Cultivating the Future: Food in the Age of Climate Change

World Future Council

World Future Council

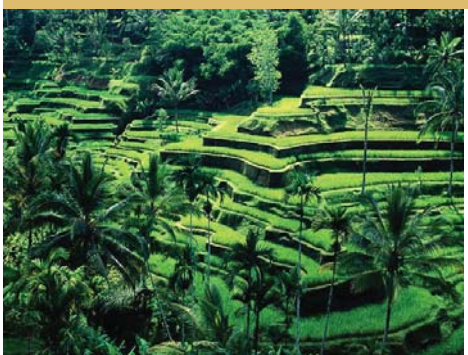
Head Office, Hamburg
Stiftung World Future Council
Bei den Mühren 70
20457 Hamburg, Germany
Phone: 0049 (0)40 3070914-0
Fax: 0049 (0)40 3070914-14
info@worldfuturecouncil.org

UK Office, London
World Future Council Foundation
100 Pall Mall
London, SW1Y 5NQ, UK
Phone: 0044 (0)20 73213810
Fax: 0044 (0)20 73213738
info.uk@worldfuturecouncil.org

EU Liaison Office, Brussels
World Future Council Foundation
Rue Marie-Thérèse 21
1000 Brussels, Belgium
Phone: 0032 (0)2 2101780
Fax: 0032 (0)2 2101789
info.eu@worldfuturecouncil.org

US Liaison Office, Washington
World Future Council Foundation
660 Pennsylvania Ave., SE, #302
Washington, DC 20003, USA
Phone: 001 (202)547 9359
info.us@worldfuturecouncil.org

www.worldfuturecouncil.org



Traditional rice terraces in Bali

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Authors:
Prof. Herbert Girardet, Dr. Axel Bree
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Conversion of Amazon Rainforest into soybean fields is releasing huge amounts of carbon dioxide into the atmosphere. When the soybeans are fed to cattle and pigs, methane is produced which further contributes to climate change.

Introduction

In an age of climate change, policies for the secure supply of food to the world have to be a major priority for national governments and the international community. Security and sustainability of food supply is of the utmost importance for the well-being of an ever increasing world population, and for future generations.

But climate change is a major concern in this context: If current greenhouse gas (GHG) emissions trends continue, the Earth's mean temperatures could increase by anything up to 6° C by 2100. Whilst crop yields in many developed countries may benefit from global warming, most developing countries will face worsening conditions. According to the UN Food and Agriculture Organization (FAO), the Amazon, the Sahel, large parts of India and northern China will be particularly badly hit. Climate change has already started to significantly affect agriculture and rural landscapes: In recent years both droughts and floods attributed to changing climatic conditions have been getting more pronounced. In the coming decades, rising temperatures are expected to bring crop-shrinking heat waves, melting glaciers and ice sheets, and rising sea levels, with major consequences for global food security.

There is no doubt that the modern food system is a major part of the global climate and environment problems we face. It is well known that it now takes 10 calories of fossil-fuel energy to produce one calorie of modern supermarket food. Meanwhile fuel is getting ever more expensive. The progressive industrialization of the food system is depleting fossil fuel resources, and it negatively affects the climate, biodiversity, soil conditions, water supply and -quality as well as human health through emissions and hazardous substances. The FAO estimates that agriculture and forestry account for a third of all GHG emissions.[1]

Meanwhile the need to assure that all the world's people are adequately fed is becoming ever more urgent. The FAO estimates that even today 1.02 billion people still suffer from hunger[2] – probably the worst disgrace of world politics.[3] In the richer countries, a billion people are obese, whilst between 30 to 50 percent of food in the rich countries is wasted. These numbers make clear that hunger is not the result of insufficient harvest[4], but a problem of allocation. It is important to make a connection between these issues, and to develop policies for access to sufficient food for all people. But meanwhile developing countries have been getting little support for optimizing their farming practices: during the last 30 years, agriculture's share of foreign aid has dropped from 17 to 3 percent of total spending.

Now climate change is making it even more imperative to rethink the world's agriculture and food system. As claimed during the 2009 FAO World Summit on Food Security, governments must "take necessary steps to enable all farmers … to adapt to, and mitigate the impact of, climate change through appropriate technologies and practices that improve the resilience of farming systems, thus enhancing their food security."[5] Today policy makers cannot afford to neglect the role that the food system plays in the climate agenda. The Intergovernmental Panel on Climate Change (IPCC) has calculated a climate change mitigation potential in the agriculture sector of up to 6.4 Gt CO2 eq per year.[6] Our research indicates that no country has, so far, developed and implemented specific policies to reduce greenhouse gas emissions from its food system, or indeed to 'climate-proof' its food policies, though in some countries government policies have indirectly had this effect. Consequently, in this booklet we present three policy concepts which effectively combine food security and climate protection … and we also introduce two theoretical policy proposals:

- **Organic agriculture:** The IPCC found that a large share of agriculture's technical mitigation potential lies in enhancing soil carbon sinks through increase of organic matter in degraded soils. To this end governments should provide a policy framework in which an organic agriculture sector can prosper. Recommended measure include abolition of detrimental subsidies, support for recycling organic waste, certification and labelling schemes, and education and information about organic farming and food for both farmers and the general public.
- **Biochar cooking:** When biochar – produced by low-oxygen combustion of biomass – is added to soils, its structure can be enhanced by the biochar carbon content that can be stored in the soil. Whilst large scale biochar production from forest plantations is unacceptable for many reasons, alternative, sustainable sources of biochar are available. The

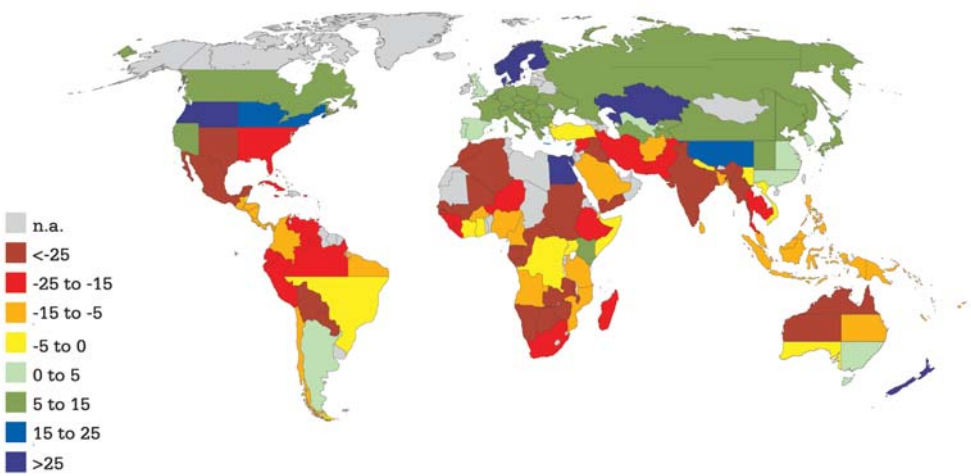
Farmers' markets are making a come-back in Europe. In the US there are now over 4000 across the country.

distribution and use of small scale bio-char cooking stoves in rural areas can contribute to sustainable farming as well as carbon-negative cooking without the release of dangerous fumes.

- **Urban agriculture:** Producing food locally, in urban or peri-urban locations, means short transport routes. Less food must be processed or deep frozen, and packaging can also be reduced. Limiting these activities can substantially reduce the carbon footprint of each meal. To install a successful urban agriculture sector, governments should enable a large part of the population to gain access and usufruct ownership of small lots of land. Further, cooperative initiatives should be supported and seed centers set up. Cuba's urban agriculture policy has proved that these measures can be very effective.
- **Carbon labelling:** The carbon footprint of food products varies considerably. Across the world, consumers play a major role in shaping the food system, and they must be given better information on the climate impacts of their food consumption habits. This implies much more comprehensive consumer information, including explicit food labelling policies, particularly in the developed countries. Labelling schemes can be voluntary or mandatory. Further, endorsement and comparative labels should be distinguished.
  In the UK a new private 'food carbon label' has been set up recently under www.climatefriendlyfood.org.uk.
- **Carbon tariff:** The IPCC has calculated that the climate mitigation potential in the agriculture sector would be greatly increased if a price was put on carbon emissions. To this end, emission trading schemes and carbon taxes might be most suitable. An alternative policy instrument could be a flexible trade tariff which internalises external environmental costs.

The differences in climate, wealth and infrastructure between regions make it impossible to propose one-size-fits-all solutions. It is important to assess the particular situation at stake, and to develop an appropriate policy framework on this basis. This booklet and its policy concepts are intended as food-for-thought – as a collection of facts, ideas and proposals that can be discussed by the stakeholder community, with the potential to being adopted nationally and internationally.

Climate change and its impact on farming



Projected changes in per cent in agricultural productivity by 2080 due to climate change
Source: WTO, adapted from Cline, 2007.
Note that the effects of carbon fertilization are incorporated.

The above map, published by UNEP in February 2009, is a product of many years of research by hundreds of climatologists and agricultural scientists. It clearly shows that the areas of our world in which most people suffer from hunger, are – in general – those which are most affected by the negative impacts of climate change on agricultural productivity.

Scientists have alerted global policy makers to the perils of climate change over the coming decades and it remains to be seen whether major international agreements can be reached to avert some of these.

Agriculture is considered to be one of the most vulnerable sectors. The Declaration of the World Summit on Food from November 2009 stated: "Climate change poses additional severe risks to food security and the agriculture sector. Its expected impact is particularly fraught with danger for smallholder farmers in developing countries, notably the Least Developed Countries (LDCs), and for already vulnerable populations."[7] In a newly published report the WTO and UNEP state that in low-latitude regions, even a small temperature increase of 1°C would lead to reductions of 5–10 percent in the yields of major cereal crops. By 2020, crop yields in African countries could fall by up to 50 percent.[8]

Few researchers now dispute that over the next 100 years, accelerated warming and expansion of water in the oceans, and increased melting rates of low-lying glaciers and ice caps are expected to raise sea levels by a metre or more. This will have major consequences for low-lying farmland across the world. For instance, a one metre sea level rise would affect half the rice land of Bangladesh. A two metre rise would inundate much of the Mekong Delta in Vietnam, the world's second most important rice exporter, etc. The melting of mountain glaciers is another global threat. Already the snow caps on Mount Kenya and Kilimanjaro in East Africa have largely disappeared. The shrinking of glaciers in the Himalayas and on the Tibetan plateau is particularly alarming since they feed the Indus, Ganges, Yangtze, Yellow and Mekong Rivers on whose waters hundreds of millions of Asian farmers depend.

As GHG concentrations increase and temperatures rise, the frequency and intensity of extreme weather events such as cyclones, floods, droughts and heat waves may also change. Rising ocean temperatures, in particular, are expected to affect storm and cyclone development.

Across the world in the last few years, flooding and other extreme weather, attributed to climate change, is affecting farmers and agriculture. For example:

- In 1995, half of Bhola Island, Bangladesh, became permanently flooded, turning 500,000 people, mainly farmers, into the world's first climate refugees.
- Since 2001, much of the Murray-Darling Basin, Australia's breadbasket, is experiencing unprecedented droughts. Storage levels will take many years of above average rainfall to recover.[9]
- Threats to Uganda's coffee crop are increasingly threatening the country's main export income.
- Increasingly erratic monsoons are causing major problems for farmers in India.

The climate impacts of the global food system

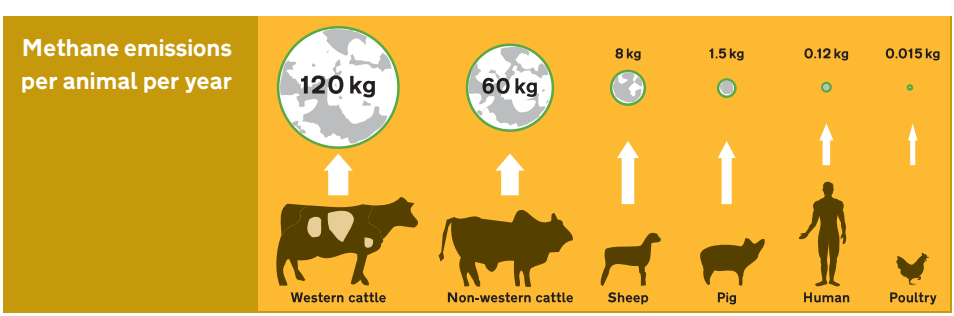
Modern agriculture is not only a victim of climate change, it is also a major contributor, led by countries with highly mechanised food supplies. Agriculture is directly responsible for almost 14 percent of total greenhouse gas emissions, and broader rural land use decisions have an even larger impact. Deforestation currently accounts for an additional 18 percent of emissions.[10] Even worse, the global trend is still for ever greater use of fossil fuels, fertilizers and pesticides in agriculture and for long-distance food trade, increasingly using air freight.

Some people worry about peak oil, but we may need to worry even more about peak soil. Globally, some 24 billion tonnes of soil erode every year, some 3.5 tonnes per person. Worldwide soil erosion was estimated in 1997 to cost in the order of $ 400 billion a year, or half the world's military budget at that time.[11] Soil erosion is contributing to increases in GHG concentrations and reduced soil carbon storage.

In this context, a historical perspective needs to be considered: Professor Rattan Lal (Ohio State University) has been researching the connections between land use changes and the transfer of carbon into the atmosphere for many years. He estimates that since the beginnings of agriculture up to 250 billion tonnes of carbon have been released by land use changes,[12] an amount similar to the quantities of carbon discharged by the burning of fossil fuels over the last 200 years. These huge reductions of carbon held in soils and vegetation have resulted from

- deforestation,
- loss of soil organic matter and biodiversity and
- accelerated soil erosion.

Soil erosion by water, wind and tillage affects both agricultural potential and the wider natural environment. It is probably the least well-known of today's major environmental problems and the resulting reduction of soil carbon storage needs to be reversed by appropriate national and international policies. Regarding GHG emissions, the discharge of methane by the world's farm animals is also very significant:



The global food system as a whole is estimated to produce nearly 40 percent of total carbon emissions – encompassing GHG release from the conversion of forest to farmland, all aspects of food production, as well as the transportation and processing of food. This huge climate impact obviously has major implications for food policy and consumption habits. An increasingly important component is the connection between rising affluence and meat consumption. Methane discharges from animal husbandry have been increased significantly because of the trend for every greater use of grains as fodder, particularly for cattle. The traditional practice of relying on grass as the main source of cattle fodder had far less climate impact. Livestock farming now generates 18 percent of the planet's greenhouse gas emissions. By comparison, all the world's cars, trains, planes and boats accounted for a combined 13 percent of greenhouse gas emissions.[13]

Another major concern is the vast amount of fossil fuel energy that goes into producing, packaging, transporting, storing and cooking food. For example, in the UK, half the vegetables and 95 percent of all fruits are imported.[14] Buying from local farmers, vegetables only have to travel about 100 kms or less. Many organisations emphasise buying organic and purchasing produce at the local farmers market to save on transportation and packaging, but this graph shows that the largest energy expense occurs after food arrives in the home.[15]

Energy and food production in the US:

Use	Percent total energy use
Food Retail	4 %
Packaging	7 %
Restaurants / Caterers	7 %
Transport	14 %
Processing	16 %
Agricultural Production	21 %
Home Refrigeration / Preparation	32 %

Reducing the impacts of farming on the global climate is one of the greatest policy challenges facing humanity. So far the global trend is for ever more mechanised farming, greater distance between food producer and consumer, ever more packaging and greater meat consumption. There is no question that these interconnected trends must be addressed in a world threatened by climate chaos.

The climate mitigation potential of agriculture

Agriculture now extends to about half the world's land surface. With the right policy measures, farmland can play a crucial role as a carbon sink. Until now, the main thrust of trying to manage greenhouse gases by land use has been to increase CO_2 sequestration by trees and plants through carbon storage in biomass. But the potential for sequestering carbon in soils is still underexposed. Soils are already the largest carbon reservoir of the terrestrial carbon cycle. The 4th IPCC Assessment Report found that 89 percent of agriculture's carbon mitigation potential can be achieved through increase of organic matter in degraded soils and by use of carbon-neutral bio-energy.[16]

Techniques such as agroforestry and organic agriculture require less tilling of the land and thus keep more carbon stored in the soil. By introducing policies for helping farmers with access to up-to-date knowledge and tools, the clearing of natural habitats for agriculture can be prevented, and forests and grasslands can be kept intact as vital carbon sinks.

To better exploit this potential, more policies to support organic low-carbon agriculture need to be adopted. In the following, we present and discuss different policy approaches to sequester greenhouse gases by better agricultural practices.

Organic solutions for mitigation

Agricultural carbon sequestration has the potential to substantially mitigate global warming impacts. According to the Rodale Institute, organic agriculture, if practiced on the planet's 3.5 billion tillable acres, could sequester nearly 40 percent of current CO_2 emissions.
"We call this approach regenerative organic agriculture to signify its focus on renewing resources through complementary biological systems which feed and improve the soil as well as avoiding harmful synthetic inputs."[17]

Regenerative organic farming, focused on enhancing long-term biological interactions, turns soil into a carbon reservoir, while conventional farming with large chemical imputs has the opposite effect of releasing carbon into the atmosphere. In

addition, organic management also changes the structure of the soil, improving its ability to store water and deliver nutrients to plants over time as soil carbon levels continue to increase. Rodale research shows that no-till organic farming can reduce the energy input into farming by about 70 percent. Further, organic food offers health advantages and has become a lifestyle choice in many societies. For these interconnected reasons, much more policy assistance for the organic sector is needed.

Case studies (UNCTAD 2008[18], IFOAM 2008[19]) have shown that the development of organic farming has, so far, been initiated mainly by NGOs or private companies.

SEKEM – An Egyptian pioneer in organic farming

In 1977, Dr. Abouleish, a member of the World Future Council, initiated SEKEM, cultivating desert areas near Cairo using sustainable agricultural practices. By 2009 SEKEM's work extended to 4500 hectares and directly involves 2000 people. Moreover circa 30,000 people from the surrounding community make use of the cultural and social services offered by the SEKEM Development Foundation and other related NGOs.

An important point is that SEKEM's agricultural practices are helping to tackle climate change. Firstly they emit less greenhouse gases by avoiding the use of chemical fertilizers and due to lower needs for irrigation. Organic practices introduced by SEKEM led to a reduction of synthetic pesticides in Egypt by over 90 percent, from over 35,000 tons per year. Secondly, the healthy soils built up by the application of organic material store much higher levels of carbon than conventional agricultural soils that are cultivated by using chemical fertilizers. Thirdly, SEKEM's farming practices also help farmers to adapt to effects of climate change such as droughts and heavy rainfall. The average yield of raw cotton was increased by almost 20 percent.[20]

Still, governments should play an important role in providing a supportive framework for organic farming. Policy strategies should consist of a combination of market supply and demand measures.[21] Since appropriate measures depend on the state of the organic agriculture market in the respective country, an in-depth integrated assessment of existing agriculture policies should be the first step.[22] Based on this initial assessment a selection of policies should be considered:

On the supply side, a policy priority must be the critical stocktaking of all agriculture subsidies (e. g. for chemical fertilizer) looking at overproduction, health and environment hazards and climate implications. If socially feasible, and without risking the food security of a given country, detrimental subsidies must be abolished and partially transferred into the organic agriculture sector.

An area particularly worthy of state support is the recycling of urban bio-waste into organic fertilizers[23]. This contributes to sanitation and environmental protection, and it provides carbon storing materials for farms. To trigger this process, governments could give financial incentives (e. g. low-interest loans) to recycling plant operators, or to erect recycling plants under state supervision. A way to directly support organic food producers is to compensate them for certification costs. In Denmark, Thailand and Malaysia, government certification is for free for farmers, and in Tunisia the government covers up to 70 percent of certification costs.[24] Producer organizations can be supported to organize efficient distribution of processed bio-wastes.

On the demand side, government can support the development of a domestic organic standard. More than 70 countries have enacted such standards. Governments must carefully assess how appropriate standards can be initiated and harmonized with international reference standards, based on the recommendations of the International Task Force on Harmonization and Equivalence in Organic Agriculture.

Government can also play a strong role regarding consumer education by drawing attention to the health and environmental benefits of organic products. To this end, organic agriculture can be introduced to the mandatory curriculums in schools and universities in agricultural regions[25]. Local governments can also promote organic foods by allocating space in open markets and in trade fairs. Integrating organics into public procurement (e. g. for schools and hospitals) stimulates market demand and improves public information and consumer exposure. Finally, if not already existent, a common label for organic products should be established and promoted.

Seed sovereignty – Navdanya

Dr. Vandana Shiva,
Founder of Navdanya

In her book 'Soil Not Oil', World Future Council member Vandana Shiva strongly endorses regenerative organic farming strategies. She makes a connection between food insecurity, peak oil, and climate change and examines why any attempt to solve one without addressing the others will get us nowhere.[26] A further component of the book, and the work of her organisation Navdanya, is to call for seed sovereignty, assuring that farmers are not forced to rely on seed, fertilizers and pesticide 'packages' supplied by multinational companies. Navdanya has worked with local communities and organizations, now serving more than 200,000 farmers from 14 Indian States. Navdanya's efforts have resulted in the conservation of more than 2000 rice varieties from all over the country, including indigenous varieties that have been adapted over centuries to meet different local ecological demands. Members have also conserved 31 varieties of wheat and hundreds of millets, pseudocereals, pulses, oilseeds, vegetables, as well as multipurpose plant species, including medicinal plants. Navdanya has established 34 seed banks across the country as it believes in operating through a network of community seed banks in different ecozones of India, and thus facilitating the rejuvenation of agricultural biodiversity, farmer's self-reliance in seed locally and nationally, and farmer's right. Navdanya has also established a conservation and training centre at its farm in near Dehradoon in Uttarkhand. In this region more than 70,000 farmers are primary members of Navdanya. Today, biodiversity conservation programs linked to Navdanya are underway in Uttaranchal, Uttar Pradesh, Madhya Pradesh, Rajasthan, Orissa, West Bengal, Karnataka, Haryana. It remains to be seen if and when the Indian government may decide to make Navdanya's practices into government policy.[27]

Sustainable biochar

Biochar can be produced by pyrolysis (low-oxygen combustion) of a great variety of organic materials. The potential benefit of biochar as a carbon storage medium in agricultural land is now widely recognised. Its production from monoculture tree plantations is vigorously opposed by an international coalition of environment groups. However, biochar produced from forest thinnings, sawdust, agricultural wastes, urban organic wastes or sewage solids is widely regarded as a sustainable carbon storage medium and soil conditioner.

On the farm, simple, innovative cook stoves that employ pyrolysis, can enable rural families to cook their food and to produce biochar at the same time. These cooking stoves can burn crop residues and other biomass fuels without releasing CO_2 and other dangerous emissions.

When biochar is added to soils, its structure can be enhanced, contributing to agricultural productivity. A further benefit arises because biochar, which contains 70–80 percent carbon, remains in soils for long periods of time, storing potentially large amounts of carbon.[28]

Although the production costs of pyrolysis cooking stoves are only between € 10 and € 20, this still makes them unaffordable for most of the targeted market. National and regional governments could, therefore, support the local production, distribution and installation of biochar cooking stoves in people's homes. Both NGOs and government agencies can be important agents in distributing stoves. In addition, there needs to be adequate instruction on the correct methods of using the stoves and the resulting biochar.[29] Changing habits that have developed over generations is not an easy task. Therefore, it is of paramount importance that substantial efforts be directed to the training of promoters and to making the technology as user-friendly as possible.

Terra Preta

Biochar stoves

Use of charcoal as a soil conditioner has ancient origins, and is best documented with reference to the 'terra preta' – meaning 'dark earth' in Portuguese – soils found in parts of the Amazon basin. Much evidence now exists that charcoal was mixed by Amazonian Indian cultivators with food and human wastes to enrich poor and acidic soils. The predecessors of today's Amazonian Indians left behind 'terra preta' soils rich in organic matter in some 10 percent of the Amazon territory. Research has shown that charcoal incorporated in this way can last in the soil for hundreds to even thousands of years. Its persistence has attracted the attention of research scientists who believe that carbon locked up in the soil as biochar can prevent the discharge of CO_2 into the atmosphere.

From globavores to locavores? – Local policy solutions

'Locavores' is a term for those who subsist on produce from their local area. The 'locavore' movement encourages consumers to buy from farmers' markets or even to grow or pick their own food, arguing that fresh, local produce is more nutritious and also taste better.

The issue of local food is one of the most commonly and enthusiastically embraced of all the issues around localisation. A particular challenge is the issue of food sovereignty for urban areas, given that by 2030 an estimated 60 percent of all people will live in cities (FAO, 2009).[30] From British allotment gardening, to community supported agriculture, to Cuban urban agriculture, to Japanese rooftop gardens – there are more and more examples of intra-urban and peri-urban areas being transformed into productive food-growing land. Producing food locally, even in an urban environment, means short transport routes, less processing and packaging. In the US, these parts of the value chain consume more than a third of all energy used for food production. Limiting these activities can substantially reduce the carbon footprint of each meal. In addition, urban food policies encourage consumption of nutritious food, provide food security and sovereignty. Members of the community can be become involved. Jobs and occupation, and income opportunities are created. Local agriculture projects create solidarity and purpose among the communities, sustaining morale and help building community pride.

To set up an urban agriculture programme, a framework of policies is needed. First, people should be enabled to gain access and usufruct ownership of land to be used

In Shanghai, and in other Chinese cities, local vegetable production is still the norm.

for agriculture purposes. Depending on the social structures of the region, land should be leased for free or for a low rent. The lease of land must be organised and monitored by the municipal government, encouraging a wide range of fruits, vegetables and spices to be cultivated in the area. The gardeners and farmers can work on their own or establish production cooperatives. In addition, they can be organized in loose associations to facilitate the dissemination of information and technical knowledge among themselves, and to exchange seeds and to share tools.

Government should set up information centers. These could sell agricultural supplies to the public that would otherwise be difficult to obtain, such as vegetable and medicinal seeds and seedlings, biological pesticides, organic fertilizer and tools. For sale of the produce, spaces at farmer markets should be provided for subsidised rent. If necessary, municipalities have to organise markets or other sales opportunities. Also, on-site sale should be encouraged. Finally, it must be ensured that produce is sold at prices that are affordable to the local community. This could be made a condition for accepting a farmer to participate in an urban agriculture programme. Helpful assistance can be provided by NGOs, and organizations such as the UN Food and Agriculture Organization (FAO) which supports urban agriculture in its 'Food in the City' programme.[31]

Urban agriculture in Havana

After the collapse of the Soviet Union and the reduction of its imports of machines, food, and fertilizers in 1989, Cuba was forced to move towards food self-sufficiency. When food shortages due to the lack of fuel for tractors and lorries caused serious food supply problems, the government decided to encourage people to practice agriculture within Cuba's cities. Soon gardens sprouted up everywhere – at housing estates, schools, community centres, hospitals and factories.

Cuba's urban agriculture program aims to provide each person with at least 300 grams of fresh vegetables per day. By 2002, over 35,000 hectares of urban land were used for the intensive production of fruits, vegetables and spices. 117,000 people working in Cuba's urban gardens produce over half the country's vegetables, fruit, chickens and rabbits with zero transportation costs.

The main source of compost is bagasse trucked in from Cuba's sugar cane fields as an organic growing medium. Cuba's urban agriculture program provides good quality seeds, advice on composting, crop rotations earthworms, and on dealing with bacterial and fungal diseases without relying on chemical pesticides.[32] Cuba's food policies have been developed out of necessity but they are highly relevant for a world faced with the need to assure food security for all in an age of climate change.

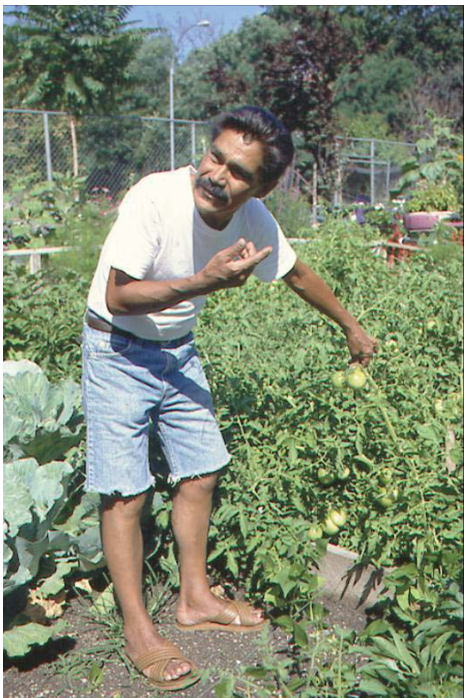
Carbon labelling policies

It has been shown that the carbon footprint of food products ('foodprint') can vary substantially. Depending on its production method (organic versus chemical), its content (meat versus vegetarian or vegan), transport routes (air freight, sea freight or local), processing method (fresh versus deep-frozen) and disposal of residues (use as organic fertilizer versus waste), each food item is responsible for a certain amount of GHG emissions during its life-cycle. Making this information available to the consumer increases transparency in the food market, raises awareness of the consumer, creates incentives for the industry to lower its carbon footprint, and rewards climate friendly products. Consumers should know whether the organic kiwi from New Zealand or the home grown chemically fertilized apple does more harm to the climate.

In general, environmental labelling has been a success story since the 1980s. Labels, such as the Energy Star, energy efficiency ratings or the Nordic Swan label have changed the behaviour of consumers and manufacturers.[33] An Eurobarometer survey showed that for an overwhelming majority of Europeans (83 percent) the impact of a product on the environment plays an important aspect in their purchasing decisions.[34]

An evaluation of the specific circumstances of the political and regulatory environment will determine the best choice in each case. Whereas a mandatory label ensures a broad participation, voluntary schemes might have a better acceptance in the industry. A food label should be based on total life-cycle emissions, as opposed to considering only the use-phase. First examples such as the 'Carbon Label' of the UK Carbon Trust[35] show that this is possible. Possible are both comparative labels which provide consumers with product information through use of a specific number (e. g. '1 kg CO_2') or rating (e. g. A–F or 1–5 stars), or endorsement labels which prove that the product meets certain criteria (e. g. below average carbon footprint).

Implementing new labelling schemes necessitates conformity assessment procedures involving testing, inspection, certification, accreditation and metrology.[36] These processes are essential for the effective implementation and acceptance of the scheme.



In and around many US cities, such as here in the Bronx in New York, local gardening is increasing rapidly.

The EU Commission has taken a first look at this issue but, not surprisingly, has received opposition from the food industry.[37] However, the example of the UK Carbon Label shows that the concept can be implemented and, with the assistance of governments and industry, can be established on a larger scale.

In the US and the UK new voluntary schemes are being set up under the term Climate Friendly Farming and Food.[38]

In Sweden, the first countrywide and comprehensive food labelling initiative has been launched recently.

The Carbon Label Company

The Carbon Label Company was set up by the Carbon Trust in 2007. Its label is privately set up and voluntary. The label shows a footprint icon along with the total greenhouse gas emissions from every stage of a product's life-cycle, including production, transportation, preparation, use and disposal. Its primary objective is described as "to help businesses to measure, certify, reduce and communicate the lifecycle greenhouse gas (GHG) emissions of their products and services, including food and drink." The secondary objective is to educate consumers on lowering their carbon footprints[39]. The Carbon Trust, along with the UK Department of the Environment (Defra), developed a standard based on PAS 2050 Standard for assessing GHG emissions of products and services. PAS 2050 is an internationally applicable standard, the development of which was informed by 20 pilot projects that examined supply chains that stretched across international borders. In addition, organisations from 40 countries were involved in the consultation process.[40]

International policies – the need for a price on CO_2

The proposals presented here have to be supported by progressive international climate policy. The Fourth Assessment Report of Working Group III of the IPCC made it very clear that agriculture is the sector most sensitive to carbon pricing policies.[41] Whereas the CO_2 eq mitigation potential with a carbon price of below 20 US $/t is calculated at around one $GtCO_2eq$/year, this potential would increase three- to fourfold at carbon prices of < 50 US $/t and < 100 US $/t respectively. Consequently, an agreement to globally tax GHG, or to establish a global carbon emission trading scheme, would be the best way to support local and organic agriculture solutions. Such a clear price signal would – in conjunction with the support policies presented above – transform markets and mean a breakthrough for sustainable agriculture.

An innovative way to price the costs of GHG emissions in the food sector was proposed by Franz-Theo Gottwald and Franz Fischler in their book "Ernährung sichern weltweit – Ökosoziale Gestaltungsprinzipien": the introduction of trade tariffs for agricultural produce equivalent to the external costs of transport, conversion into farmland and emission of greenhouse gases from food production and distribution. Countries that introduced appropriate national food policies would benefit from reduced trade tariffs. Such a policy would be a significant step towards preventing environmentally unsustainable patterns of food trade. Gottwald and Fischer acknowledge that such an international food trade policy would be difficult to implement in the short term, but that such proposals would be a useful stimulus for national and international policy debates.[42]

Moreover, under the policies of the Kyoto Protocol, developed 'high emission' countries agreed to reduce their total GHG emissions but they could also choose to fund climate-friendly projects in developing countries. The 'Clean Development Mechanism' enabled developing countries to participate in global agreements and to access funds to help them introduce sustainable technologies into their economic development. The successor agreement to the Kyoto Protocol should extend such arrangements to bio-sequestration projects – with the explicit exception of 'Round Up Ready' GMO crops – for both local and global benefit.

Conclusion: global policies on food and climate

The development of climate-resilient farming systems is a major challenge for policy makers. Around the world, extreme weather conditions are forcing a rethink on land use strategies. It is clear that we need to develop appropriate policies for a food system designed to feed the world without contributing to the deterioration to the health of soils, the contamination of water courses and detrimental impacts on the global climate.

In this brochure we have emphasised, above all else, that farmers can be encouraged and even funded to become *global* carbon stewards, for the benefit for their *local* communities as well as for the benefit of the *global* environment and climate. With all that is now known about the challenges of climate change for the global food system, a major paradigm shift in policy incentives needs to be implemented across the world. We need policies for a global food system based on biology, not chemistry, one that will feed us indefinitely if we treat the soil right. Governments are now obliged to create policy incentives for lowering agricultural greenhouse gas emissions and expanding carbon sinks by supporting farmers to:

- sequester carbon in agricultural soils by organic farming and reduced tillage,
- reduce nitrous oxide emissions through minimal use of nitrogen fertilizer,
- capture methane emissions from anaerobic manure handling facilities,
- substitute renewable fuels for gasoline, diesel fuel and natural gas used on the farm,
- increase the generation of electricity from wind, solar and small-scale hydro,
- expand the use of practices like hedges, shelterbelts and forested riparian zones,
- expand local food supply for local consumption,
- support the use of sustainable biochar derived from farm and urban organic wastes.

To this end, this booklet has tried to compile a first collection of appropriate policies in this area. All in all, there is still much to do to conceptualise policies that fully respond to the new challenges of creating a sustainable global food system in an age of climate change. The climate negotiations of the coming years will need to recognise the crucial role of agricultural soils and forests in absorbing greenhouse gases and assuring global food security. There is little doubt that policy makers across the world are beginning to recognise the need for climate-proof food policies for an ever more environmentally challenged and crowded world. The challenge is to truly 'cultivate the future': to assure sustainable food supplies from healthy rural communities and soils, and within a stable climate for the benefit of present and future generations, but we have barely begun to understand what this actually means.

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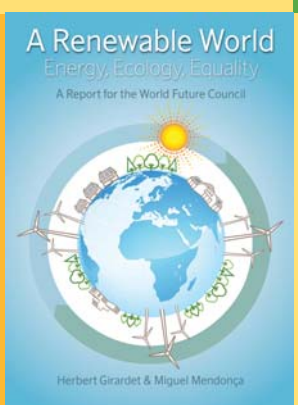

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