

The Benefits of Organic Agriculture

Review of Scientific Research & Studies

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Inngangur *Icelandic Introduction*

Á síðustu árum hefur orðið mikil vitundarvakning meðal vísindamanna, vísindastofnana, bænda og matvælaframleiðenda almennt um mikilvægi aukinna grunnrannsókna á lífrænum aðferðum. Í kjölfar þessa hafa stjórnvöld og fjölþjóðastofnanir varið auknum fjármunum til slíkra rannsókna, með þeim árangri að nú má finna umtalsverð gögn um vísindalegar rannsóknir, ræktunartilraunir og samanburðarrannsóknir á lífrænum aðferðum.

Um skeið hefur Sandra B. Jónsdóttir ritað og uppfært fyrir Vottunarstofuna Tún ehf. skjal með samantekt um nokkrar merkustu niðurstöður þessara rannsókna á lífrænum aðferðum.

Þann 7. mars 2011 verður haldinn stofnfundur samtaka neytenda lífrænna afurða. Í tilefni af þeim merku tímamótum í sögu lífrænnar þróunar á Íslandi ákvað Vottunarstofan Tún að færa samtökunum að gjöf sérprentun á þessu yfirlitsriti um hin fjölþættu gæði sem lífrænar aðferðir færa neytendum og umhverfi þeirra.

Um leið og Tún óskar hinum nýju samtökum velfarnaðar er þess vænst að félagsmenn þeirra gefi sér tóm til að kynna sér efni þessa rits og safna sér þannig í sarpinn fyrir upplýsta rökræðu um gildi lífrænna aðferða.

Health Benefits

Nutritional comparisons between conventional and organic food have not been available until recently when studies from Europe and America have shown convincingly that organic food has higher nutritional value than conventional food. The reason is because organic agriculture focuses on soil health - and healthy soil produces healthy food. Organic growing methods maximise the nutrient density in soil through use of natural fertilisers, crop rotation and limited the use of pesticides, making food grown from organic rich soils higher in vitamin and mineral content.

The largest study ever conducted on the nutritional value of organic food was carried out in Europe and completed in 2007. It found that organic milk has 60-80% more nutrients in the summer than conventional milk, and 50-60% more in the winter. Organic milk has higher levels of vitamin E than milk from conventionally reared cows, and organic cheese can have twice as many nutrients as conventional cheese. Organic tomatoes, wheat, potatoes, cabbage and onions have 20-40% more antioxidants than their conventional counterparts, and organic spinach and cabbage contain more minerals (zinc, iron and copper) than conventional spinach and cabbage.¹

A recent American study showed that organic production increases antioxidant levels by an average of 30% and in some cases by as much as 50%. It found that organic fruit, has on average, higher antioxidant and polyphenol content and that organic apples show higher organoleptic quality.²

A ten year study carried out at the University of California compared organic and non-organic tomatoes and found that the organic tomatoes had twice the quantity of antioxidants (flavonoids) which help to protect against high blood pressure, thus reducing heart disease and strokes. The study found that flavonoids quercetin and kaempferol were, on average, 79% to 97% higher respectively.³

A study commissioned by The Soil Association in the UK reviewed over 400 scientific papers which found organic food contained higher levels of Vitamin C, minerals and trace elements like calcium, magnesium, iron and chromium.⁴

Three independent European research projects revealed that organic tomatoes, peaches and processed apples all had higher nutritional quality than their non-organic counterparts.⁵

Another three-year study undertaken in the UK showed that a pint of organic milk contains on average 68% more total Omega-3 fatty acids than non-organic milk and has a ratio of Omega-6 to Omega-3 acids beneficial to health.⁶

And still another research study in the UK confirmed that organically reared cows, which eat high levels of fresh grass, clover pasture and grass clover silage, produced milk that contains higher levels of Omega-3 essential fatty acids.

- ¹ **Quality Low Input Food project**, headed by Professor Carlo Leifert is a four year study funded by 20 million Euros of EU money to assess the environmental and nutritional value of organic food. The project numerous sites in the EU, including a 725 acre farm attached to Newcastle University, UK, which were divided into organic and non-organic growing sites and the resulting milk, fruits and vegetables were analysed. It is the largest study of its kind to date and the first to investigate the physiology of produce from different farming techniques. The individual studies, which will be peer reviewed, have partly been published or will be published over the next months. www.qlif.org/about/index.html.
- ² **Dr. Charles Benbrook** produced a report called 'Organic Food and Nutritional Value: Current Research on the Benefits of Organic Food', at the Organic Centre, USA (published on the website www.organic-centre.org).
- ³ **The University of California, USA**, has produced a 10 year study which compared organic and non-organic tomatoes. See www.newscientist.com/article/dn6844.html.
- ⁴ **Soil Association, UK**, commissioned an independent nutritionist to review over 400 scientific papers. See **Organic farming, food quality and human health**, A review of the evidence, Soil Association, 2001.
- ⁵ **Three Independent European research projects** completed in March 2007. See http://orgprints.org/view/projects/int_conf_2007qlif_2_food_quality_and_safety.html
- ⁶ **The University of Liverpool and Glasgow** carried out a 3 year study, published in 2006 in the Journal of Dairy Science. See Journal of Dairy Science, 89: 1938-1950. **The University of Aberdeen and the Institute of Grassland and Environmental Research** conducted a similar study which confirmed that organically reared cows, which eat high levels of fresh grass, clover pasture and grass clover silage, produced milk that contains higher levels of omega 3 essential fatty acids.

Organic Agricultural Methods Build Healthy Soil by Forbidding the Use of Pesticides and Synthetic Fertilisers

In Conventional agriculture

Pesticides (herbicides, insecticides and fungicides) are used to control weeds, insect infestations and fungus. These chemical inputs destroy the microbes in soil and consequently the mineral and vitamin content of food grown from it. Conventional food not only lacks essential nutrients, but poses risks to health from the presence of harmful pesticide residues. Conventional farmers have access to 440 active ingredient pesticides formulated over 4000 products. UK government figures show that between 1998-2001 at least 40% of fruit and vegetables in UK supermarkets contained pesticides. The British Medical Association say that due to the manner in which pesticide residues are stored in fatty tissues they may remain in the body for several years, with possible neurobehavioural and neurotoxic effects, mutagenicity, teratogenicity, carcinogenicity, and allergic and other immuno-regulatory disorders. Pesticide residues in food such as organophosphates are linked with cancers, foetal abnormalities, chronic fatigue syndrome, Parkinsons, allergies, (especially in children), and breast cancer in women. The US government has linked pesticide residues to the top three environmental cancer risks.

In Organic agriculture

Synthetic fertilisers are not allowed in organic growing and pesticides are not allowed except in exceptional circumstances. Organic certification in the UK permits the use of only 4 pesticides of natural origin or made from simple chemicals. Only 10 tons of the 4 permitted pesticides were used on UK organic farms in 2003, as opposed to 31,000 tons of pesticides used on conventional farmland.

Organic Growing Methods Use Crop Rotation and Natural Organic Matter as Fertiliser Which Produces Healthy Soil

In Conventional Agriculture

The intensive use of land in conventional agriculture depletes the soil and the nutrients in food grown from it. A study carried out by the Ministry of Agriculture, Fisheries and Food (MAFF) in the UK over a period of 50 years, from 1940-1991 showed a 12-76% decline in the trace mineral content of UK fruits and vegetables. Crops grown conventionally are often planted on the same fields for more than one year, and mono-cropping (growing the same crop on the same field every year) is all too often practised. To restore soil content, chemical fertilizers are applied. The high nitrogen levels in synthetic fertilisers make vegetables and fruits grow bigger more quickly which increases water uptake. High water content and rapid growth rates not only dilute nutrient density in food, but also reduce taste. It is increasingly suspected that diets full of such foods promote over eating. People eat more if that is necessary to acquire needed nutrient levels, and the 'satisfaction' levels once gained through eating tasteful food are now being replaced with the 'satisfaction' gained from over eating.

In Organic Agriculture

In organic food production the land is 'rested' and renewed. Food crops are 'rotated' every growing season so that the same crop is not grown on the same land each year. The soil is enriched with the use of natural fertilisers like manure and 'cover crops' (clover and legumes) which fix nitrogen naturally. Manure is used in accordance with strict guidelines, and clover and legumes crops are planted alternatively with food crops (in between growing seasons) and ploughed into the soil to improve nitrogen levels and the growth of soil microbes. These natural fertilisers promote normal growth rates (and normal water intake) which produce vegetables and fruits with compact cellular structures which concentrate taste and nutrient density. Higher nutrient density in organic food gives more vitamins and minerals per ounce than conventional foods thereby reducing the need to over consume. The taste premium in organic food provides eating gratification and lessens the need to obtain 'satisfaction' from over eating.

Organic Animal Production Forbids Use of Growth Hormones and Limits Use of Medicines

In Conventional Agriculture

Conventional animal farms often use antibiotics as 'growth promoters'. This widespread practice has greatly increased levels of antibiotic resistance in humans. Over use of antibiotics causes bacteria to become resistant to them making antibiotics administered as medicines ineffective. Hospitals now struggle to control simple infections that standard antibiotics used to cure. Animals conventionally bred are fed chemically produced feed crops which can result in less healthy animals with a greater need for medical treatment, - adding to the health risks posed to consumers from eating meat, milk and eggs.

In Organic Agriculture

Organic standards do not allow the use of antibiotics as growth hormones. Medicine use of all kinds is highly regulated by organic standards to reduce health risks to animals and the food supply.

Organic Production Standards Forbid the Use of Genetically Modified Organisms (GMO's) for Both Environmental and Health Reasons

In GM Agriculture

The biotech industry has waged a massive propaganda campaign to promote GM food as 'substantially equivalent' to conventional food and therefore 'the same' as conventional food. This is a presumption with no scientific validity. GM technology uses imprecise and unpredictable techniques which can produce changes in the genetic make-up of GM plants and the food grown from them - resulting in new proteins which can cause toxic or allergenic reactions. 'Substantial equivalence' tests do not look for these new proteins, and therefore it cannot be claimed that GM food is safe to eat or that it is 'equivalent' to conventional food.

In Organic Agriculture

Organic standards worldwide outlaw the use of GMO's on the basis that they have the potential to harm both the environment and human and animal health. No tests have been conducted to assess the health risks to humans from eating GM food even though GM food contains genes that have never been part of the human diet - and in spite of the fact that the techniques used in GM technology can cause unintended mutations to the genetic make-up of plants and the food grown from them. While GM food has not been tested on humans, no less than thirteen animal studies have been carried out in recent years by independent scientists which showed serious damage to virtually every major organ of laboratory animals fed GM feed. Organic standards reject GMO's for environmental reasons. GM crops, wherever they have been grown in the world, have contaminated conventional and organic crops with GM DNA. Genetic damage cannot be reversed once released into the environment and contamination incidents cannot be rectified. No containment methods employed to date have prevented GM crops from escaping into the environment and contaminating other crops and the wider environment. GM contamination crises are so common that there is an entire website devoted to incidents worldwide. See www.gmocontaminationregister.org.

Ecological Benefits

It has long been known that organic farming methods benefit the environment more than conventional farming practices, but the contribution organic agriculture can make to solving the problems of global warming and feeding the world have only recently been evaluated.

Global Warming and Carbon Sequestration

Organic agriculture helps combat global warming by capturing atmospheric carbon dioxide, CO₂, and incorporating (sequestering) it into the soil - whereas conventional farming exacerbates the greenhouse effect by producing a net release of carbon into the atmosphere. Scientists are not clear on the precise mechanisms which make organic farming methods more successful than conventional ones for 'fixing' carbon into soil, but they believe that organic methods which build organic matter in soil, with carefully controlled applications of composted animal manure and with ploughing in cover-crops like legumes and clover, are part of the answer. They believe these natural inputs contain the right carbon-to-nitrogen ratio which promotes gradual decomposition which holds onto carbon. They also suspect that crop rotation practices employed in organic farming may help keep the carbon-nitrogen ratio balanced and contribute to carbon sequestration. One study headed by Dr. David Douds at the Rodale Institute, USA, believes that healthy mycorrhizal fungi populations in organic systems slow down decomposition which enables organic soils to hold carbon. Scientists believe conventional farming fails to sequester CO₂ because its systems (which use chemical inputs and mono-cropping) deplete the organic content of soil which encourages rapid decomposition, releasing carbon into the atmosphere.

In 1981, a 23 year study was launched by The Rodale Institute, USA. It was called The Rodale Institute Farming Systems Trial, and was designed to compare organic farming systems with conventional farming systems. The study made unexpected and radical discoveries:

1. Over the 23 year trial period there was a 15% to 28% increase in soil carbon in organic systems, with virtually no increase in non-organic systems.

2. The study found that farmlands (soils) are better 'carbon sinks' than forests (foliage), and that organic farmlands sequester more carbon than conventional farmlands. It estimated that soil holds more than twice as much carbon as does terrestrial vegetation (forests) - and that organic farm soils which are rich in natural organic matter are better able to capture carbon than conventional farm soils which are typically depleted of organic matter.
3. It concluded that farmland is a more secure long term 'sink' for carbon than forests because forests are subject to logging and wildfires.
4. The study produced some dramatic statistics which demonstrate how important organic farming may be to redressing the problems of climate change. The amount of carbon that soil can sequester depends on the climate and soil type, but the study found that America could meet ¾'s of its Kyoto Treaty reductions in carbon emissions if it converted the 160 million acres of corn and soya grown there to organic production. (Multiplying 3,670 pounds of captured CO₂ per acre times the 160 million acres mentioned, yields a potential CO₂ capture on the order of 293 million tons per year - or ¾'s of the reductions required by the Kyoto Treaty.) www.newfarm.org/depts/NFfields_trials/1003/carbonsequest.shtml or www.rodaleinstitute.org

Organic Systems Capture More Carbon Than Conventional No-Till Systems

Conventional farming systems utilize a no-till regime where weeds are removed by pesticides rather than ploughing. Organic systems do not use pesticides but remove weeds by tilling the soil. It is known that disturbing soil allows carbon to escape into the atmosphere, and it has therefore been assumed that conventional no-till systems sequester more carbon than organic systems. However, a study carried out by the Agricultural Research Service at the United States Department of Agriculture in 2007 found that organic farming systems beat no-till conventional systems for sequestering carbon. The study showed that addition of manure and cover crops (which hold carbon) in organic farming more than offset the losses from tillage. Over the nine year study, organic plots contained more carbon and nitrogen and yielded 18% more corn than conventional plots. See www.ars.usda.gov/is/pr/2007/070710.html or www.ars.usda.gov. An FAO report, May 3-5 2007, called Organic Agriculture and

Food Security, estimates that organic agriculture could double soil carbon sequestration in livestock based systems and decrease green house gases (CO₂, nitrous oxide, methane) by 48-60%. www.fao.org/organicag

Organic Farming Can Feed the World

The chemical companies that produce pesticides and synthetic fertilisers and the biotech industry which has developed high-tech GM seeds contend that organic agriculture is 'old fashioned' and cannot be relied on to produce enough food to feed the world's growing populations. These multi-national seed and chemical companies have vast commercial investments in global agriculture and have sustained a long campaign to convince the public and politicians that the future of agriculture is only secure with the use of high-tech, high-put, high-cost agricultural systems. Recent studies show them wrong.

Researchers at Michigan University, USA, developed models to compare yield ratios between organic and conventional crops in developed and in undeveloped countries. It was discovered that in developed countries properly managed organic farms produced yields almost equal to conventional yields. However, in developing countries, food production could double or triple using organic farming methods. The study produced models which showed that organic methods could produce enough food on a global per capita basis to sustain the current human population, and potentially an even larger population, without increasing the agricultural land base. www.ns.umich.edu/htdocs/releases/story.php?id=5936

An FAO report, May 3-5 2007, called Organic Agriculture and Food Security, concluded that in developing countries, food quality, quantity and availability in urban areas are enriched by organic market gardens where local produce is sold to international markets and domestic supermarkets. This reduces dependence on cheap subsidized food imports, which are projected to rise to more than 160 million tonnes by the year 2010. Farming organically can also reduce dependency on multinational chemical and seed companies whose expensive chemical inputs and seeds often bankrupt poor farmers. Organic practices would help farmers to retain control of their food security by allowing them to save seeds from one season to be used the following season and by encouraging them to develop indigenous seed types suitable to local and regional climates and soils. www.fao.org/organicag

Economic Benefits

Organic Farming May Attract Lucrative 'Carbon Credits'

Policy mechanisms by which farmers and landowners can quantify the carbon sequestered on their properties are being investigated internationally. These schemes will enable farmers to apply for payments from regional or federal governments for ecosystem services, or allow them to participate in 'carbon-trading' markets which are fast emerging in the European Union and elsewhere. Carbon trading could become big business world-wide and could provide substantial income for farmers who can demonstrate that their land sequesters carbon. Organically farmed land, which research proves captures more CO₂ than conventionally farmed land, (and more than forests), stand to gain financially. See www.newfarm.org/depts/NFfields_trials/1003-carbonsequest.shtml & www.rodaleinstitute.org.

Organic Systems Conserve Energy and Save Money

A study conducted by Dr. David Pimentel of Cornell University found that organic farming systems use just 63% of the energy required by conventional farming systems, largely due to the massive amounts of energy required to synthesize nitrogen fertiliser (used extensively in conventional farming). He calculates that organic farming sequesters more carbon than it emits, but that conventional agriculture emits more carbon than it sequesters. In conventional farming the minimal carbon gains have to be subtracted from the excessive carbon losses - while in organic agriculture there is a net gain. See www.newfarm.org/depts/NFfields_trials/1003-carbonsequest.shtml. An FAO report calculates that organic management systems have decreased the use of fossil fuels by between 10-70% in Europe and 29-37% in the USA. www.fao.org/organicag

Farmers Can Profit by Converting to Organic

A study conducted at the Swan Lake Research Farm in Minnesota, USA analysed both the economic risks and transition effects of converting to organic farming. Computer simulation projected costs, yields and risks over a 20-year period using yield and economic data

from the 4 year study, as well as crop price records of recent years. Records showed that organic crops fetched much more than conventional crops: soybeans, up to USD (dollar) 14 more per bushel; corn, up to USD 3 more; and wheat, up to USD 5 more. Another computer model projected that farmers would net an average of USD 50 to USD 60 more per acre a year by going organic, even with the highest transition costs. The organic price premium would outweigh the initial higher costs and possibly lower yields, even if organic prices were to drop by half.
www.ars.usda.gov/is/pr/2006/060725.htm

FAO Studies

Two important reports from United Nations Food and Agriculture Organisation (FAO) demonstrate how the world can benefit nutritionally, ecologically and economically from organic agriculture.

Organic Agriculture and Food Security – FAO Report May 3-5 2007

The United Nations Food and Agricultural Organisation (FAO) came out in favour of organic agriculture in its report, Organic Agriculture and Food Security, by stating that organic agriculture can address local and global food security challenges. An FAO official stated that organic farming is “a holistic production management system that avoids the use of synthetic fertilisers and pesticides and genetically modified organisms, minimises pollution of air, soil and water, and optimises the health and productivity of plants, animals and people”.

Report at: www.fao.org/organicag

Comments and summary at: www.i-sis.org.uk/FAO-PromotesOrganicAgriculture.php

The FAO report identified major problems that are connected to conventional agriculture:

1. The use of chemical inputs is increasing yet grain production is falling
2. The cost of chemical inputs is increasing, but the price of food has fallen over the last five decades
3. Nutritionally related diseases are increasing.
4. Pesticide poisoning incidents are rising.
5. High input costs and use of new seed types is failing Third World farmers. They are increasingly going bankrupt, deserting the land and migrating to cities where they become unemployed and impoverished.

The FAO report concludes that organic agriculture offers an alternative food system that improves agricultural performance to better provide access to food, nutritional adequacy, environmental quality, economic efficiency and social equity. Having considered and studied many research inputs from organisations in America and Europe, the report recommend a switch to organic agriculture especially for poor developing countries:

1. The conversion of global agriculture to organic farming, without converting wild lands for agriculture and using nitrogen fertilisers, would result in a global agricultural supply of 2,640 to 4,380 Kcal/day/person. These conclusions came from a research team led by Catherine Badgley at the University of Michigan, based on extensive review of the evidence from both the developed and developing world. (Report entitled Scientists Find Organic Agriculture Can Feed the World and More.)
2. Organic Management systems have doubled yields in arid and degraded soils in Tigray, Ethiopia. (Report entitled The Tigray Project and Organic Production for Ethiopia). Alexander Mueller, the FAO assistant director-general praised the research, and noted that as the effects of climate change are expected to hurt the world's poorest, a shift to organic farming could be beneficial to cope with the rising number of global hungry.
3. Recommendations arising from the FAO report feed directly into the framework for the Right to Adequate Food and also into the Millennium Development Goal (MDG1) for reducing hunger and poverty, MDG7 for environmental sustainability, and MDG8 for global partnerships with emphasis on hidden, acute or chronic hunger.
4. FAO statistics show that organic farming is no longer a niche market within developed countries, but a vibrant commercial system practiced in 120 countries, covering 31 million hectares of cultivated land plus 62 million hectares of certified wild harvested areas. The organic market was worth USD 40 billion in 2006 and expected to reach USD 70 billion by 2012.
5. Evidence presented to the FAO by the Danish Research Centre for Food and Farming confirm the potential of a new organic farming paradigm to secure more than enough food to feed the world, and with reduced environmental impacts. They suggest that a 50% organic conversion by 2020 in the food exporting regions of North America and Europe would have little impact on the availability and prices of food.

The IAASTD Report – FAO Report April 2008

This report was the most comprehensive and rigorous global study ever done on agricultural science and technology. The report was conducted by The International Assessment of Agriculture Science and Technology for Development (IAASTD) which consulted over 400 scientists from more than 80 countries and was sponsored by five United Nations Agencies (FAO, GEF, UNDP, UNEP, UNESCO), the World Bank and the World Health Organisation. Sixty governments and about fifty NGO's met in April 2008 to sign up to the reports findings. All sixty governments approved the report with the exception of three nations – USA, Canada and Australia . These countries, all of which are heavily committed to growing GM crops, declined to sign the report because the report findings were sceptical about the role GM Agriculture could play in the future of global agriculture.

The report concluded that organic agriculture had much to offer regarding agricultural models for the future, but failed to endorse GM crops. The report stressed that GM crops concentrate control of global agriculture in the hands of multinational companies which drives up the costs of seeds and chemical inputs, inhibits independent research, and undermines local farming practices by forbidding farmers to save seeds. It noted that GM crops have not succeeded in raising crop yields and that the risks to the environment and human and animal health are as yet fully understood or assessed.

Summary

Organic Food is Healthier Than Conventional Food

1. Organic food contains more nutrients and vitamins and minerals than conventional food.
2. Organic food does not contain pesticide residues found in conventional food.

Organic Farming Protects the Environment

1. Organic farming does not pollute air, water and land with chemical fertilisers and pesticides.
2. Organic farming helps reduce global warming because its methods use animal manure and cover crops like clover and legumes to enrich the soil which helps sequester CO₂ from the atmosphere.
3. Organic farming helps reduce global warming because it uses less energy than conventional farming.

Organic Farming Provides Economic Advantages

1. Organic food attracts price premiums of up to 30%.
2. In developed countries, well managed organic farms produce crop yields which almost match those of conventional yields.
3. In under developed countries organic crop yields produce yields 2-3 times higher than conventional crops.
4. Organic farming is a cheaper method of food production because it does not use expensive chemical inputs (synthetic fertilisers and pesticides) and because it reduces the use of medicines in animal husbandry.
5. Organic farming may produce profits for farmers from 'carbon credit' trading systems being developed around the world.
6. Organic agriculture can help feed the hungry by allowing them to produce their own food and by reducing the need to import subsidised food. It can provide commercial opportunities where poor farmers can produce a diverse range of certified organic surpluses to be exported at premium profit. Because organic methods exclude the use of chemical inputs, poor farmers have less capital outlay on fertilizers and pesticides, and thus have less dependency on multinational seed and chemical companies.

