxide emissions[31].

- Drinkwater et al. in their study contrasting conventional and alternative longer course organic corn - soybean cropping systems in Pennsylvania, found that longer rotations involving leguminous plants did not necessarily add more total organic matter to the soil, but because of the lower carbon to nitrogen ratio additions resulted in greater organic carbon sequestration and improved soil physical properties[32]. As well, they cut nitrogen losses in half compared to the conventional system. A recent update (5 more years of data, to 23 years in total for the trials) shows that the organic rotations are actually accumulating 15-28% more organic carbon thann the conventional trials[33].

- The most comprehensive comparative studies to date have been carried out by research teams at Michigan State University. They have compared corn-soybean-wheat systems under conventional tillage, no-till, low input and organic systems (with legumes, but without animals and manure). Using CO_2 equivalents (g/m/year) as their measure for systems comparisons, they found that no-till had the lowest net Global Warming Potential (GWP) (14), followed by organic (41), low-input (63) and conventional tillage (114)[34]. The no-till system superiority over organic was a result of higher soil C sequestration (-110 to -29). However, there is some debate about the extent to which no-till systems actually sequester carbon. In some studies, soil C content increases within the top 7.5 cm of the soil profile, but results in no changes over the entire profile[35]. The Michigan study only measured soil C changes in the top 7.5 cm, so the C

sequestration benefits of no-till may be overestimated relative to organic systems. The Michigan study also found that perennial crops (alfalfa, poplars) and successional communities all had much lower emissions and in fact most were net sinks.

- A German case study comparing a comparable organic and integrated farm found a 30% reduction in CO_2 equivalents, and about a 20% reduction in animal emissions on the organic farm, largely because of lower emissions from animal waste management. This result was obtained despite having higher livestock units[36].

- Other studies, from the US mid-west, examining corn, soybean, wheat systems reveal that longer rotations involving legumes leave farms better able to withstand drought[37]. One series of studies from the University of Nebraska showed that the longer rotations reduced the risks of suffering through a bad year, and less variable net returns[38]. The Rodale trials show 25-75% greater corn and soybean yields in drought years[39]. These longer rotation systems have performed consistently as well or better than short corn - soybean rotations. This result appears to be due to some combination of root development, associations with soil organisms and soil tilth[40]. Organic matter, especially in more loamy soils, can improve soil aggregation. Aggregation creates more pore space for root movement. The traditional view is that the kind of organic matter is less significant than the quantity, but it is the more digested organic matter fractions that appear to be significant for these processes - microbial gums and mucilages, low molecular weight fulvic acid molecules, and fats and waxes[41]. Farming systems that favour these organic matter components do better.

- a 12-year organic vs. conventional cropping trial in Manitoba showed that energy efficiency was nearly doubled in the organic systems studied, with the greatest efficiencies coming from a wheat - alfalfa - alfalfa - flax rotation. The absence of inorganic N fertilizer is the main contributor to reduced energy inputs and greater efficiency[42].

- A study of organic vs. conventional apple production in Washington state found 9% lower energy inputs and 7% higher energy efficiency in the organic system[43].

- a modelling study in Atlantic Canada examining 19 different dairy production scenarios found that a seasonal - grazing organic system was 64% more energy efficient and emitted 29% less greenhouse gases compared with the average of all other analyzed systems[44].

<u>How solid is the evidence?</u>

Tentative. Although almost all comparative studies come to similar conclusions, there are insufficient numbers of them to have more confidence in the data.

<u>Where is there a pressing need for more information?</u>
In general, European studies show a 40-60% reductions in CO_2 emissions on a per hectare basis. Data on CH_4 and NO_2 suggests similar results though data remains limited[45]. In general, there is

a need for more comparative studies in more countries under a wider variety of cropping systems and conditions.

Although differences in production are significant, the larger contributor to greenhouse gas emissions comes from food miles - the global transportation of food. Food Miles are now a consumer issue. European consumer surveys show that many are suspicious of long distance transport of organic foods. In some markets, confidence in organic deteriorates with distance travelled. At least one Swiss certifier prohibits transport by air[46]. Further research on the impacts of food miles and the potential of more local distribution of organic food to reduce emissions will be important.

What appear to be the weaknesses in the organic system and how might they be addressed?

Organic farms may have higher emissions relative to conventional farms from the following sources because these practices are more frequently used on organic farms: CO_2 from composting manure and tillage (both soil release and fuel use); N_2O from nitrogen fixing crops and crop residues. Composting and tillage are sometimes offered up as reasons why organic farming should not be supported as a greenhouse gas mitigation strategy. Frequently, fuel usage for tillage is highlighted by organic farming critics. In a limited number of systems like potatoes with mechanical weeding, the increased energy from tillage may mean energy use is roughly comparable, but in most other production systems, even with tillage, energy use is often half of conventional[47]. Fuel use increases relative to no-till operations is usually a relatively small part of total farm greenhouse gas fluxes[48]. But, to produce a gain in carbon storage, a management practice or system must (a) increase the amount of carbon entering the soil as plant residues or (b) suppress the rate of soil carbon decomposition. What's critical is that the carbon enter at a rate that exceeds the decomposition rate. Organic farmers generally add so much more organic C and a more diverse range of materials relative to conventional and no-till operations. There is evidence that adding diverse materials with suitable C:N ratios also creates a more stable pool of organic material[49].

To reduce CH_3 and N_2O emissions, additional advances can be made with improvements to animal housing systems and manure management[50].

2c. Organic farming can improve biodiversity relative to conventional farming

Context

Agriculture as practiced in Canada has largely been a force reducing biodiversity. This has happened as a result of numerous activities:

1. The destruction of native habitat when farmland is created. For example, 93% of Prairie ecozones are in agriculture and only 1% of the tall grass prairie, 19% of the mixed grass prairie and 16% of aspen parkland remain[51]. One of the likely impacts is that over half of bird species in the Breeding Bird Survey are in decline on the prairies, particularly grassland species[52].

2. The destruction of corridors and habitat adjacent to farmed fields. Agriculture is a major cause of habitat fragmentation, with disconnected parcels of woodlots across the landscape, and the elimination of field borders that serve as corridors for wildlife movement.
3. Pollution from agricultural practices (e.g., synthetic pesticides, synthetic fertilizers, soil and manure runoff associated with poor management) disrupts terrestrial and aquatic ecosystems and changes wildlife populations. Pesticides kill many non-target organisms, especially birds and insects.
4. Simplification of agroecosystems (e.g., very limited crop rotations that result in vast acreages in only 2 or 3 crops, and poor range management) removes habitat and food sources.
5. Weed management practices (excessive tillage, herbicides, HT - tolerant crops) that eliminate food sources and disturb ground habitats
6. Poor management of wetlands, streams and riparian zones on farm properties, including excessive excess to these areas by grazing animals.
7. Introduction of exotics (e.g., new plants, new pests). Agriculture is a major source of introduction of weed species (and some cultivated plants that become weeds) into natural ecosystems.

What do the data say about the benefits of organic food and farming?

A review of 33 comparatives studies of organic and conventional farming systems found that the organic farming system led to biodiversity improvements for most of the studied organisms. Results were particularly positive for birds, flora and some arthropods. Some negative results were reported for beetles, earthworms and some flora. The authors also categorized the biodiversity benefits of practices that are part of (though not always unique to) organic farming. Of the 10 parameters discussed, 7 had positive impacts, 2 were mixed and 1 (mechanical tillage) was negative. The results are summarized in Table 1.

Table 1. Biodiversity comparison of organic and conventional farming
(adapted from Bartram and Perkins, 2003[53])

Number of studies showing the effect of organic farming relative to conventional farming

	Birds	Mam-mals	Beetle	Butter-flies	Spider	Soil Microb es	Earth-worms	Other Arthr-opods	Flora
Pos.	6	1	6	1	3	2	2	4	8
Same	0	0	1	0	0	0	1	0	3
Neg.	0	0	3	0	0	0	1	0	2

Some specific results from some comparative studies:

Plant species
- 15% higher numbers of *plant species* on organic than conventional grassland farms in southern Germany[54]
- Two - three times more *weed species* in organic as compared to conventional fields; in regions with rich soils, the ratio jumped to 10:1. Endangered species were occasionally found on organic fields, but never on conventional fields. Differences were often much more pronounced in the centre of fields as compared to field margins[55].

Soil organisms
- Farming systems employing crop rotation and overwintering cover crops without chemical input had higher populations of several species of *arbuscular mychorrhizal fungi* than conventionally grown fields[56].
- Earthworms respond better to organic manure than to chemical fertilizers, and incorporation of crop residues or cover crops improves earthworm activity and biomass. Species number and, especially population density, were much higher on organic than conventional apple orchards and nearby deciduous woodlands[57]
- A number of studies have found higher abundances and species numbers of *carabid beetles*, important pest predators, in organic compared to conventional systems[58].
- Higher populations of *springtails, mites, yeast and bacteria* were found in organic as compared to conventional soils[59].
- Higher total microbial biomass is associated with the high inputs of organic matter common to organic farming, though it is unclear whether biomass increases are associated with higher microbial species diversity[60]. However, one 21-year Swiss comparative study of conventional and organic systems found dramatically higher levels of both biomass and microbial species diversity[61]

Above ground beneficials:
- Greater numbers of *predators* and *parasitoids*, though not of plant-eating arthropods, were found in organic as compared to conventional tomato fields[62].

Birds
- a Prairie study by the Canadian Widlife Srvice concluded that organic management can be less harmful to wetland bird populations than other forms of farm management[63].
- a study of birds on organic and conventional farms in southern Ontario found higher species richness and abundance, particularly for about 20% of species analyzed. A majority of these were in long-term species decline between 1967 and 1998. Five percent of species analyzed were more abundant on conventional farms[64].

In-situ genetic conservation in agricultural plants and animals
- economic use of older plant varieties and animal breeds tends to be more common on organic compared to conventional operations as they frequently have characteristics more suitable to organic operations[65]

How solid is the evidence?

Solid. There are many European studies confirming that for most indicator species, greater biodiversity results on organic farms. Canadian studies are somewhat more limited.

Where is there a pressing need for more information?

Organic farmers do not always optimize biodiversity opportunities for reasons that may be as much lack of knowledge as finances. Such opportunities should be further investigated.

What appear to be the weaknesses in the organic system and how might they be addressed?

Mechanical tillage appears to the most significant issue, so where organic farming relies more than conventional farming on tillage, this is a relative weakness in the system. Organic systems that rely on minimal tillage would suffer less from this problem.

3. Consumer issues

3a. Adopting organic farming builds consumer confidence by not using products, practices and processes seen to be controversial by some consumers.

Context

In the OECD world, consumer confidence in the food supply has been tested of late. Disease outbreaks, worries about new technologies, and concerns about the ability of regulatory systems to keep up with changes in a globalized food system are all contributing factors. Whether real or perceived, the loss of consumer confidence is worrisome to governments and the food industry and is producing more onerous management and record keeping conditions for many farmers and merchants.

What do the data say about the benefits of organic food and farming?

Organic farming and food processing standards[66] do not permit a number of products and practices perceived to be risky by many consumers:

Synthetically compounded pesticides
- some 50 million kg of pesticides are applied annually in Canada[67]. Almost all pesticides believed to have potentially negative health impacts on humans are not permitted in organic production. Of the more than 500 active ingredients registered in Canada, probably a dozen or less are permitted in organic production.

- Consequently, residues of production pesticides are almost always lower in organic foods[68]. One recent study found that the organic foods examined had residues on 23% of samples, while the conventional foods had residues on 75% of samples. In both types of food most detected residues lay below established safety limits[69]. Baby foods may sometimes be an exception, where residues are often similar, in part because of higher quality control measures applied by conventional baby food manufacturers[70]. At least one study has found significantly lower levels of organophosphate pesticide metabolites in the urine of children fed a predominantly organic diet[71].
- organic farmers are unable to control atmospheric deposition of airborne pollutants; consequently, organic food is not residue free[72]. Other possible reasons for the presence of residues in organic foods include processing contamination, inadvertent or intentional mixing of organic and non-organic ingredients in the distribution chain, and fraud[73].

Fertilization
- in contrast to conventional farmers, organic farmers in North America are generally not permitted to use uncomposted or unaerated manure, except under very specific circumstances[74].
- The composting and aging process reduces pathogen levels and leaching of nutrients. During experiments, most, but not all, bacterial pathogens are killed following exposure to temperatures of 55-60^{o}C for a few hours or less. Such temperatures are achieved and last for days to weeks[75].

Animal rearing practices
- growth hormones are not permitted, and animals must be a fed a diet for which their digestive system is adapted. Consequently, the digestive conditions associated with elevated E. coli 0157:H7 levels do not normally occur on organic farms[76].
- Mycotoxin levels in animal feeds are no higher than in conventional agriculture, and some European studies have found lower levels in organic than conventional milk[77].
- Standards do not permit the use of antibiotics, unless the life of the animal is in jeopardy. Most standards then require that the animal be removed from the organic stream, although some permit its return following an extended withdrawal period. As a result, levels of antibiotic resistant bacteria are likely to be lower in organic than conventional systems[78].
- although BSE is not completely avoidable on organic farms, due to either random events or import of conventionally reared young onto organic farms, if BSE is a product of feeding ruminants infected animal protein, then organic farms have provided some risk reduction possibilities since standards to not permit feeding of animal protein to ruminants.
- also some evidence of lower levels of chlorinated hydrocarbons, PCBs, nitrates, DDT and lindane in organic milk[79]

Bacterial contamination of vegetables
- one study of organic vegetables in Northern Ireland found no confirmed pathogenic bacteria although the authors did find that Aeromonas bacteria, a possible pathogen, were present, at levels comparable to those found in conventional produce. They cautionned that ready to eat vegetables could contain more Aeromonas since conventional ready to eat products can be washed with bacteriacides like chlorine that are not permitted in organic production[80].

Synthetic preservatives and additives, and irradiation
- the use of synthetic preservatives and additives is severely restricted, largely to materials derived from naturally occurring substances. Of the 500 or so additives in general use, only 30 or so are generally permitted in organic processing[81]. Food irradiation is not permitted.

Genetically engineered organisms and products derived from them
- these are not permitted in organic farming or food processing, except in cases where no organic sources exist, and conventional ones may be inadvertently contaminated
- unfortunately, genetic contamination of organic foods is happening because, as with chemical contaminants, organic producers are unable to control the movement of genetic material across the landscape

Traceability
- organic certification provides for many of the traceability systems that are now emerging in food safety requirements for conventional products[82]. Because of this capacity in Europe, inadvertent contamination of organic food has been found more quickly than in conventional foods[83].

How solid is the evidence?

Tentative. That organic farming does not use many of the controversial practices, technologies and products is well established. The debate is about the risks associated with these things that organic farming and processing avoids. Comparative studies of bacteriological contamination are quite limited at this point.

Where is there a pressing need for more information?

- Infectious and zoonotic diseases are poorly studied in organic systems, although there is some evidence of no differences in hygienic quality between organic and conventional milk[84]
- there's limited data on whether organic systems have an impact on plant uptake of heavy metals. One study examining cadmium, lead, chromium, and zinc suggests that factors other than production system may be more important, for example inherent soil conditions and climatic conditions[85].

What appear to be the weaknesses in the organic system and how might they be addressed?

- although pesticides used in organic systems generally have lower Environmental Impact scores, some pesticides still permitted in some organic systems are hazards to either workers or some organisms[86].
- some disease organisms are reasonably well controlled in conventional systems directly or indirectly with pesticides so they or their associated disease hazards (e.g., fumosins, aflotoxins) are generally under control. If organic systems are not properly managed to minimize their presence, there may be additional risks. It is often argued by critics of organic farming that these hazards are inherently more elevated in organic systems, but most have alternative control

strategies that can be applied. Unfortunately, there is limited data on the effectiveness of these alternative control measures. Increasingly, however, they are the subject of innovative ecological research (e.g., competitive fungi for fusarium).
- generally, organic farmers and processors may need to exercise a higher degree of quality control than their conventional counterparts. Because it is an emerging sector, without the appropriate level of support, resources, information dissemination and skills development, there may be an argument that some in the organic sector do not have the skills or resources to practice that level of quality control. However, in Denmark where organic is well supported relative to Canada, a study suggests that when comparing farmers practicing integrated production and organic, there are differences in the degree of compliance with the complex rules of both systems. In Denmark, both systems are inspected in similar ways by the same public agency. In the case of organic farming, between 0.0 and 0.2% of certified farms were deprived of certification every year between 1995 and 1999, while the percentage lay between 5.8 and 24.9 in the case of certified integrated farms for 1996 to 1999 (Michelsen, 2001b). The author concluded that the higher entry and exit costs of organic farming inspired greater commitment to the rules[87]. The result suggests that greater quality control and management can be a product of the sector's support and evolution by the state.
- Because organic farmers use composted manure on a wider range of crops than conventional growers do, there is a significant premium on good composting techniques and proper timing of application. There is insufficient data available to assess whether compost is always well managed on organic farms.
- Because animals spend more time outside in organic systems, they are sometimes subject, given the state of general environmental contamination, to additional exposure to pollutants, whether atmospheric or soil based. One Swedish comparative study found that cadmium levels were lower in organic than conventional feed, but higher in kidneys and manure, suggesting in part that rooting around outdoors might contribute to higher environmental exposure[88]. For both systems, cadmium levels were lower than reported in other studies of conventional pig production. Outdoor conditions may also lead to higher levels of parasitic infections[89].
- there are some reports of higher *Salmonella* contamination in organic eggs, poultry meat and pork meat[90], though the reasons for this result were not clear.

3b. Organic farming can improve animal welfare

Context

Concerns about welfare of farm animals have been rising as confinement has increased and breeding programs and diets have been refined to increase productivity. Agriculture is frequently pilloried by animal welfare organizations and some consumers have become more wary in their purchasing decisions. Some governments in Europe have enacted animal welfare regulations forcing changes upon farmers. In this environment, animal welfare organizations have worked with farm organizations, particularly organic farming groups, to further animal welfare objectives in organic production. Their interest is related to organic farming standards

which require less confinement, usually lower stocking densities, different feeding regimes, and preventive approaches to health.

What do the data say about the benefits of organic food and farming?

Evaluations of animal welfare on organic farms conclude that organic farms generally receive higher marks than conventional systems[91]. Here are some examples why:

- by standard, organic farmers avoid many of the more egregious features of confined industrial livestock rearing, including broilers that can not walk under their own power, animals that never leave their confined space, and dramatically shortened lifespans due to hyperproductivity. In Europe, organic standards exceed most of the standards for animal welfare set down by the EEC-Council directives on the protection of animal welfare[92].
- in European studies, organic dairy cows tend to have a longer average productive life than conventional dairy cows, and this may be associated with the intensity of management[93]. One contributing factor may be lower rates of metabolic disorders in organic dairy cows[94].
- later weaning in organically-reared pigs likely has positive impacts on nutritional health and welfare, including lower incidence of weaning diarrhea[95]

How solid is the evidence?
Tentative. In a number of areas, organic consistently demonstrates better results than conventional, but in other areas, results of many studies are mixed. Because there remains some significant debate amongst researchers regarding the best measures of animal welfare[96], it is difficult to make definitive conclusions at this point.

Where is there a pressing need for more information?

This whole field remains understudied. A 2001 literature review found only 22 peer-reviewed papers on the subject, all dealing with health rather than broader welfare issues. The vast majority were on either dairy herd health or parasite management. None of the papers were from North America[97].

What appear to be the weaknesses in the organic system and how might they be addressed?

- Although research indicates that organic production standards are positive for animal welfare, and animals in organic production are generally found to be as healthy or healthier than in conventional production[98], there remains the potential for nutritional problems for animals solely grazing on forage plants, particularly a lack of selenium, sodium, cobalt and iodine. Whether alternative remedies used by organic farmers are always adequate substitutes for chemical interventions is also an outstanding question[99].
- parasite control remains a challenge in many organic operations[100].
- feather pecking and cannibalism have been reported as higher in poultry layer operations and it is believed that better stockmanship, nest design and selection of breeds suitable for extensive operations without debeaking will reduce these problems[101].

3c. Organic foods may be nutritionally superior to conventional foods

Context

For at least 80 years, scientists have known that soil conditions affect some nutritional parameters of foods[102]. This knowledge led to refinements in such things as fertilization strategies to improve wheat milling quality or to lengthen the storage period of many foods. Because organic farmers employ fundamentally different soil management practices compared to conventional farmers, the question has been raised whether organic foods may have a more optimal nutritional profile than conventional foods, in particular those constituents that exist in smaller quantities and may have more subtle impact on health than deficiencies of protein and carbohydrates. Although some argue it is an irrelevant consideration given the amount of food available to Canadians, data from historic nutrient files in Canada, the US and the UK suggest that levels of some micronutrients have fallen significantly over the past 50 years[103]. Given that over half the Canadian population likely does not follow Health Canada's Healthy Eating Guidelines[104], and some 10% of Canadians report being deprived sporadically of sufficient food due largely to poverty[105], it is possible that such possible nutrient losses could have an impact on health.

What do the data say about the benefits of organic food and farming?

Results of studies looking at plant foods are highly variable, with some showing no difference, some showing organic to be superior in certain parameters, and some showing conventional to be superior. The official position of most health authories at this point is that there is no evidence to support a claim that organic is nutritionally superior. Review studies, where authors have examined a wide range of results, have also been divided in their opinions, some concluding that differences are minimal or non-existent[106], others determining that organic is superior in a number of constituents[107].

Most studies examine particular nutrients (e.g., vitamins, minerals) in organic vs. conventional foods and these particularly produce mixed results. The most consistent (but not definitive) results pertain to lower quantity but higher quality grain protein, and lower nitrate and higher vitamin C levels in many organic foods[108]. The reason for the conflicting results appears to be that specific nutrient levels are affected by a whole host of factors, including the type of soil, fertilization, tillage, the variety of plant, the particular micro-climate, planting and harvesting dates, harvesting and handling techniques, and post-harvest handling. Managing all these variables in order to identify the organic vs. conventional comparison is very difficult, and many studies have not managed it well, making their conclusions suspect. Additionally, it may be the wrong comparion. The specific nutrient content may be less important for nutrition than the ratios of nutrients. In other words, the body’s ability to utilize nutrients may, within a specified range, be less related to absolute levels of a particular nutrient and more connected to the relationships between a variety of nutrients. Consequently, studies that focus on comparing absolute levels of a small range of nutrients may not be particularly helpful.

A bit more consistency is found in studies where test animals are fed an organic vs. conventional diet. In these studies, the researchers look at larger indicators - the health and fertility status of the animal as an indicator of its overall health. In these studies, animals on an organic diet tend to perform better in fertility and infant morbidity parameters than those on a conventional diet[109]. However, the reasons for this result are not clear. Is it related to nutritional parameters or possibly the lower levels of pesticide residues found on the organic foods (see discussion above)? The limited number of studies on humans consuming organic vs. conventional diets have produced mixed results, some showing fertility advantages for those on primarily an organic diet, others showing no significant differences[110].

More recently, studies have focused on food components other than minerals and vitamins. In a limited number of comparative studies, higher levels of some nutritionally significant phytonutrients have recently been reported in organic foods[111], and this may prove to be an interesting research area in the future.

How solid is the evidence?

Tentative. There is a substantial body of information on soil health - food quality relations, much of it produced in earlier years as part of the Commonwealth Agriculture Bureau's research work. More recently, German agricultural and food scientists have been doing very interesting work on the topic, much of it only published in German and therefore inaccessible to most North American scientists. There are only a few researchers in North America interested in the topic and even those who are interested have difficulty getting research dollars. At a minimum, there is enough interesting work here, to make the topic of great interest to NA researchers. Instead, most are highly resistant to entertaining the possibility because of the implications for the food system and previous research.

Where is there a pressing need for more information?

The entire field requires more attention, but the nutritional quality of animal products is even less well studied than plants. Comparisons are complicated by additional factors - different growth rates, different feed, different breeds, limited micronutrient supplementation, and free range husbandry. Extensive vs. intensive rearing practices (rather than organic vs. conventional) may be the biggest factor determining differences in quality[112].

What appear to be the weaknesses in the organic system and how might they be addressed?

Some critics of organic farming argue that reliance on boosting a plant's capacity to defend itself from pest attack increases production of non-nutritive constituents in the plants. It is likely that plant resistance to disease involves some form of biochemical response in the plant which may be elevated in organic cultivars compared to conventional ones[113], but the significance for the human diet is not well understood. Are these constituents positive or negative for humans?

This criticism of organic foods is connected to the argument that natural toxicants in plants are a more significant problem than synthetically compounded pesticide residues. There is insufficient data at this point to determine whether organic foods have higher levels of natural toxicants than conventional foods, and equally important, the validity of the natural toxicants argument is subject to considerable debate.

The natural toxicant argument has been promoted particularly by Bruce Ames. In many studies he has provided data and analysis leading him to conclude that carcinogen hazards from pesticides are minimal compared with those presented by natural toxicants in foods[114]. His work is criticized conceptually[115] by many ecologists and public health specialists because:

- It does not distinguish between novel and age-old compounds. Synthetically-compounded pesticides have existed for less than 50 years. Neither ecosystems or the human body have evolved in the presence of such substances[116]. Based on ecological theory, it is reasonable to assume that many of such products or their partial breakdown products will do harm to humans or other organisms. In contrast, the human digestive system and ecosystems have evolved over millennia in the presence of natural toxicants. Although the toxicity of some is not to be dismissed, humans and the human body have evolved sophisticated mechanisms for detoxifying many natural toxicants[117].
- Ames appears to presume that single agents cause a single disease, hence his interpretation that the existence of the natural toxicant at a particular level will result in a significant risk. This view does not take into account the multitude of interacting risk factors associated with cancer development[118]. Nor does it acknowledge the possibility that other constituents in food can offer protective qualities.
- Ames has a narrow view of alternatives to existing pesticides, therefore his conclusion that restricting many pesticides will lead to increased levels of potential carcinogens (e.g., those associated with moulds) is only supportable if no other pest control strategies are applied.
- To make the debate even more confusing, there is an argument that the historical role of secondary metabolites and natural toxicants in the human diet is to suppress over consumption so that the body does not digest all the calories available to it when overconsumption occurs[119], thus suggesting that such constituents can play both harmful and positive roles, depending on the dietary circumstances.

4. Economic

4a. Adopting organic farming can reduce financial pressures on farmers.

Context

Many farmers are in financial difficulty. Prices for many commodities are low, and the costs of inputs to maintain yield levels rise at a higher rate than average price levels. In discussions about solving these problems, most of the attention has focussed on the design of farm financial safety net programs, the squeeze on prices associated with US and EU subsidies, global market

pressures, and the need for even greater productivity. Little attention has been devoted to input cost reductions and markets with price premiums.

What do the data say about the benefits of organic food and farming?

That organic agriculture systems are usually more profitable than conventional farming systems is not widely appreciated by policy makers. This result is a product of yields, input costs, and price premiums.

Regarding yields, in organic systems, from worldwide evaluations[120]:

* Globally, plant yields are on average 10% below conventional systems. Global averages do vary between extensive and intensive systems because the conventional comparator is different. In Europe, where conventional production is very intensive, organic system yields look comparatively poorer than in extensive system like those found in North America and Australia. In North America and Australia, crop yields generally range from 20% less to slightly more. In Europe they can be 20-40% less, except in forages where the range is more like 0-30%[121]. For examples of yields of different crops in different regions, see Table 2. These results have occurred almost entirely without the support of institutions normally involved in agricultural development.

Table 2. Comparing yields in organic vs. conventional production

Product	Country / Region	Organic vs. Conventional
Tomato	California, past 10-15 years	Equal[122]
Apples	Washington State, 1995-99	Equal[123]

Many crops	Developing countries, numerous projects	80-300% higher[124]
Cereals	Europe	Org 30-40% lower[125]
Corn	Major corn regions of US, past 10-15 years, experimental station studies	Org 94% of conv[126]
Soybeans	Five US states, past 10-15 years, experimental station studies	Org 94% of conv[127]
Wheat	2 research institutions, past 10-15 years	Org 97% of conv[128]
Dairy	Canada	Equal[129]
Dairy	Europe	Organic 0-20% lower / cow, but stocking rates 20-40% lower / farm[130]

Yields in organic systems continue to rise as understanding of them grows and as more money is devoted to research. These increases are not always as great as those under some conventional systems, but occur at much lower environmental costs[131].

* For animal product yields are on average 20% below conventional, with the same caveats regarding comparisons. But for animal systems, such comparison are even more difficult than plant systems.. For ruminants, yields per animal are roughly equivalent, but since stocking rates are generally lower, output per hectare is usually lower in organic systems. The exception is when comparing dairy and beef systems where concentrate feeding is dominant from early in the animal's life. There is limited data on chicken and swine systems, and comparison are even more difficult because of the way these animals are integrated into the farm systems, but yields per animal are generally significantly lower[132].

*·Gross margins are at least as good, if not better than, systems under conventional regimes. In more extensive systems like NA, input cost reductions are often sufficient to maintain gross margins, whereas in more intensive production systems such as are found in Europe, premiums are often required to offset yield declines[133]. In Europe, most farm comparisons show profits for organic farms lie between plus or minus 20% of conventional[134]. Four factors usually account for these positive income results.
- First, operating costs may be up to one third lower, particularly for energy, chemicals, and drugs. Variable input costs are 50-60% lower for cereals and grain legumes, 10-20% lower for potatoes and horticultural crops, and 20-25% lower for dairy cows.
- Second, where premium prices are available, the likelihood of a superior net income situation is even greater.
- Third, many organic farmers achieve higher net income by making more direct links with consumers which allows them to capture a greater percentage of the consumer dollar[135].
- Finally, in many European states, government payments for environmental stewardship compensate for yield declines relative to conventional production. Organic farmer support payments account for between 16 and 46% of farm profits depending on product and country[136]. Of course, in Europe, almost all farmers rely on support payments of various kinds. In aggregate, government investments in organic farming produce savings on other farm subsidies that consequentially organic farmers do not use[137], suggesting that organic farms rely less on payments than conventional farmers.

<u>How solid is the evidence?</u>

Solid. In most cases, organic farmers are better off financially then they were as conventional farmers, due to some combination of yield levels, premiums, and input cost reductions.

<u>Where is there a pressing need for more information?</u>

Improving the profitability of livestock systems, particularly hogs and chickens, is the greatest priority.

What appear to be the weaknesses in the organic system and how might they be addressed?

Labour productivity / yield is generally lower in organic than conventional systems, and traditional economic analyses view this as problematic. Labour requirements are generally reported as higher in Europe and in more intensive production systems[138]. More extensive ones, however, often do no report additional labour requirements[139]. Average increases in requirements are in the 10-20% range, but there is wide variability amongst cropping systems. Field crop and mixed operations report slightly higher requirements for organic production, horticulture substantially higher. In dairy production, however, requirements are comparable. The farms involvement in further processing and direct marketing may also be a significant contributor to increased labour requirements. Labour demands on organic farms are, however, generally falling relative to the early 90s[140].

These increased labour requirements sometimes require additional hirings (see below) and are sometimes absorbed within the farm family. Interestingly, returns to total labour may be higher on organic farms, and wages may also be higher (see below). There is also evidence that the quality of labour is more positive in organic farming[141]. Because of both the difficulty of doing labour comparisons and the debates about the most useful labour measures, it is not clear that increased demands for labour are actually problematic.

Additionally, there may be issues around labour supply. Although in many operations, additional requirements are absorbed within the family, there is also in intensive operations greater hiring. There are few studies yet to be able to draw conclusions about how these demands will affect labour supply.

4b. Adopting organic farming can decrease the need for government farm payments.

Context

Governments in Canada continue to modify farm financial safety net programs in the hope of balancing farm financial stability with government financial conditions. Direct payments to farmers are down dramatically this decade. Many of these reductions are appropriate in that the payments acted as disincentives to the transition to more sustainable practices[142]. However, on average, net farm income for farmers continues to worsen, and vulnerability to more erratic market and climatic conditions is increasing, putting more pressure on the safety net system.

What do the data say about the benefits of organic food and farming?

Although a good safety net system is important, governments should help to create the conditions to improve farm financial health and lower financial risks. Organic farming systems can create these conditions. They are at least as, if not more, profitable than conventional systems as well as less vulnerable to climate variability[143]. In general, they have a greater capacity to resist both wet and dry conditions. This occurs because these systems rely on building soil organic matter levels to ensure optimum health for crops and greater pest resistance.

The side benefit is both greater moisture retention capacity during dry years and better soil tilth for improved drainage during wet ones. As well, these systems tend to be more diverse, providing more revenue streams. Reduced yields or revenues in one crop/animal/product are less likely to penalize the operation as dramatically as in systems where financial health is dependent on a limited number of crops or animals. Overall, these farming systems are less likely than many conventional farms to suffer yield and revenue losses that would trigger safety net payments[144].

The investigations attempting to analyse the impact of a major shift to organic agriculture have been methodologically controversial, underscoring the need for more study in this area[145]. However, existing studies have concluded that significant benefits would result from the shift, including improved food quality, enhanced environmental and human health, higher net farm income, and lower government subsidy payments and crop storage costs[146]. European governments have drawn related conclusions – that supporting the conversion to organic agriculture significantly reduces their public farm program expenditures[147]. A very conservative estimate is that 46% of direct support payments to organic farmers are recouped by reductions in support payments for other measures that would have had to be paid were they not organic farmers[148]. This estimate does not include all the other less direct savings described in this section.

How solid is the evidence?

Tentative. Although studies are generally positive, this is a difficult area to study well and insufficient work has been done to draw more definitive conclusions.

Where is there a pressing need for more information?

The entire field needs additional study. There are some significant methodological limitations in most studies that must be resolved. Many have not been able to model well a limited area conversion, let alone the resulting changes in organic prices. Also, the impacts on conventional markets have simultaneously received limited attention[149].

What appear to be the weaknesses in the organic system and how might they be addressed?

The studies highlight, directly or indirectly, many of the unknowns regarding future yields and prices. Organic yields are much higher in extensive production areas than organic critics like to admit. The presumption is that with research and extension support comparable to what conventional agriculture has received, the remaining differences will disappear, but this remains unproven. The yield question is closely connected to supply issues which in turn will have some impact on prices, both conventional and organic. There are a number of complications that are difficult to study. For example, widespread adoption of organic farming will shift cereal and soy production to human markets and away from animal feed, and concomitantly increase use of forages in animal diets, a positive development. Although cereal yields might fall, this does not

necessarily cause supply problems for either human or animal feed markets[150], depending on a number of variables. See the next session for more on the subject of price.

4c. Organic food prices reflect internalization of historically externalized costs

Context

Food prices do not reflect the real costs of producing, processing and distributing food. The agrifood sector receives considerable direct and indirect subsidies. These include government payments, govenrment subsidies to non-renewable fuel exploration and development, and extensive environmental subsidies (as outlined above) in that many costs of agricultural production and distribution are externalized to the environment. Most of these externalized costs remain unpaid. This situation distorts market signals, producing a disfunctional food market place, where both producers and consumers do not behave as they would were these externalized costs internalized.

What do the data say about the benefits of organic food and farming?

The theoretical arguments have been articulated by Bateman[151]. They identify how widespread adoption of organic farming and food distribution can better enlist consumers as allies in improving the environment and financial situation of growers.

Empirical work, however, is limited. There are a number of studies articulating the billions of dollars in externalized costs of conventional food production and distrubtion[152]. Only a few have attempted to relate these costs to consumer food prices. Unpublished work by Jules Pretty indicates that the externalized costs of greenhouse gas emissions are in the order of 200 fold higher for a conventional UK meal imported from various global locations, compared with an organic meal sourced within 50 miles of where it is consumed. The study concludes, " When externalities are included, the cost in Britain of an individual's weekly food basket rises by 3% if organic-locally sourced, and rises by 16.3% if conventional-global"[153].

How solid is the evidence?

That conventional agriculture is heavily subsidized and produces externalized costs is very solid. However, comparisons of externalized costs of organic vs. conventional food are limited at this point, so precise conclusions cannot yet be drawn - evidence is weak.

Where is there a pressing need for more information?

The whole field requires further study.

What appear to be the weaknesses in the organic system and how might they be addressed?

Current organic food prices can be problematic for some consumers and remain one of the limiting factors to more widespread (across product lines and consumer demographics) organic purchasing. However, a number of factors, in addition to market distortions caused by cost externalities, contribute to the higher prices of organic foods, and many of these are a function of the conventional food distribution chain, not organic production and distribution per se:
- Structure of the distribution chain: Price premiums for organic farmers do exist in some commodities and some regions, but these often are not the main contributors to higher consumer prices. In Canada, according to Statistics Canada estimates, less than 25% of the average consumer dollar goes to the farmer. Globally, distributors, shippers and retailers now retain 2/3 of the economic value of food, while the farm sector (9%) and input sector (24%) share the other third[154]. Farmers are, thus, usually price takers, having little control over both input and output prices[155]. This explains, in part, why many organic farmers direct market, to get around the financial conditions of the distribution system.
- Corporate concentration, product research, development and promotion, and long distribution lines all contribute to higher food distribution costs and prices[156]. This is particularly true for immature markets like organic where volumes are frequently too low to capture savings or to sufficiently spread costs.
- Even if the transition to organic farming results in higher prices at the production end (a disputable conclusion), it need not result in higher consumer prices if appropriate changes are made to what is distributed and how. For example, German studies have shown that an organic diet need not be more expensive, and may even be cheaper, than a conventional one, if consumers coincidentally eat more at home, purchase from non-traditional distribution sources and are consuming lower levels of some animal products[157]. A survey of packaged food in New York state stores, based on a 4-day menu plan, found that a mainly organic diet purchased in supermarkets and health food stores was no more expensive than brandname shopping in a supermarket. Purchasing organic foods at a food coop was by far the cheapest means of acquiring any of the menus of the study[158].

Some of the price dilemmas can be resolved with supports from agricultural institutions. As more dollars are devoted to research, lower cost production, distribution and processing strategies will emerge. As volumes increase, distribution costs / unit shipped will decrease. As more market players enter the field, increased competition will reduce prices in some cases. There is anecdotal evidence that production, distribution, processing and retailing costs are already coming down[159]. It is likely, however, that organic prices will be higher than the articially deflated prices that exist in some products sold through some distribution channels.

5. Social

5a. Adopting organic farming can help with rural community revitalization

Context

Rural revitalization is a pressing government priority and one of the pillars of the Agricultural Policy Framework (APF). Although much of the attention is non-agricultural, the federal government's efforts to improve rural community viability could be complimented by more widespread adoption of organic farming.

What do the data say about the benefits of organic food and farming?

A variety of studies suggests that sustainable agriculture[160] can contribute significantly to rural vitality[161]. A Nebraska study of an agriculture-dependent community concluded that if more farms were following sustainable practices, total family income would more than double, compared to a scenario where all the farms remained in conventional practices. The property tax base would be larger. More would be spent on supplies, utilities, feed, veterinary expenses, charity, food and personal care products[162]. Less, however, would be spent on agrichemicals, fuel, hired labour, livestock purchased for resale, seed, taxes and interest.

A study of four communities in the US Midwest found those with more sustainable agriculture practitioners had a greater capacity to mobilize community resources for local development, including more active participation in local government, the creation of new community economic development structures and new businesses. This result was attributed, in part, to the problem solving and self-reliance skills of sustainable agriculture practitioners[163]. Using data from farm-level studies, Lockeretz[164] concluded that lower production levels in sustainable systems may reduce economic benefits for farming communities in the short term. However, because a greater percentage of the value of production remains in the community, greater long-term financial benefits might result from sustainable systems, particularly as production methods improve.

A North Dakota study concluded that some economic sectors would be enhanced (transportation, utilities, business services, and non-metal mining), but others would decline (construction, professional services, finance, retail trade, agricultural processing). A better infrastructure for new marketing, processing and storage needs would ensure that the overall benefits were positive[165]. Because many communities lack products and services required by sustainable farmers, significant local economic opportunities are currently lost[166].

There is also evidence, particularly from intensive systems in Europe, that labour demands are generally higher on organic farms, although the degree varies considerably from enterprise to enterprise and activity to activity. There is some evidence that under conditions of good prices, wages are higher in organic systems as well. Although difficult to examine, a few studies have attempted to estimate the labour impacts of significant conversion in a region, finding increased

employment in the 10-100% range depending on region, commodities involved and scope of the food chain examined. In more extensive systems, however, organic farming may be labour saving[167].

One additional reported benefit is increased tourism in regions with significant numbers of organic farms, likely due to the more positive image of agriculture conveyed[168].

How solid is the evidence?

Tentative. Although most existing studies conclude that organic farming has net positive community benefits, it is not a sufficiently widely studied topic to make more definitive conclusions.

Where is there a pressing need for more information?

The entire subject requires further study. Some researchers feel that the question of scale of enterprises in a region may actually be more important than the whether it is organic or conventional[169], although since organic farms are often smaller in scale, the two issues are not likely separable.

What appear to be the weaknesses in the organic system and how might they be addressed?

The shift to organic farming clearly causes dislocations in more traditional agricultural service sectors, so those dislocations must be managed in order to fully benefit from widespread adoption of organic systems.

Appendix 1 - Penetration of organic agriculture worldwide
Source (unless otherwise indicated): Youssefi, M and Willer, H. (Ed.). 2003. The World of Organic Agriculture: statistics and future prospects. SOL and FiBl, Germany and Switzerland. http://www.soel.de/inhalte/publikationen/s/s_74.pdf

Jurisdiction	Growth rates	% agric. output	% land area or farms	% food sales	Sales
Global	20% (production) over 10 years[170] 23% (market) in 2000.		0.4% land area[171] 23 million ha		$19 billion US from major markets
OECD	15-30% (market)[172]	0.08		<2% (2000)[173]	
US	30% / year (land area certified), 91-97[174] 20%/yr over decade (market)	0.2[175]	Area: 0.2%	3% fresh produce sales[176]	$9.5 billion (2001)
Mexico	140% (land in production), 96-98[177]		Area: 0.1%		$70 million US, 1999[178]
Canada	10-20% sales over the next 10 years		0.6%	1.5-2%	$650 million US

Europe	30%/yr since 1998 (production) Dairy sales 26% in 2001[179] Projected: 10-20% of production by 2010[180]		Farms: 1%[181] Area: 3%[182]		$9 billion US (2001) 20-30 billion Euro projected retail sales for 2010[183]
Austria			Area: 11.3%	2-2.5%	$325-375 million US
Sweden			Area: 6.3%,	1.5-2%	
Switzerland			Area: 9.7%	3.2-3.7%	
Germany	Fruit sales 8%/annum recent years; vegetable sales 15% [184] 16% land area (2001)		Area: 3.7% Target: 20% by 2010[185]	1.7-2.2%	
Denmark			Area: 6.5% Target 12% [186]	2.2-2.7%	
Netherlands			Area: 1.9% (2001)[187] Target: 10% by 2010[188]	1-1.5% Target: 5% of market share by 2004[189]	
France			Area: 1.4%	1-1.5%	

UK	30-50% past few years (market), 29% (area)[190]		Area: 3.9% (2001)[191]	1.5-2%	Imports: 70% of primary produce sales, conventional only 25%[192]
Japan			Area: 0.9% certified organic[193]	<0.5%	$250 million US (2000)
New Zealand			Area: less than 0.5% (2002)[194]	<0.5%	Exports: less than 1% of total agricultural exports[195]
Australia			Area: 2.3% Farms: 1.4%	<0.5%	

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