

Feeding the future

How organic farming can help feed the world



Soil Association

Summary

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- ▶ **There is enough food produced today for everyone to have the nourishment they need**
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- ▶ **Nearly 1 billion people are hungry and more than 1 billion people are overweight**
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- ▶ **Globally one third of the food produced for human consumption is lost or wasted**
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- ▶ **If all cereals were fed to people not animals, we could feed an extra 3.5 billion people**
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- ▶ **The IAASTD report recommends agroecology to maintain and increase the productivity of global agriculture**
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- ▶ **Organic and other agroecological farming systems can help the world feed itself, but as well as changing our farming systems, we need to eat differently, feed our livestock differently, and waste less food**
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How can organic farming feed the world?

To answer this question, we need to say how much food needs to be produced, what sort of food, who produces it and where it is produced, and whether farmers have access to land, technology and knowledge needed to produce the food, and whether those who need it most will be able to buy it.

There is enough food produced today for everyone to have the nourishment they need, and yet nearly 1 billion people are hungry, and 1 billion malnourished. Also, currently, more than 1 billion people are overweight, leading to major diet related health problems, and this number is growing.

Different systems of agriculture cannot put right the main causes of hunger – poverty, natural disasters and conflict – but poor agricultural practice and infrastructure, and over-exploitation of the environment can be addressed.

The majority of people who are hungry live in the Global South, in poor rural areas, although hunger amongst the urban poor is growing. A growing number of international experts agree that agro-ecological systems such as organic are best suited to meet the needs of the poorest people, while reversing environmental degradation.

Agro-ecology encourages: recycling of nutrients on farm; promotion of mixed farming of livestock

and crops; and the use of diverse crops and livestock. Agro-ecological farming looks at the productivity of the whole farming cycle, and relies more on knowledge intensive techniques, rather than intensive inputs and large-scale mechanisation.

The IAASTD report, produced by 400 scientists and supported by 60 countries, recommends agroecology to maintain and increase the productivity of global agriculture. The largest study of agroecology in the Global South analysed 286 projects covering 37 million hectares in 57 countries, and found that on average crop yields increased by 79%. A UN study of organic agriculture in Africa looked at 114 projects and found these increased food availability for local people, and gave the farmers involved higher incomes.

It is predicted that there will be 9 billion people in the world by 2050. Those that argue this will require a 70% increase in food production are assuming the spread of a Western diet, involving much higher consumption of meat and dairy products leading to diet related ill-health, to people in the Global South, while also assuming there will be no reduction in the amount eaten in the Global North.

This projected 70% increase in the production of food will not solve the problem of hunger, with 290 million people predicted still to be malnourished in 2050.

Any increase in meat and dairy production, let alone a massive 70%, would cause huge increases in global

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warming emissions from farming, which under climate change policies in fact need to fall significantly.

The UK Government commissioned Foresight report said that it should be a priority 'to work to change consumption patterns' and to 'contain demand for the most resource intensive types of food'. The Government's Committee on Climate Change has said that 're-balancing diets' might be needed for the agricultural sector to reduce its greenhouse gas emissions after 2030.

35–40% of all cereals produced worldwide are fed to livestock, and this could rise to 50% by 2050 if meat consumption continues to rise as predicted. If all cereals were fed to people not animals, we could feed an extra 3.5 billion people. If meat and dairy consumption were held at the levels we reached in 2000, 400 million tonnes of cereals would be freed for human consumption, enough to feed an additional 1.2 billion people in 2050.

If we switch from meat which is mainly fed on grains, to beef, lamb and mutton from grazing animals eating grass which we cannot eat, this would provide better quality meat and reduce greenhouse gas emissions.

Reducing food waste is an important part of the solution, globally about one third of food produced for human consumption is lost or wasted, but much more food (about 280–380kg per person per year) is wasted in Europe and North America, compared

to 125–165kg in low income countries in the Global South. Food wastage in the Global South is mainly caused by financial and technical limitations in harvesting, storage, infrastructure and packaging; reducing this wastage would have a significant impact.

Scientists have modeled how we can feed 9 billion people in 2050 with a healthy diet in an environmentally sustainable way. French researchers assumed 3,000kcal per person per day, with 500kcal from animals, a decrease for higher income consumers, but an increase in Asia and sub-Saharan Africa. Waste reduction would reduce food demand by 25% in richer countries. Worldwide, people would eat more diverse and healthy diets, with a 25% decline in demand compared to the business as usual scenario.

A similar scientific study in Germany and Austria found that organic agriculture can probably feed the world population of 9.2 billion in 2050 if relatively modest diets are adopted, with a low level of inequality in food distribution required to avoid malnutrition. These scenarios assume that in countries like the UK, we will both produce food differently and eat differently, as it is clear for health and environmental reasons that diets must change.

In the UK little modeling has been done, but one study in England and Wales found that if all farming was organic, we would produce more grass-fed beef and sheep, far less grain fed dairy, pigs and poultry, more grain would be available for human

consumption despite lower yields, and vegetable and fruit production could increase.

We do not need to increase production in the UK to help feed the world. According to the UN Food and Agriculture Organisation, IAASTD and development charities, helping to feed those currently starving or malnourished means increasing food production, supply and availability in those countries where the problems are occurring, and to the poorest people in those countries, and local agro-ecological systems are best suited to achieve this. This is particularly the case when considering future threats to agricultural production, as the resources currently needed to produce food, oil based fertilisers and pesticides, mined phosphates and fresh water, become scarcer and more expensive.

Organic and other agro-ecological farming systems can help the world feed itself, but as well as changing our farming systems, we need to eat differently, feed our livestock differently, and waste less food.

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Introduction

The benefits that organic farming can bring for wildlife protection and animal welfare are now widely recognised, but at a time of rising food prices and a predicted global population of 9 billion by 2050, we are often asked about the contribution that organic farming can play to achieving food security. In answering the question of 'how can organic farming feed the world?', this report seeks to shed some light on the myths about hunger and sets out the contribution that organic farming and other forms of agro-ecological agriculture can make in providing healthy food for all.

This is not just about moving from a 'business-as-usual' food system to 'organic business-as-usual' – it is about big changes to how we produce and consume food

How to 'feed the world' is of course a massive issue concerning questions not only about how food is produced, but what is produced, where and by whom, as well as who has access to the land, technology and knowledge to produce it, how it is traded, as well as who can afford to buy it.¹ We are certainly not attempting to address all these issues here, but we want to be clear that feeding the world using organic and other agro-ecological farming methods

is not just about farming differently and moving from a 'business-as-usual' food system to 'organic business-as-usual'.² It is about big changes to how we produce and consume food. It is about investing in the development of smallholder agriculture and local markets in the Global South, but it also means action to end food waste, estimated at one-third of all food produced globally. Critically, it is also about changing diets in the Global North to make them more healthy for people and more sustainable for the planet.

These are no small tasks, but it is worth remembering that in a future of resource-constraints and scarcities, climate change and diet-related public health challenges, this will be the only viable option.

If people are going hungry, don't we just need to produce more food?

Food has never before existed in such abundance. There is enough food in the world today for everyone to have the nourishment they need, and yet there are nearly 1 billion people in the world today who are hungry and another billion who are malnourished, lacking the essential micronutrients they need to lead healthy lives.³ At the same time, more than 1 billion are overweight, of which 300 million are obese, posing a major risk for diet-related illnesses such as type-2 diabetes and cardiovascular disease.⁴ There are clearly huge global inequalities in the distribution of food.

People continue to go hungry because they cannot afford to buy food, or access it in other ways such as growing it themselves. This arises directly because of poverty, but natural disasters, conflict, poor agricultural practices and infrastructure and over-exploitation of the environment can all be contributory factors.⁵

There is enough food in the world today for everyone to have the nourishment they need – there are clearly huge global inequalities in the distribution of food

The recent increase in food prices has pushed yet more people in the Global South, who are reliant on food imports and spend a large proportion of their income on food, into hunger. Small countries that are dependent on imports especially in Africa were deeply effected by the food and economic crises.⁶ The causes of this price hike include biofuel policies that have diverted grain away from the food supply, harvest failures and commodity speculation.

The majority of the people who are hungry live in the Global South, in poor rural areas, and are often directly involved in producing food. Many do not have land of their own and work for others, often in seasonal jobs, to earn money to survive. Poor people living in urban areas are another group that are at risk of hunger, and this is a growing issue as cities continue

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to expand.⁷ Urban agriculture is already a reality for many people in the Global South, but there is an increasing focus on the important role it can play in reducing hunger for the urban poor.⁸

Of course, in poor countries with a food-deficit production levels should be increased where appropriate, but agriculture also needs to play a role in reducing hunger through growing farmer and household incomes, building infrastructure and markets, and protecting and enhancing the natural environment.⁹

So how can organic and other agro-ecological farming systems reduce hunger?

Investment by governments and donors in agriculture in the Global South had dropped over the last three decades, although this is now changing with new investment from agri-food companies and new global policy initiatives.¹⁰

New support for smallholder agriculture, especially in Africa, is urgently needed to increase productivity and provide economic opportunities for small scale farmers. This investment needs to be focused on agro-ecological systems, such as organic, rather than on intensive farming methods that will further degrade the environment and require expensive inputs made from fossil fuels, that will become increasingly scarce in the future.

The United Nation's Special Rapporteur on the Right to Food, Olivier De Schutter, has argued for the scaling up of such models of agriculture and ensuring that they work for the benefit of the poorest farmers.¹¹ Developing agroecology requires supportive policy.¹² However, in most African countries organic agriculture is not specifically supported by agricultural policy, and is sometimes actively hindered by policies advocating the use of high-input farming.¹³

The IAASTD report, supported by 400 scientists and 60 countries, recommends support for agro-ecological sciences that would contribute to addressing environmental issues whilst maintaining *and* increasing productivity

Agroecology is a science and a set of farming practices that seek to improve agricultural systems by mimicking natural processes, creating beneficial biological interactions among the different components of the agro-ecosystem.¹⁴ Organic systems put into practice the core principles of agroecology such as recycling nutrients on the farm, integrating livestock and crops, diversifying species and genetic resources, and considering the productivity of an entire agricultural system rather than a single crop. Agro-ecological farming is based on highly knowledge-intensive techniques that

are developed through farmers' knowledge and experimentation.¹⁵

The International Assessment of Agricultural Knowledge, Science and Technology for Development ('the IAASTD report') is supported by 400 scientists and 60 countries and recommends support for agro-ecological sciences that would contribute to addressing environmental issues whilst maintaining and increasing productivity.¹⁶ It also recommended that community-based innovation and local knowledge combined with science-based approaches as the best way to addressing the problems, needs and opportunities of the rural poor.¹⁷

There are many existing examples of innovation in agroecology. In Cameroon, training for local people in tree propagation and the setting up of nurseries has led to the widespread planting of trees that can fix their own nitrogen and can rehabilitate degraded land. Yields of wheat, maize, beans and potatoes have doubled. It has also led to the cultivation of indigenous fruit and nut trees for planting and for sale to neighbouring communities.¹⁸

In East Africa, fodder shrub species have been researched and introduced as a reliable source of less expensive and easily available protein feeds for dairy cattle that can improve milk production and reduce soil erosion and increase soil fertility. It is estimated that 25,000 smallholder farmers have planted fodder shrubs, contributing about

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3.8 million US dollars to farmer incomes across East Africa.¹⁹

The largest ever study of agroecology approaches in the Global South analysed 286 projects covering 37 million hectares in 57 countries. The study found that on average crop yields increased by 79%.²⁰

Doubling the production of food would not solve the hunger problem

A report by the United Nations on organic agriculture in Africa found that organic and near-organic methods and technologies are ideally suited for many poor, marginalised smallholder farmers in Africa because they require minimal external inputs and make use of locally and naturally available materials. They studied 114 projects in Africa and they found that organic farming increased the availability of food over time. Access to food improved through increased quantity of food production ensuring household food security, but also selling food surpluses at local markets led to farmers benefiting from higher incomes.

Fresh organic produce was found to become more available to more people in the wider community, whilst organic farming enabled new and different groups in a community to get involved in agricultural production and trade.²¹

But what about feeding all those extra people in 2050?

It is predicted that there will be 9 billion people in the world by 2050, and it has been frequently argued that a massive increase in food production, of 70–100%, will be needed to feed them all. This is not just due to more people, but reflects the assumptions made by the authors of the modeling study about the diet we will all be eating. In making and using these predictions, policy-makers are assuming that many more people in countries in the Global South will be eating a 'Western' diet with more intensively-produced meat, dairy products, sugar and vegetable oils, following the shift in eating habits that has already occurred in countries in the Global North as incomes rise.

The model also assumes that there will be no reduction in the amounts eaten in the Global North, and in fact that there will be further 14% increase in the consumption of such foods,²² despite growing recognition of the negative health impacts of such diets in both low and high income countries.²³

This continuing shift towards higher consumption of livestock products from intensively reared animals has implications for mitigating climate change. A large rise in the production of cereals would be needed for animal feed. The greenhouse gas emissions from such intensively-reared livestock are significant; from converting natural habitat to land to grow feed crops,

the methane from cattle and sheep, and nitrous oxide from the production and application of manufactured fertilizers to grow animal feed.

Massive increases in food produced would have huge negative impacts on both the environment and human health

A 70% increase or doubling in the production of food would not solve the hunger problem with 290 million people predicted to still be malnourished in 2050 if such a strategy was implemented.²⁴ Moreover, such massive increases in food produced like this would have huge negative impacts on both the environment and human health, and are not necessary with action to change diets and reductions in food losses and waste.

Why is changing diet so important?

There are already widespread concerns about the health impacts of 'Western' diets which include rising levels of obesity and diseases such as Type-2 diabetes, some cancers and cardiovascular disease. In the UK, the Cabinet Office has acknowledged that 'existing patterns of food consumption will result in our society being loaded with a heavy burden of obesity and diet-related ill health'.²⁵

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Policy advice now also advocates changing diets. Commissioned by the UK Government, the Foresight report on the future of food and farming said it should be a priority for policy-makers to 'work to change consumption patterns'²⁶ and 'contain demand for the most resource-intensive types of food'.²⁷ The UK Committee on Climate Change now acknowledge that 're-balancing' diets is one of the more 'radical' solutions needed if the agriculture sector is going to continue to reduce its GHG emissions after 2030.²⁸

At least 35–40% of all cereals produced worldwide are fed to livestock, and this could rise to 50% by 2050 if meat consumption increases as has been predicted.²⁹ Using cereal crops to feed animals is a highly inefficient use of calories and is very resource-intensive. The loss of calories by feeding the cereals to animals instead of using the cereals directly as human food represents the annual calorie need for more than 3.5 billion people.³⁰

Scientists have started to measure how many extra people we would be able to feed if we reduced our meat consumption to different levels. One study estimated that if we reduced meat consumption in the Global North and restrained it worldwide to the 2000 levels of 37.4kg per person per year, an estimated 400 million tons of cereals per year would be freed up for human consumption, which is enough to cover the annual calorie needs for an additional 1.2 billion people in 2050.³¹ This represents nearly

half of the predicted population growth from 7 billion in 2011 to 9.3 billion in 2050.³²

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As well as eating less meat overall, changing how we feed animals through shifting to grass-reared systems rather than predominantly grain-fed, is also important in tackling this problem. Beef, lamb, and mutton from grazed livestock have the added advantage of helping to mitigate climate change by sequestering carbon in the soil. Grass-reared meat can also be the best option if grazed on land that would not be suitable for any other type of agriculture, thus converting something we cannot eat, grass, into something we can.

Why is reducing food waste so important?

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Our current food system produces a lot of waste. In the UK, households waste an estimated 6.7 million tons of food every year. Approximately 32% of all food bought is not eaten.³³ On a global scale it is estimated that about one-third of food produced for human consumption is lost or wasted, about 1.3 billion tons per year.³⁴

Much more food, about 280–300kg per person per year is wasted in Europe and North America, compared to the 125–165kg in low income countries such in Sub-Saharan Africa and South/Southeast Asia. In the Global North, most of the waste occurs at the consumption stage due to a lack of co-ordination between different actors in the food chain, sales agreements between farmers and buyers leading to farm crops being wasted, quality standards which reject food items not uniform in shape or appearance, as well as lack of purchase planning by consumers, expiring 'best-before-date' labels and the attitudes of those who can afford to waste food.

In the Global South, the cause of food losses and waste are mainly due to limitations (financial, managerial and technical) in harvesting techniques, storage and cooling facilities, infrastructure, packaging and marketing systems. These high levels of food waste represent resources that are used and green-house gas emissions that are produced in vain. For smallholder farmers in the Global South, many of whom suffer food shortages, a reduction in food losses could have an immediate and significant impact.³⁵ Eliminating food losses opens up a new supply of food to feed the population of 2050.

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What evidence is there that organic and agro-ecological farming could feed 9 billion people?

Scientists have modeled alternative scenarios of how we could successfully feed 9 billion people in 2050 a healthy diet in an environmentally-sustainable way.

French researchers showed how the world could be fed in 2050, assuming that global food availability was 3000 kcal per person per day in 2050 of which 500 kcal is of animal origin, representing a decrease for higher-income countries and a rise in Asia and sub-Saharan Africa compared to the present. They assumed in richer countries that successful waste reduction strategies and more effective nutrition policies meant food demand declined by 25%. In sub-Saharan Africa, food availability increases, mainly as a result of agricultural development. Diets are more diverse world-wide. All in all, in 2050, global needs in food calories are 30% less than in a business-as-usual scenario.

If modest diets are adopted, with a low level of inequality in food distribution, organic agriculture could feed a world population of 9.2 billion

Agricultural land is cultivated in a different way with 'ecological intensification' practices encouraged to

increase yields, optimizing local know-how, lowering consumption of fossil fuels, making better use of the soil's ability to mobilise organic matter, and managing pests and improving resistance to disease through mixing species and varieties and using crop rotations.³⁶

In Germany and Austria, a group of scientists have modeled 72 different scenarios for 2050 that included four different diets, three different livestock systems, three crop yields (intensive, intermediate and organic) and two levels of land use. They measured the technical level of feasibility of each.

They found that for a 'western high meat diet' to be 'probably feasible' 'would require a combination of massive land use change, intensive livestock production systems and intensive use of the arable land.' This would have negative impacts for animal welfare and lead to further destruction of natural habitats. The report provides evidence 'that organic agriculture can probably feed the world population of 9.2 billion in 2050, if relatively modest diets are adopted, where a low level of inequality in food distribution is required to avoid malnutrition'.³⁷

Whilst such modeling does offer technical possibilities for the future of the food system, and provides useful 'visions' of what might be achieved, we need to focus on the political, social and economic changes necessary to realise these alternatives for 2050.

Wouldn't switching to organic farming in the UK and Europe mean much less food is produced?

There is now evidence that a switch to organic and other agro-ecological farming in the Global South can maintain and even increase yields, but it is often assumed that in the Global North widespread organic farming would mean we just produce a lot less. It is perhaps more useful to think that we would produce *differently*, and therefore also eat differently as it is clear that diets must change.

Calculations about how much food of different types would be produced in the UK if all farming was organic, depend on a wide range of assumptions that could be made about the type and distribution of different organic farms, future improvements in technology in organic systems, patterns of global trade, import substitution and demand drivers.

It is perhaps more useful to think that we would produce *differently*, and therefore also eat differently

However, a report by the University of Reading highlighted some of the main changes that would occur if all agriculture in the UK went organic. Under organic systems, mixed farms are more common as

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grass-clover leys that are essential for building and maintaining fertility are commonly used for grazing livestock. A wholly organic agriculture would supply 68% more beef and 55% more sheep meat than current non-organic agriculture. On this basis, beef production would exceed current domestic demand and self-sufficiency would be achieved for lamb. Organic vegetables yields are fairly comparable to non-organic.

Intensive livestock production is banned under organic standards, so there would be no factory-farmed chickens, eggs or pork. This has clear benefits for animal welfare. Pig and poultry production would fall to about a third of current levels although there would be some potential for expansion of production onto areas of grassland on organic farms. For eggs, organic systems would produce three-quarters of current egg numbers.

The high use of manufactured nitrogen fertilisers in Northern Europe, with all the associated environmental costs, does produce very high cereal yields with the result that a conversion to organic systems would see an approximate drop in yields by 30–40%.³⁸ However, with the end of intensive systems under organic practices, much of the grain that we feed to livestock would be free to feed people directly, or the land used to grow or rear something else. Currently, 40% of wheat produced in the UK is used in animal feed rations going to chickens, cows and pigs.³⁹ We can also factor in the gains that could be

made by reducing food waste in the UK. Given that it is estimated that 36% of bakery purchases in the UK are wasted,⁴⁰ the availability of grain for human consumption under organic systems could match that currently available under non-organic systems.

But don't we need to increase production in the UK?

The UK Government seems to be keen to promote the need to increase food production in the UK, albeit whilst improving environmental performance.⁴¹

Experts are arguing for the critical importance of local food production and markets for achieving food security

The idea of 'sustainable intensification' has got a firm hold on the direction of agriculture policy. However, there seems to be little hard evidence of why this is needed, particularly given the understanding of the 'food security' problem outlined here that means it will not be solved by just increasing food production.

The implication of a goal of increasing production in the UK implies that UK farms should be contributing to 'feeding the world'. This goes right to the heart of huge questions of how 'food security' is best achieved;

through increasing trade in global markets or by supporting local production in the Global South for local markets. The position of the UK Government is clear; Caroline Spelman, the Secretary of State for Environment, Food and Rural Affairs sees our food security as 'dependent upon global supply and international patterns of production and consumption'.⁴²

Over the last 50 years, countries in the Global South have increasingly become importers of basic food products and the drop in self-sufficiency in Africa has been particularly marked.⁴³ This has resulted from international economic policies promoting the liberalization of the agricultural sector in countries in the Global South⁴⁴ and agricultural advice focused on promoting opportunities for increased exports to international markets.⁴⁵ This is one reason why recent increases in food prices have had such an impact on people in the Global South.

With the opening up of markets, cash crops for exports have been promoted, and the most productive land is then used to grow these crops, squeezing out domestic food producers. Small-scale and subsistence farming is being replaced by larger and more globally focused farms. This process impacts on the type of farming system, from traditional crops suited to ecological conditions and the knowledge and resources of farmers, to cash crops that rely on purchased inputs.⁴⁶

Today, however, the Food and Agricultural Organisation,⁴⁷ the IAASTD scientists⁴⁸ and development

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charities,⁴⁹ are arguing for the critical importance of local food production and markets for achieving food security in low-income countries. As we have already said, support for smallholder agriculture, especially in Africa, is urgently needed to increase productivity and provide economic opportunities for small scale farmers and this investment needs to be focused on agro-ecological systems, such as organic.

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There is a growing body of evidence that organic farming systems can be more energy, nutrient and water efficient than their non-organic counterparts

The IAASTD report recognises that trade policies that are designed to ensure sufficient levels of domestic food production are an important part of food security and should be implemented to balance those promoting export. There is of course an important role for international trade, given that it is likely that in countries with difficult climatic conditions and limited natural resources, in the Middle East and North Africa, sub-Saharan Africa and Asia, increased food security will require trade. Nonetheless, it is essential that any new trade rules and agriculture geared for export do not undermine growth in local agriculture and are closely linked to environmental regulations.⁵⁰

How can agriculture ensure food security in a resource-constrained future?

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Ensuring food security in a future which will have constrained resources, and which will be feeling the effects of climate change, is one of the thorniest issues facing policy makers today. The natural resource base upon which agriculture depends, soils, water and biodiversity, is being degraded. Supplies of fossil fuels used to make inputs, and minerals such as phosphate, will become increasingly scarce. This means that we urgently need to improve the resource use efficiency of farming systems.

There is a growing body of evidence that organic farming systems can be more energy, nutrient and water efficient than their non-organic counterparts. Research published in the journal *Science* found that nutrient inputs of nitrogen, phosphate and potassium in the organic systems to be 34–51% lower than in non-organic systems, whereas average crop yields were only 20% lower over a period of 21 years.⁵¹ In terms of water use efficiency, studies have shown organic crops out-yielding conventional crops by 70–90% under severe drought conditions.⁵²

So organic farming can feed the world then?

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In short, the answer is yes, although we should perhaps be talking about how organic farming can help the world feed itself. As well as investment in organic and other agro-ecological methods for farmers in the Global South in order to increase local food production and markets, for the Global North it is imperative that we see a significant shift in diets.

As well as changing our farming systems, it's as much about eating differently, feeding our livestock differently and wasting much less food.

References

- 1 UNEP-UNCTAD (2008) *Organic Agriculture and Food Security in Africa*, United Nations
- 2 Urs Niggli presentation to European Commission, RTOACC, Brussels October 2011
- 3 FAO/OECD (2011) *Improving food systems for sustainable diets in a green economy, Expert Meeting on Greening the Economy with Agriculture Paris, 5–7 September 2011* Working Document 4 (www.fao.org/fileadmin/user_upload/sustainability/papers/GEA_Utilization_Rev.1_-_30_August.pdf)
- 4 WHO (2010) *Global Strategy on Diet, Physical Activity and Health* (www.who.int/dietphysicalactivity/publications/facts/obesity/en/)
- 5 World Food Programme (2011) *Frequently-asked-questions* (www.wfp.org/hunger/faqs)
- 6 FAO (2011) *The State of Food Insecurity in the World 2011* (www.fao.org/publications/sofi/en/)
- 7 FAO (2011) *Hunger – FAQs* (www.fao.org/hunger/en/)
- 8 FAO (2010) *Fighting Poverty and Hunger, What Role for Urban Agriculture?* Policy Brief 10, Economic and Social Perspectives, August 2010 (www.fao.org/docrep/012/al377e/al377e00.pdf)
- 9 UNEP-UNCTAD (2008) *Organic Agriculture and Food Security in Africa*, United Nations
- 10 De Schutter, O., 7 December 2010. Human Rights Council Sixteenth Session, Agenda Item 3 Promotion and Protection of All Human Rights, Civil, Political, Economic, Social and Cultural Rights, Including the Right to Development, report submitted by the Special Rapporteur on the Right to Food
- 11 Ibid; de Schutter, O., (2010) Press release, Right to Food: "Agroecology outperforms large-scale industrial farming for global food security," says UN expert
- 12 European Commission (2011) Standing Committee on Agricultural Research (SCAR) 'Sustainable food consumption and production in a resource-constrained world' (http://ec.europa.eu/research/agriculture/scar/pdf/scar_feg_ultimate_version.pdf)
- 13 UNEP-UNCTAD (2008) *Organic Agriculture and Food Security in Africa*, United Nations
- 14 De Schutter, O., 7 December 2010. Human Rights Council Sixteenth Session, Agenda Item 3 Promotion and Protection of All Human Rights, Civil, Political, Economic, Social and Cultural Rights, Including the Right to Development, report submitted by the Special Rapporteur on the Right to Food
- 15 Ibid
- 16 McIntyre, B.D., Herren, H.R., Wakhungu, J.W., Watson, R.T., (Eds) (2009) *Agriculture at a Crossroads: Executive Summary of the Synthesis Report* Washington, D.C, Island Press for International Assessment of Agricultural Knowledge, Science, and Technology for Development ([www.agassessment.org/reports/iaastd/en/agriculture%20at%20a%20crossroads_executive%20summary%20of%20the%20synthesis%20report%20\(english\).pdf](http://www.agassessment.org/reports/iaastd/en/agriculture%20at%20a%20crossroads_executive%20summary%20of%20the%20synthesis%20report%20(english).pdf))
- 17 Ibid
- 18 Ebenezar K.A., Tchoundjeu, R., Leakey, R., Takoung, B., Njong, J., and Edang, I. (2011) Agroforestry and multifunctional agriculture in Cameroon, *International Journal of Agricultural Sustainability*, 9 (1) 2011, pages 110–119
- 19 Wambuğu, C., Place, F., and Steven, F. (2011) Research, development and scaling-up the adoption of fodder shrub innovations in East Africa, *International Journal of Agricultural Sustainability*, 9 (1) 2011, pages 100–109
- 20 Pretty, J., et al (2005) Resource-conserving agriculture increases yields in developing countries. *Environmental Science and Technology*, 40 (4), 1114–1119
- 21 UNEP-UNCTAD (2008) *Organic Agriculture and Food Security in Africa*, United Nations
- 22 FAO (2006) *World Agriculture: Towards 2030/2050. Interim Report*. FAO, Rome
- 23 Lopez, A., Mathers, C., Ezzati, M., Jamison, D., and Murray, C., (Eds) 2006. *Global Burden of Disease and Risk Factors*, Oxford, Oxford University Press
- 24 FAO (2006) *World Agriculture: Towards 2030/2050. Interim Report*. FAO, Rome
- 25 The Cabinet Office (2008) *Food: an analysis of the issues*, Cabinet Office, The Strategy Unit, January 2008 (Updated and reissued August 2008) Executive Summary (www.cabinetoffice.gov.uk/media/cabinetoffice/strategy/assets/food/food_analysis.pdf)
- 26 Foresight. The Future of Food and Farming (2011) Executive Summary. The Government Office for Science, London (www.bis.gov.uk/assets/bispartners/foresight/docs/food-and-farming/11-547-future-of-food-and-farming-summary.pdf)
- 27 Ibid.
- 28 Committee on Climate Change (2010) The Fourth Carbon Budget – Reducing emissions through the 2020s (www.theccc.org.uk/reports/fourth-carbon-budget)
- 29 Nellemann, C., MacDevette, M., Manders, T., Eickhout, B., Svihus, B., Prins, A.G., Kaltenborn, B.P. (Eds). (2009) *The environmental food crisis – The environment's role in averting future food crises. A UNEP rapid response assessment*. United Nations Environment Programme, GRID-Arendal (www.grida.no/publications/rr/food-crisis/ebook.aspx)
- 30 Ibid.
- 31 Ibid.
- 32 United Nations Press Release, 3 May 2011, World Population to reach 10 billion by 2100 if Fertility in all Countries Converges to Replacement Level (http://esa.un.org/unpd/wpp/other-information/press_release_wpp2010.pdf)
- 33 WRAP (2008) *The Food we Waste*. Most of the food waste (4.1 million tonnes or 61%) is avoidable and could have been eaten had it been better managed.
- 34 Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., and Meybeck, A., (2011) *Global Food Losses and Food Waster: Extent, causes and prevention*. FAO, 2011.
- 35 Ibid.
- 36 Paillard S., Treyer S., Dorin B. (coordinators) (2010) *Agrimonde: Scenarios and Challenges for Feeding the World in 2050*. Éditions Quæ, Paris (www.international.inra.fr/the_institute/foresight/agrimonde/); T. Ronzon, S. Treyer, B. Dorin, P. Caron, P. Chemineau, H. Guyomard. (2011) Feeding the world in 2050; Key findings and hopes for policy making and agricultural research from the Agrimonde foresight project, *Food Ethics*, Autumn 2011 Volume 6 Issue 3 available at www.foodethicscouncil.org
- 37 Erb, K., Haberl, H., Krausmann, F., Lauk, C., Plutzer, C., Steinberger, J., Müller, C., Bondeau, A., Waha, K., and Pollack, G. (2009) 'Eating the Planet: Feeding and fuelling the world sustainably, fairly and humanely – a scoping study', Social ecology working paper 116, Vienna.Commissioned by Foe and CIWF.
- 38 Jones, P., and Crane, R. (2009) England and Wales under organic agriculture: how much food could be produced? Centre for agricultural strategy, Reading University, Report 18, May 2009; Lampkin, N., Measure, M., and Padel, S., (2011) *Organic Farm Management Handbook*
- 39 Living Countryside (2011) 'wheat – farming and production' (www.ukagriculture.com/crops/wheat.cfm)
- 40 WRAP (2011) *Final Report: Household Food and Drink Waste in the UK* (www.wrap.org.uk/downloads/household_food_and_drink_waste_in_the_uk_nov_2011.adca11be.8048.pdf)
- 41 HM Government (2011) *The Natural Choice: Securing the value of nature*, Natural Environment White Paper (www.official-documents.gov.uk/document/cm80/8082/8082.asp)
- 42 Spelman, C., 2010. Food Security news insert, distributed by the *Financial Times*, 14 October 2010 (www.feedingthefuture.eu/)
- 43 Anderson, K., 2010. Globalisation's effects on world agricultural

References

- trade, 1960–2050, *Philosophical Transactions of the Royal Society*, B, Biological Sciences, 365, pp.3007–3021.
- 44** Nally, D., 2010 The biopolitics of food provisioning, *Transactions of the Institute of British Geographers*, 36: pp.37–53.
- 45** McIntyre, B.D., Herren, H.R., Wakhungu, J.W., Watson, R.T., (Eds) (2009) *Agriculture at a Crossroads: Executive Summary of the Synthesis Report*
- 46** Ghosh, J., 2010. The Unnatural Coupling: Food and Global Finance, *Journal of Agrarian Change*, vol. 10, no. 1, January 2010, pp.72–86.
- 47** FAO (2006) *World Agriculture: Towards 2030/2050*. Interim Report. FAO, Rome.
- 48** McIntyre, B.D., Herren, H.R., Wakhungu, J.W., Watson, R.T., (Eds) (2009) *Agriculture at a Crossroads: Executive Summary of the Synthesis Report*
- 49** Christian Aid, 2008. *Fighting food shortages: Hungry for Change*.
- 50** McIntyre, B.D., Herren, H.R., Wakhungu, J.W., Watson, R.T., (Eds) (2009) *Agriculture at a Crossroads: Executive Summary of the Synthesis Report*.
- 51** Mader, P., Fliessbach, A., Dubois, D., Gunst, L., Fried, P., and Niggli, U. (2002) Soil Fertility and Biodiversity in Organic Farming, *Science*, 296, p.1694–1697.
- 52** Gomiero, T., Pimentel, D., and Paoletti, M.G. (2011) Environmental Impact of Different Agricultural Management Practices: Conventional vs. Organic Agriculture, *Critical Reviews in Plant Science*, vol.30, no. 1–2.



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