Seedling

Biodiversity, Rights and Livelihood

October 2009

Climate crisis special issue

GRAIN

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GRAIN is an international non-profit organisation which promotes the sustainable management and use of agricultural biodiversity based on people's control over genetic resources and local knowledge. To find out more about GRAIN, visit www.grain.org.

Seedling

Seedling is GRAIN's quarterly magazine, published in January, April, July and October. It provides background articles, news, interviews and much more on the issues GRAIN is working on. *Seedling* is available free both in paper format and on GRAIN's *Seedling* website (www.grain.org/seedling). To receive *Seedling* in paper format or to inform us of a change of address, please contact GRAIN at the address or email above.

Seedling is published as a collective effort of GRAIN staff. If you would like to contribute an article or other information to *Seedling*, please contact us. Outside contributions are attributed to their respective authors.

Printed on 80% recycled paper
Deposito Legal No. B-25.166.92, Spain
ISSN: 1002-5154

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Front cover: *A Maasai herdsman leads his animals to find water, Maasai Mara, Kenya. (Photo: Practical Action)*

Back cover: *A woman collects leaves to feed her goat, Maasai Mara, Kenya. (Photo: Practical Action)*

In this issue...

In this special edition of *Seedling* we examine the role of the world's farming and food systems both in causing the climate crisis and potentially in helping to resolve it. The link between the industrial food system and global warming is not often addressed directly, largely because of the way the statistics on the factors behind the climate crisis are generally presented, and some of our conclusions may well be surprising.

It is clear that the move away from traditional methods of farming to industrial agriculture and modern food production has been hugely important in creating the crisis. As we spell out in one of our main articles, the extensive use of chemical fertilisers and pesticides, the expansion of the meat industry and the destruction of the world's savannahs and forests to grow agricultural commodities are together responsible for about one third of the greenhouse gases that are causing global climate change. When you add to this the extraordinary amount of fossil-fuel energy used to transport commodities around the world, to process them, to freeze them and then finally to package and to distribute the final products to supermarkets, the food industry's role in creating the crisis increases significantly. The global food system may well be responsible for almost half of the world's greenhouse gas emissions.

A return to agro-ecological farming on a massive scale would mitigate a large part of the present crisis. As all agronomists know, soils contain enormous amounts of carbon, mostly in the form of organic matter. The rise of industrial agriculture, with its use of chemical fertilisers and pesticides, has provoked a huge depletion of this organic matter in the soil. Much of the lost matter has ended up in the atmosphere in the form of carbon dioxide. As we demonstrate in our opening article, it would be possible to recapture this carbon dioxide by a wholesale return to agro-ecological farming. In about half a century (which is the same amount of time in which large-scale soil depletion has occurred) the lost organic matter could be reincorporated into the soils, capturing in the process more than two-thirds of the present excess carbon dioxide in the atmosphere. Although it may already be too late to avert widespread environmental damage, such a strategy would offer the world a way out of the crisis.

Such a radical change in our farming methods would clearly require fundamental changes in what food we eat and how we produce it. The current anti-farmer policies, such as laws that foster the monopolisation and privatisation of seeds and regulations that protect corporations but kill off traditional food systems, would have to be dismantled. The current trends towards increased land concentration and the expansion of industrial farming would have to be reversed. Millions of farmers and farming communities would have to gain access to the land so that they could join in the task of restoring billions of tonnes of organic matter to the soil. It all adds up to a daunting political challenge.

Such an approach, based on tried-and-tested farming techniques developed by farming communities over millennia, would produce results. The obstacles it faces are political, not technical. Such confidence cannot be felt with respect to the plethora of new technical fixes (such as biochar, "climate-ready" genetically modified crops and the breeding of cows genetically engineered to produce less methane) that the corporate sector is developing as its response to the crisis. As is shown in another article in this issue, these so-called solutions may well create far more problems than they solve.

Time is running out, for the climate crisis is gaining momentum at an alarming rate. Climate change is already seriously affecting 325 million people a year – with 315,000 dying from hunger, illness and weather disasters induced by climate change. The annual death toll could well rise to half a million by 2030, with 10 per cent of the world's population seriously affected. As a consequence of the increased stress induced by the climate crisis on soils, plants and animals, agricultural yields are expected to fall calamitously throughout the century, particularly in the warmer countries in the South. Such a scenario would inflict unimaginable suffering upon billions of people. It is high time to turn this situation around. In this issue of *Seedling* we show that it can be done, resulting in a healthier planet, improved soils and more sustainable agricultural production, more and better food, and vigorous rural communities.

The editor

Today's global food system, with all its high-tech seeds and fancy packaging, cannot fulfil its most basic function of feeding people. Despite this monumental failure, there is no talk in the corridors of power of changing direction. Large and growing movements of people clamour for change, but the world's governments and international agencies keep pushing more of the same: more agribusiness, more industrial agriculture, more globalisation. As the planet moves into an accelerating period of climate change, driven, in large part, by this very model of agriculture, such failure to take meaningful action will rapidly worsen an already intolerable situation. But in the worldwide movement for food sovereignty, there is a promising way out.

The international food system and the climate crisis

GRAIN

This year more than one billion people will go hungry, while another half a billion people will suffer from obesity. Three-quarters of those without enough to eat will be farmers and farm workers (those who produce food), while the handful of agribusiness corporations that control the food chain (those who decide where the food goes) will amass billions of dollars in profits. Now the latest scientific studies are predicting that, in a business-as-usual scenario, rising temperatures, extreme climate conditions and the severe water and soil problems related to them will push many more millions into the ranks of the hungry. As population growth raises demand for food, climate change will sap our capacities to produce it. Certain countries already struggling with severe hunger problems could see their food production cut by half before the end of this century. Yet where elites gather to talk about climate change, very little is being said about such consequences for food production and supply, and even less is being done to address them.

There is another dimension to this interaction between climate change and the global food system that reinforces the urgent need for action. Not only is today's dysfunctional food system utterly ill-equipped for climate change, it is also one of the main engines behind it. The model of industrial agriculture that supplies the global food system essentially functions by converting oil into food, producing tremendous amounts of greenhouse gases (GHGs) in the process. The use of huge amounts of chemical fertilisers, the expansion of the industrial meat industry, and the ploughing under of the world's savannahs and forests to grow agricultural commodities are together responsible for at least 30 per cent of the global GHG emissions that cause climate change.[1]

But that is only a part of the current food system's contribution to the climate crisis. Turning food into global industrial commodities results in a tremendous waste of fossil-fuel energy in transporting it around the world, processing it, storing it and freezing it, and getting it to people's

1 International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), Global Report, 2008, http://tinyurl.com/6r82ry

homes. All these processes are contributing to the climate bill. When added together, it is not at all an exaggeration to say that the current global food system could be responsible for nearly half of the world's GHG emissions.

The rationale and urgency for an overhaul to the world's food system has never been more stark. From a practical point of view, there is nothing preventing transition to a saner system, and people everywhere are showing willingness to change – whether they be consumers searching out local foods or peasants barricading highways to defend their lands. What stands in the way is the structure of power – and it is this, more than anything, that requires transformation.

The forecast is for famine

In 2007, the Intergovernmental Panel on Climate Change (IPCC) issued its long-awaited report on the state of Earth's climate. The report, while stating in unequivocal terms that global warming is happening and saying that it is "very likely" that humans are responsible for it, cautiously forecasts that the planet will heat up by 0.2° Celsius (C) per decade if nothing is done to reduce our GHG emissions. The report warns that a rise in temperature of 2–4°C, which may be reached by the end of the century, would produce a dramatic rise in sea levels and a sharply increased frequency of climatic catastrophes.

Now, just two years later, it appears that the IPCC was too optimistic. Today's scientific consensus is that a 2°C increase over the next few decades is already a virtual certainty, and that the business-as-usual scenario could heat up the planet by as much as 8°C by 2100, pushing us over the tipping point and deep into what is described as dangerous and irreversible climate change.[2] Already, the impact of much milder climate change is hitting hard. According to the Geneva-based Global Humanitarian Forum, climate change is seriously affecting 325 million people a year – with 315,000 dying from hunger, sickness and weather disasters induced by climate change.[3] It predicts that the annual death toll from climate change will rise to half a million by 2030, with 10 per cent of the world's population (700–800 million people) seriously affected.

Food is and will remain at the centre of this unfolding climate crisis. Everyone agrees that agricultural production has to continue to rise significantly over coming decades to feed the growing population. Climate change, however, is likely to put agricultural production into reverse.

Table 1: Estimates for impact of global warming on world agricultural output potential by the 2080s (%)

	without carbon fertilisation	with carbon fertilisation
Global		
output-weighted	−15.9	−3.2
population-weighted	−18.2	−6.0
median by country	−23.6	−12.1
Industrial countries	−6.3	7.7
Developing countries	−21.0	−9.1
median	−25.8	−14.7
Africa	−27.5	−16.6
Asia	−19.3	−7.2
Middle East/North Africa	−21.2	−9.4
Latin America	−24.3	−12.9

Source: edited table taken from William R. Cline, *Global Warming and Agriculture*, p. 96

In the most comprehensive survey of studies modelling the impact of global warming on agriculture to date, William Cline estimates that by 2080, in a business-as-usual scenario, climate change will reduce the potential output of global agriculture by more than 3.2 per cent as compared with today. Developing countries will suffer the most, with a potential 9.1 per cent decline in agricultural output. Africa will suffer a 16.6 per cent decline. These are horrific numbers, but, as Cline says, the actual impacts are likely to be much worse than even these figures suggest.[4]

A major weakness in the forecasts of the IPCC and others when it comes to agriculture is that their predictions accept a theory of "carbon fertilisation", which argues that higher levels CO_2 in the atmosphere will enhance photosynthesis in many key crops, and boost their yields. Recent studies show that this is a mirage. Not only does any initial acceleration in growth slow down significantly after a few days or weeks, but the increase in CO_2 reduces nitrogen and protein in the leaves by more than 12 per cent. This means that, with climate change, there will be less protein for humans in major cereals such as wheat and rice. There will also be less nitrogen in the leaves for bugs, which means that bugs will eat more leaf, leading to important reductions in yield.[5]

When Cline removed carbon fertilisation from his calculations, the results were much more gruesome (*see* Table 1). Global yields would decline by 15.9 per cent by the 2080s, with yields declining 24.3

2 Chris Lang, "The gaping chasm between climate science and climate negotiations", World Rainforest Movement Bulletin, No. 143, June 2009.

3 Global Humanitarian Forum, Human Impact Report, May 2009, http://tinyurl.com/lqvs6v

4 William R. Cline, *Global Warming and Agriculture: Impact Estimates by Country*, Center for Global Development and the Peterson Institute for International Economics, 2007, http://tinyurl.com/nc4hsr

5 John T. Trumble and Casey D. Butler, "Climate change will exacerbate California's insect pest problems," California Agriculture, Vol. 63, No. 2, http://tinyurl.com/m3qf85

per cent in Latin America, 19.3 per cent in Asia (38 per cent in India) and 27.5 per cent in Africa (more than 50 percent in Senegal and Sudan).[6]

But even this dreadful forecast may be an underestimate. Cline's study, like the IPCC report and other major reports dealing with agriculture and climate change, did not factor in the looming water crisis associated with climate change. Currently 2.4 billion people live in highly water-stressed environments, and recent predictions indicate that this number will rise to 4 billion by the second half of this century. Sources of water for agriculture have run out or are running dangerously low in many parts of the world, and global warming is predicted to compound the problem, as higher temperatures generate drier conditions and increase the amount of water needed for agriculture.[7] It is going to get much harder to sustain current levels of food production even as the demand for it grows with increasing populations.[8]

Also outside Cline's forecast are the impacts from the increase in extreme weather that climate change will foster. Droughts, floods and other "natural" disasters are expected to increase in frequency and intensity, wreaking havoc for agriculture. The World Bank forecasts that the intensification of storms caused by climate change will make an additional three million hectares of farmland in coastal areas vulnerable to inundation.[9] At the same time, wild fires, which already affect an estimated 350 million hectares of land each year,[10] are expected to increase dramatically as a result of global warming, creating a serious problem of carbon aerosol pollution, which would further aggravate the greenhouse effect. One study foresees a 50 per cent increase in wild fires in the western USA by 2055 as a result of the predicted increase in air temperature.[11]

And then there is the market to consider. The global food supply is increasingly controlled by a small number of transnational corporations that exert near-monopoly positions all along the food chains – from seeds to supermarkets. The amount of speculative capital in agricultural trade is also on the rise. In this context, any disruptions to the food supply, or even perceived disruptions, lead to tumultuous price increases and extreme profit-taking by the speculators, which makes food inaccessible to the urban poor and derails agricultural production in the countryside.[12] Indeed, talk of a looming global food shortage is already attracting private equity speculators into agriculture and impelling a global farmland grab, the like of which has not been since since the colonial era.[13]

We are moving into an era of severe disruption of food production. There has never been a more pressing need for a system that can ensure that food is distributed to everyone, according to need. Yet never has the world's food supply been more tightly controlled by a small group, whose decisions are based solely on how much money they can extract for their shareholders.

Cooking the planet for dinner

Proponents of the Green Revolution boast of how its basic recipe of uniform plant varieties and chemical fertilisers saved much of the world from starvation. Defenders of the so-called Livestock and Blue (aquaculture) Revolutions sell a similar story about uniform breeds and industrial feeds. The narratives, however, sound less convincing today, with nearly a quarter of the planet going hungry and with crop yields stuck on a plateau since the 1980s. In fact, they read more like horror stories when the environmental consequences are considered, especially as the world learns more about the contribution that these transformations in agriculture and the larger food system make to changing the climate.

The scientific consensus is that agriculture is now responsible for around one third of all human-made GHG emissions. But lumping all forms of farming into a single pile hides the truth. In most agriculture-based countries, agriculture itself makes little contribution to climate change. Those countries with the highest percentages of rural populations and whose economies are most dependent on agriculture tend to make the lowest GHG emissions per capita.[14] For instance, although Canadian agriculture is said to account for only 6 per cent of the country's overall GHG emissions, this works out at 1.6 tonnes of GHG per Canadian, whereas in India, where agriculture is much more important to the national economy, per capita GHG emissions from all sources are only 1.4 tonnes, and only 0.4 tonnes from agriculture.[15] There is a difference therefore in the kind of agriculture that is practised, and one cannot just point a finger at agriculture in general.

Moreover, when we break down agriculture's overall contribution to climate change we see that just a small section of activities account for almost all of agriculture's GHG emissions. Deforestation caused by land use changes account for around half the total, while, with on-farm emissions, the biggest culprits by far are livestock production and fertilisers. All of these sources of GHGs are closely linked to the rise of industrial agriculture

6 William R. Cline, Global Warming and Agriculture: Impact Estimates by Country, Center for Global Development and the Peterson Institute for International Economics, 2007, http://tinyurl.com/nc4hsr

7 According to Cline, evapotranspiration (the combined loss of moisture from soil through evaporation and plants through stomatal transpiration) increases with temperature.

8 According to the report of the IAASTD, irrigation water supply reliability is expected to decline in all regions, with a global decrease from 70% to 58% from 2000 to 2050. International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), Global Report, 2008, http://tinyurl.com/6r82ry

9 Susmita Dasgupta, Benoit Laplante, Siobhan Murray, David Wheeler, "Sea-Level Rise and Storm Surges: A Comparative Analysis of Impacts in Developing Countries," The World Bank, Development Research Group, Environment and Energy Team, April 2009.

10 FAO, "The wildland fire problem", Rome, 27 July 2009, http://tinyurl.com/n4qfcv

11 American Geophysical Union and Harvard University, "Damage, pollution from wildfires could surge as western US warms", 28 July 2009, http://tinyurl.com/l53keg

12 See GRAIN's resources web page on the food crisis, www.grain.org/foodcrisis/

13 See GRAIN's resources web page on the global land grab, www.grain.org/landgrab/

14 Wikipedia, list of countries by carbon dioxide emissions per capita, 1990–2005, http://tinyurl.com/yzh39x

15 Greenpeace Canada, "L'agriculture ... pire que les sables bitumineux! Rapport de Statistique Canada", 10 June 2009, http://tinyurl.com/nkd5pp

Box 1: The roots of deforestation

The reason that land-use change is often lumped in with agriculture in the statistics on factors responsible for climate change is that much of it occurs through the conversion of forest or grassland to crop production or cattle raising. The FAO estimates that 90 per cent of deforestation is caused by agriculture, nearly all of it in developing countries. Even so, farmers are conserving significant areas of forest. A recent study using detailed satellite imagery, carried out by the World Agroforestry Centre, shows that 46 per cent of the world's farmland contains at least 10 per cent tree cover.[1] "The area revealed in this study is twice the size of the Amazon and shows that farmers are protecting and planting trees spontaneously", said Dennis Garrity, the Centre's director-general. These trees already play an important role in protecting farmers against climate change and could help more, particularly as farmers in the tropics have a staggering 50,000 different tree species to choose from. "When crops and livestock fail, trees often withstand drought conditions and allow people to hold over until the next season", said Tony Simons, the Centre's deputy director-general.

There are clearly other important reasons, apart from farming, why forests get cut down. Logging, mining, roads, urban sprawl and dams are also major causes of deforestation. So too is small-scale collection of fuel-wood, which is often driven by lack of access on the part of the poor to public sources of energy. In many countries, deforestation is camouflaged as agricultural development by companies who want to acquire land concessions for the timber. Palm oil and rubber companies are notorious for clearing virgin forest to get at the lumber, while not following through on promises to develop the land for agriculture.[2]

That said, farmers do cut down forests to get at new farm lands. But we have to ask why they do so. Population pressures are only one part of the story. As the World Rainforest Movement has extensively documented, more often the problem is not a lack of agricultural land, but the concentration of land and/or resources in the hands of an elite, or the expulsion of communities to make way for development projects.[3] Deforestation tends to happen when communities lose control over their resources. Where deforestation occurs, there are usually local communities trying to stop it – especially communities of indigenous people. And where poor people clear forest for farmland, they were often pushed off of their former lands – and the odds are that they tried to resist the process, as witnessed by the backlog of court cases and petitions over land conflicts in countries such as Vietnam and China.

Moreover, those converting forests and grasslands to agriculture are not, in many cases, small farmers but transnational corporations (TNC), or large-scale farmers producing for TNCs. The expansion of oil-palm plantations in Indonesia's rain forests or sugar-cane plantations in Brazil's *cerrado* are two obvious examples.[4] Indeed, it is hard to imagine how small farmers could cuase large-scale deforestation when, in many countries, they occupy only a small percentage of the agricultural land. In Latin America, in countries where such data is available, small farmers occupy only 3.5 per cent of the agricultural land in Ecuador, 8.5 per cent in Brazil and 5 per cent in Chile.[5] In Colombia and Peru, where small farmers own most of the farms (82 per cent and 70 per cent, respectively, of the holdings), they occupy only a modest share of the farmed land (14 per cent and 6 per cent, respectively).[6]

1 Robert J. Zomer *et al.*, *Trees on Farm: Analysis of Global Extent and Geographical Patterns of Agroforestry*, ICRAF Working Paper No. 89, World Agroforestry Centre, Nairobi, 2009, http://www.worldagroforestry.org/af/newsroom/for_journalists/agroforestry_assessment_report
2 See for example, Chris Lang, "The expansion of industrial tree plantations in Cambodia and Laos," *Focus Asien*, 26 December 2006, http://chrislang.org/2006/12/26/the-expansion-of-industrial-tree-plantations-in-cambodia-and-laos/
3 See, for example, World Rainforest Movement, "Zambia: Causes of Deforestation linked to government policies", *Bulletin* No. 50, 2001, http://www.wrm.org.uy/bulletin/50/Zambia.html
4 Almuth Ernsting, "Agrofuels in Asia: Fuelling poverty, conflict, deforestation"; GRAIN, "Corporate power: Agrofuels and the expansion of agribusiness", *Seedling*, July 2007, http://www.grain.org/seedling/?type=68
5 Ecuador: Breve análisis de los resultados de las principales variables del censo nacional agropecuario 2000, http://www.sica.gov.ec/censo/contenido/estud_an.htm
III Censo agropecuario del Ecuador, 2000, http://www.sica.gov.ec/censo/docs/nacionales/tabla1.htm
Serafín Ilvay, Foro brasileño por la reforma agraria: "Repartir la tierra y multiplicar el pan", 13 June 2000, http://movimientos.org/cloc/mst-br/show_text.php3?key=10. Censo Agropecuario y Forestal de Chile, www.censoagropecuario.cl
6 Edelmira Pérez Correa and Maniel Pérez Martínez, "El sector rural en Colombia y su crisis actual", redalyc.uaemex.mx/redalyc/pdf/117/11704803.pdf

and the expansion of the corporate food system (*see* Box 1 above, "Earth matters" on p. 9, and "Real problems, false solutions" on p. 23). So too is our food system's heavy reliance on fossil fuels and the significant carbon footprint generated by trucking and shipping inputs and food all around the world, wrapped in all manner of plastics.

Since most of the energy used in the industrial food system comes from fossil fuel consumption, the amount of energy it uses translates directly into the emission of GHGs. The US food system alone is calculated to account for a formidable 20 per cent of the country's fossil fuel consumption. This figure includes the energy used on the farm to

Box 2: Five key steps towards a food system that can address climate change and the food crisis

1. Move towards sustainable, integrated production methods

The artificial separations and simplifications that industrial agriculture has brought upon us have to be undone, and the different elements of sustainable farming systems must be brought together again. Crops and livestock have to be reintegrated on the farm. Agricultural biodiversity has to become the cornerstone of food production again, and local seed saving and exchange systems need to be reactivated. Chemical fertilisers and pesticides must be replaced by natural ways of keeping soil healthy, and pests and diseases in check. The restructuring of the food system along these lines will help to create the conditions for near-zero emissions on farms.

2. Rebuild the soil and retain the water

We have to take the soil seriously again. We need a massive global effort to build organic matter back into the soils, and bring back fertility. Decades of soil maltreatment with chemicals in many places, and mining of soils in others, have left soils exhausted. Healthy soils, rich in organic matter, can retain huge amounts of water, which will be needed to create resilience in the farming system, to deal with the climate and water crises that are already encroaching on us. Increasing organic matter in soils around the world will help to capture substantial amounts of the current excess CO_2 in the atmosphere (see "Earth matters", p. 9).

3. De-industrialise agriculture, save energy, and keep the people on the land

Small-scale family farming should become the cornerstone of food production again. By allowing the build-up of mega-industrial farm operations that produce commodities for the international market rather than food for people, we have created empty countrysides, overpopulated cities, and destroyed many livelihoods and cultures in the process. De-industrialising agriculture would also help to eliminate the tremendous waste of energy that the industrial farming system now produces.

4. Grow close by and cut the international trade

One principle of food sovereignty is to prioritise local markets over international trade. As we have seen, international trade in food, and its associated food processing industries and supermarket chains, are the food system's chief contributors to the climate crisis. All of these can largely be cut out of the food chain if food production is reoriented towards local markets. Achieving this is probably the toughest fight of all, as so much corporate power is concentrated on keeping the trade system growing and expanding, and so many governments are happy to go along with this. But if we are serious about dealing with the climate crisis, this has to change.

5. Cut the meat economy and change to a healthier diet

Perhaps the most profound and destructive transformation that the industrial food system has brought upon us is in the livestock sector. What used to be an integral and sustainable part of rural livelihoods has become a mega-industrial meat factory system spread around the world, but controlled by a few. The international meat economy, which has grown fivefold in recent decades, is contributing to the climate crisis in an enormous way (see p. 27). It has also helped to create the obesity problem in rich countries, and destroyed – through subsidies and dumping – local meat production in poor countries. This has to stop, and consumption patterns, especially in rich countries, have to move away from meat. The world needs to return to a decentralised system of meat production and distribution, organised according to people's needs. Markets that supply meat from smaller farms to local markets at fair prices need to be restored and reinvigorated, and international dumping has to stop.

grow the food, and the post-agricultural processes of transporting, packaging, processing, and storing food. The US Environmental Protection Agency reported that US farmers emitted as much carbon dioxide in 2005 as 141 million cars in the same year! This hopelessly inefficient food system uses 10 non-renewable fossil-fuel calories to produce one single food calorie.[16]

The difference in energy use between industrial and traditional agricultural systems could not be starker. There is much talk of how efficient and productive industrial agriculture is compared with traditional farming in the global South but, if one takes into consideration energy efficiency, nothing could be further from the truth. The FAO calculates that, on average, farmers in industrialised countries spend five times as much commercial energy to produce one kilo of cereal as do farmers in Africa. Looking at specific crops, the differences are even more spectacular: to produce one kilo of maize, a farmer in the US uses 33 times as much commercial

16 Data in this paragraph is from Food & Water Watch, "Fuels and Emissions from Industrial Agriculture", Washington , November 2007, http://tinyurl.com/mdgypy

energy as his or her traditional neighbour in Mexico. And to produce one kilo of rice, a farmer in the US uses 80 times the commercial energy used by a traditional farmer in the Philippines![17] This "commercial energy" that FAO speaks of is, of course, mostly the fossil-fuel oil and gas needed for the production of fertilisers and agrochemicals, and that used by farm machinery, all of which emit substantial amounts of GHGs.[18]

But then, agriculture itself is responsible for only about a quarter of the energy used to get food to our tables. The real waste of energy and the pollution happen in the broader international food system: the processing, packaging, freezing, cooking, and moving of food. Crops for animal feed may be grown in Thailand, processed in Rotterdam, fed to cattle somewhere else, which are then eaten in a McDonalds in Kentucky.

Transporting food consumes huge amounts of energy. Looking at the USA again, it is calculated that 20 per cent of all the commodity transport within the country is to move food, resulting in 120 million tonnes of CO_2 emissions. The US import and export of food accounts for another 120 million tonnes of CO_2. Add to that moving supplies and inputs (fertilisers, pesticides, etc.) to industrial farms, transporting plastic and paper to the packaging industries, and moving consumers to increasingly faraway supermarkets, and we get a picture of the tremendous amount of GHGs produced by the industrial food system's transport requirements alone. Other big GHG producers are the food processing, freezing, and packaging industries, which account for 23 per cent of the energy consumed in the US food system.[19] It all adds up to an incredible waste of energy. And on the subject of waste, the industrial food system discards up to *half* of all the food that it produces, in its journey from farms to traders, to food processors, to stores and supermarkets! This is enough to feed the world's hungry six times over.[20] Nobody has begun to calculate how much GHG is produced by the rotting of all this thrown-away food.

Much of this tremendous global waste and destruction could be avoided if the food system were decentralised and agriculture oriented more towards local and regional markets. Small farmers and consumers would get closer together again, and large agribusiness would be cut out of the food system. Healthier food, happier producers and consumers, and a sustainable planet would be the result.

Yet, as today's decision-makers contemplate what to do in the face of the current food crisis and the accelerating collapse of the planet's life-giving systems, all they offer is more of the same, with the addition of a few useless techno-fixes (*see* p. 22). The corporate food order is thus clearly at a dead end. It proposes industrial agriculture and globalised food chains as a solution to the food crisis. But these activities drive climate change, thereby severely intensifying the food crisis. It is a vicious spiral that spews out extremes of poverty and profits, with the chasm between the two growing ever deeper. It is way past time to overhaul this global food system.

Which way out?

At a most basic level, the climate crisis means that "business as usual" has to stop, now. The profit motive, as an organising principle for our societies, is bankrupt, and we have to build alternative systems of production and consumption organised according to the needs of the people and life on the planet. When it comes to the food system, such a transformation cannot happen when power is vested in corporations, as it currently is. Nor can we trust our governments – as the mismatch between what the scientists say must be done to stop catastrophic climate change and the actions that politicians take becomes ever more preposterous. The force for change rests with us, in our communities, organising to take back control of our food systems and territories.

In the struggle for another food system our main obstacles are political, not technical. We can put seeds back in the hands of farmers, eliminate chemical fertilisers and pesticides, integrate livestock into mixed farms, and organise our food systems so that everyone has enough safe, nutritious food to eat – without plastics. The potential for such a transformation is being borne out by thousands of projects and experiments in communities around the world. Even the World Bank-led International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) has admitted as much. At the farm level, ways for dealing with climate change and the food crisis are pretty straightforward (*see* Box 2).

The political challenges are more difficult. But here, too, much is already happening on the ground. Even in the face of violent repression, local communities are resisting large-scale projects for dams, mines, plantations and timber (*see* Box 3). Although rarely recognised as such, this resistance is at the core of climate action. So too are the movements, such as the movement for food sovereignty, that are coming together to resist the imposition of neo-liberal policies and to develop collective visions for the future. It is in these spaces and through such

17 FAO, "The energy and agriculture nexus", Rome 2000, Tables 2.2 and 2.3, http://tinyurl.com/2ubntj

18 GRAIN, "Stop the agro-fuel craze!", *Seedling*, July 2007, www.grain/seedling/?id=477

19 Data in this paragraph is from Food & Water Watch, "Fuels and Emissions from Industrial Agriculture", Washington , November 2007, http://tinyurl.com/mdgypy

20 Tristram Stuart, "Waste: Uncovering the Global Food Scandal", Penguin, 2009, http://tinyurl.com/m3dxc9

organised resistance that the alternatives to today's destructive food system will emerge, and where we will find the collective strength and strategies to transform power in the food system.

Box 3: The clash of two worlds in the Peruvian Amazon

The Peruvian government chose the symbolic date of World Environment Day to launch a bloody attack on the peoples of the Amazon. The reason for this repression? The steadfast opposition of Amazonian communities to the invasion of their territory by socially and environmentally destructive industries such as mining, oil drilling, and monoculture plantations of trees and agrofuel crops.

On 9 April local communities throughout the Peruvian Amazon had begun what they called an "indefinite strike" in protest against the failure of the Peruvian Congress to review a series of legislative decrees that endanger the rights of indigenous peoples. These decrees were issued by the executive branch in the framework of the implementation of the Free Trade Agreement signed with the United States.

By unleashing this massacre on World Environment Day, Alan García's government showed the world how little concern it has for environmental protection and how highly it values the large corporations that hope to exploit – and simultaneously destroy – the country's natural resources. Even worse, it publicly declared its contempt for the lives of the indigenous people struggling to defend what little has been left to them by the advance of a "development" model that has proved to be socially and environmentally destructive.

As a result of this bloody repression and the public attention it attracted worldwide, the Peruvian Amazon became a symbol of the clash between two different conceptions of the present and future of humanity, played out on the international stage.

On one side of this conflict there is the world of economic interest, which signifies social and environmental destruction, imposition by force, violation of rights. Obviously, this world is not controlled by the Peruvian president, who is merely a temporary and disposable assistant to the corporations – a fact now made evident by the fate of ex-president Fujimori. Nevertheless, the role played by these assistants is very important, since they are the ones who lend the necessary trappings of "legality" to actions that clearly violate the most basic human rights.

On the other side there is the world of those who aspire to a future of solidarity and respect for nature. In this case, they were symbolised by the indigenous people of the Amazon, but they can also be found in similar struggles around the world, confronting other governments who are also at the service of the economic interests of big corporations. To mention just a few examples, we could point to the current struggle in south-east Asian countries to defend the Mekong river – which provides sustenance for millions of people – from destruction by giant hydroelectric dams; the struggle of the peoples of Africa against oil-drilling and logging; the struggle of the tribal peoples of India to protect their forests from mining.

In this confrontation, the hypocrisy of those striving to impose the destructive model seems unbounded. In the case of Peru, President Alan García, who now wants to open up the Amazon to extractive industries, declared just over a year ago that he wanted "to prevent this basic wealth that God has given us from being degraded by the works of man, by the incompetence of those who work the land or exploit it economically, and that is why we created this Ministry of the Environment."

Governmental hypocrisy is evident all around the world, especially with regard to climate change. During an endless international process that began in 1992, the governments of the world agreed that climate change is the worst threat facing humankind. They also agreed that the two main causes of climate change are greenhouse gas emissions created by the use of fossil fuels and deforestation. Finally, they agreed that something must be done about it. After signing the relevant agreements and flying back to their countries, they have done everything in their power to promote oil-drilling and/or deforestation.

Without needing to create ministries of the environment or participate in international processes to combat climate change, people around the world are taking action to defend the environment and the climate. In almost all cases, their actions are criminalised or repressed – in both the South and the North – by those who should be encouraging and supporting them: their governments.

In the now symbolic case of Peru, the peoples of the Amazon – with the support of thousands of citizens around the world – have won an important battle in this clash between two worlds. No one believes that this is the end of the struggle. But it is a victory that provides hope for others fighting for similar goals, and ultimately for the whole world, because the outcome of this confrontation between two worlds will determine the fate of all of humanity.

Edited from the World Rainforest Movement *Bulletin*, No. 143, June 2009

"We know more about the movement of celestial bodies than we do about the soil underfoot"

Leonardo da Vinci

"Look after the soil, and everything else will look after itself"

Farmers' proverb

Earth matters

Tackling the climate crisis from the ground up

GRAIN

Some things have not changed much since da Vinci's time, 500 years ago. For many, soil is a mix of dirt and dust. But in reality soils are one of Earth's most amazing living ecosystems. Millions of plants, bacteria, fungi, insects and other living organisms – most of them invisible to the naked human eye – are in a constantly evolving process of creating, composing and decomposing organic living matter. They are also the unavoidable starting point for anyone who wants to grow food.

Soils also contain enormous amounts of carbon, mostly in the form of organic matter. On a global scale soils hold more than twice as much carbon as is contained in terrestrial vegetation. The rise of industrial agriculture in the past century, however, has provoked, through its reliance on chemical fertilisers, a general disrespect for soil fertility and a massive loss of organic matter from the soil. Much of this lost organic matter has ended up in the atmosphere in the form of carbon dioxide (CO_2) – the most important greenhouse gas.

The way that industrial agriculture has treated soils has been a key factor in provoking the current climate crisis. But soils can also be a part of the solution, to a much greater extent than is commonly acknowledged. According to our calculations, if we could manage to put back into the world's agricultural soils the organic matter that we have been losing because of industrial agriculture, we would capture at least one third of the current excessive CO_2 in the atmosphere. If, once we had done that, we were to continue rebuilding the soils, we would, after about 50 years, have captured about two thirds of the excess CO_2 in the atmosphere. In the process, we would be constructing healthier and more productive soils and we would be able to do away with the use of chemical fertilisers, which are another potent producer of climate change gases.

Via Campesina has argued that agriculture based on small-scale farming, using agro-ecological production methods and oriented towards local markets, can cool the planet and feed the population (*see* Box 1, on p. 10). They are right, and the reasons lie largely in the soil.

Soils as living ecosystems

Soils are a thin layer that covers more than 90 per cent of the land surface of the planet and, contrary

Box 1: Small scale sustainable farmers are cooling down the earth[1]

Current global modes of production, consumption and trade have caused massive environmental destruction, including global warming, which is putting our planet's ecosystems at risk and pushing human communities into disasters. Global warming shows the failure of a development model based on high fossil-energy consumption, overproduction and trade liberalisation.

Via Campesina believes that solutions to the current crisis have to emerge from organised social groups who are developing modes of production, trade and consumption based on justice, solidarity and healthy communities. No technological fix will solve the current global environmental and social disaster. Sustainable small-scale farming is labour-intensive and requires little fuel; it can contribute to cooling down the earth.

All around the world, we practise and defend small-scale sustainable family farming and we demand food sovereignty. Food sovereignty is the right of peoples to healthy, culturally appropriate food produced through ecologically sound, sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems and policies, rather than the demands of markets and corporations. Food sovereignty prioritises local and national economies and markets, and empowers peasant and family farmer-driven agriculture, artisan-style fishing, pastoralist-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability.

We urgently demand of local, national and international decision makers:

- The complete dismantling of agribusiness companies: they steal the land of small producers, produce junk food and create environmental disasters.
- The replacement of industrialised agriculture and animal production by small-scale sustainable agriculture supported by genuine agrarian reform programmes.
- The promotion of sane and sustainable energy policies. This includes consuming less energy, and producing solar and biogas energy on farms – instead of heavily promoting agrofuel production, as is currently the case.
- The implementation of agricultural and trade policies at local, national and international levels supporting sustainable agriculture and local food consumption. This includes a ban on subsidies that lead to the dumping of cheap food on markets.

1 Extracted from La Via Campesina's statement on climate change, http://www.viacampesina.org/main_en/index.php?option=com_content&task=view&id=457&Itemid=37

to what many people think, is a living, dynamic ecosystem. Healthy soil teems with microscopic and larger organisms that perform many vital functions, including converting dead and decaying matter (and minerals) into plant nutrients. Different soil organisms feed on different organic substrata. What distinguishes this living system from dust is that it can retain and slowly provide the nutrients needed by plants to grow. It can store water and slowly release it into rivers and lakes or into the microscopic surroundings of plant roots, so that rivers can run and plants can absorb water long after rain has fallen. If soils did not allow these processes to take place, life on earth as we know it simply wouldn't exist.

A key component of what makes soils function is known as soil organic matter (SOM). It is a mixture of substances that originate from the decomposition of plant and animal materials. It includes substances excreted by fungi, bacteria, insects and other organisms. As manure and dead organisms decompose, they gradually liberate nutrients that can be taken up by plants and used in their growth and development. As all these substances get mixed into the soil, they form new molecules that give the soil new characteristics. Molecules of SOM can absorb up to 100 times as much water as those of dust, and they can retain and later release to plants a similar proportion of nutrients.[1] Organic matter also provides binding molecules that keep soil particles together, thus protecting the soil against erosion and rendering it more porous and less compact. These characteristics are what allows soils to absorb rain and slowly release it to lakes, rivers and plants. They also allow plant roots to grow. As plants grow, more stubble reaches or stays in the soil and more organic matter is formed, thus creating a continuous cycle that accumulates organic matter in the soil. This process has taken place for millions of years, and the accumulation of organic matter in soils was a key factor in lowering the amount of

1 C.C. Mitchell and J.W. Everest, "Soil testing and plant analysis", Southern Regional Fact Sheet, Department of Agronomy & Soils, Auburn University, http://tinyurl.com/lbg6st

CO_2 in the atmosphere millions of years ago, thus making possible the emergence of current forms of life on Earth.

Organic matter is mostly found in the top layer of soil, which is the most fertile. Being on the top, it is prone to erosion and needs to be protected by a plant canopy, which is in turn a permanent source of additional organic matter. Plant life and soil fertility have thus been mutually enhancing processes, and organic matter has been the bridge between the two. But organic matter is also the food of bacteria, fungi, small insects and other organisms that live in the soil. They are the ones that turn manure and dead tissue into nutrients and the amazing substances described above, but they are also the ones that decompose organic substances in the soil. So organic matter must be replenished constantly; if it is not, it will slowly disappear from the soil. When micro-organisms and other living beings in the soil decompose organic matter, they produce energy for themselves and release minerals and CO_2 in the process. For each kilogram of organic matter that decomposes, 1.5 kilograms of CO_2 are released into the atmosphere.

Rural peoples around the world have a deep understanding of soils. They learned through experience that soil has to be cared for, nurtured, fed and rested. Many common practices of traditional agriculture reflect this knowledge. The application of manure, crop residues and compost feed the soil and renovate organic matter. Leaving some land unplanted (fallow) in a system of rotation, especially when spontaneous wild vegetation is encouraged (covered fallow), allows the soil to rest, so that the decomposition processes can take place properly. Limits on tilling, terraces, mulching and other conservation practices protect the soil against erosion, so that organic matter is not washed or blown away. Forest cover is often kept intact, altered as little as possible or mimicked, so that trees can protect the soil against erosion and provide additional organic matter. At those times in history when these practices have been forgotten or laid aside, a high price has been paid. This seems to have been one of the main causes of the disappearance of the Maya kingdom in Central America. It may have also been behind a number of crises in the Chinese empire, and it is certainly a central cause of the dust bowl in the United States and Canada.

The industrialisation of agriculture and the loss of soil organic matter.

The industrialisation of agriculture, which started in Europe and North America and was later replicated in the Green Revolution that took place in other parts of the world, was based on the assumption that soil fertility can be maintained and increased through the use of chemical fertilisers. Little attention was paid to the importance of organic matter in the soil. Decades of industrialisation in agriculture and the imposition of industrial technical standards on small farming have weakened the processes that ensure that soils obtain new supplies of organic matter and that protect the organic matter already stored in the soil from being washed or blown away. The effects of not renovating organic matter and applying fertilisers initially went unnoticed because of the large stocks of organic matter within the soils. But over time, as these stocks have been depleted, the effects have become more visible -- with devastating consequences in some parts of the world. From a global point of view, the pre-industrial equilibrium between air and soils was that for every tonne of carbon in the air, approximately 2 tonnes existed in soils. The current ratio is down to approximately 1.7 tonnes in soils for each tonne in the atmosphere.[2]

Soil organic matter is measured in percentages. One per cent means that in every kilogram of soil, 10 grams are organic matter. Depending on soil depth, this is equivalent to 20–80 tonnes per hectare. The amount of organic matter necessary to ensure fertility varies widely, according to how the soil was formed, what other components it has, climatic conditions, and so on. It can be said, however, that generally 5 per cent organic matter is a good minimum for healthy soil, but for some soils the best growing conditions will be reached only when the organic matter content is more than 30 per cent.

Photo: Practical Action

Crops destroyed by drought

2 Y.G. Puzachenko et al., "Assessment of the Reserves of Organic Matter in the World's Soils: Methodology and Results", *Eurasian Soil Science*, Vol. 39, No. 12, 2006, pp. 1284–96, http://tinyurl.com/npd648

Box 2: The growing problem with industrial fertilisers

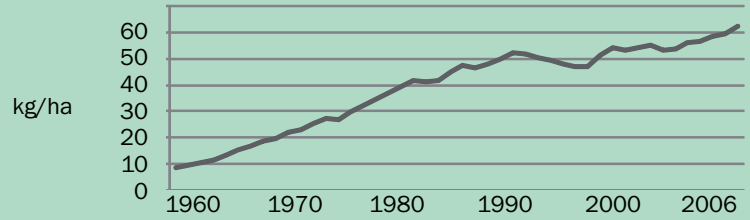
An important factor in the destruction of soil fertility has been the tremendous global increase in the use of chemical fertilisers in farming, with consumption more than quintupling since 1961.[1] Graph 1 tracks the increase of world consumption of nitrogen per hectare, a seven-fold increase since the 1960s.[2] But a lot of this extra nitrogen does not reach the plants, and ends up in groundwater or the air. The more nitrogen fertiliser is applied, the less efficient it becomes. Graph 2 shows the relationship between yields and nitrogen fertiliser consumption for corn (maize), wheat, soya and rice, the four crops that cover almost a third of all cultivated land. For all of them, the yield per kilo of nitrogen applied is today about one third of what it was in 1961, when fertiliser use started to expand worldwide.

The ever decreasing efficiency of industrial fertilisers should come as no surprise. Soil experts and farmers have long known that chemical fertilisers destroy soil fertility by destroying organic matter. When chemical fertilisers are applied, soluble nutrients become immediately available in huge amounts, provoking a surge of microbial activity and multiplication. This increased microbial activity, in turn, speeds up the decomposition of organic matter, as it is consumed at high speed, and CO_2 is released into the atmosphere. When nutrients from fertilisers become scarce, most micro-organisms die, and the soil is left with less organic matter. As this process has been going on for decades, and is reinforced by tilling, soil organic matter is depleted. It is made worse because the same technological approach that promotes chemical fertilisers rules that crop residues should be discarded or burnt, not put back into the soil.

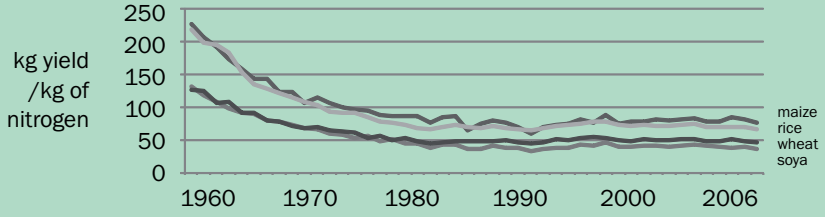
As soils lose organic matter, they become more compact, absorb less water and have a diminished capacity to retain nutrients. Roots grow less and have less capacity to absorb nutrients, nutrients are more easily lost from the soil, and less water in the soil is available for growth. The result is that the use of nutrients from fertilisers becomes less and less efficient, and the only way to overcome such inefficiency is to increase fertiliser doses, as world trends show. But increased application only compounds the problem; inefficiency and soil destruction continue apace. It is not uncommon to hear organic farmers say that they turned organic because their yields collapsed after years of heavy industrial fertiliser use.

Problems with industrial fertilisers do not end there. The forms of nitrogen provided by chemical fertilisers are readily transformed in the soil, so that nitrous oxides are emitted into the air. Nitrous oxides have a greenhouse effect more than two hundred times as strong as that of CO_2,[3] and they are responsible for more than 40 per cent of the greenhouse effect caused by current agricultural practices. Worse, nitrous oxides also destroy the ozone layer.

Graph 1: Increasing nitrogen fertilisation: from a world average of 8.6 kg/ha in 1961 to 62.5 kg/ha in 2006.[4]



Graph 2: For each kg of nitrogen applied, 226 kg of maize were obtained in 1961, but only 76 kg in 2006. The figures were, respectively, 217 and 66 kg for rice, 131 and 36 kg for soya, and 126 and 45 kg for wheat.[5]



1 See website of the International Fertilizer Industry Association (IFA), http://www.fertilizer.org/ifa/Home-Page/STATISTICS
2 Data obtained by GRAIN based on statistics provided by IFA (see note 1), and FAO, http://faostat.fao.org/default.aspx
3 P. Forster *et al.*, "Changes in Atmospheric Constituents and Radiative Forcing", in S. Solomon *et al.* (eds), *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, London and New York, Cambridge University Press, 2007, p. 212.
4 Data from IFA website (see note 1)
5 Data obtained by GRAIN based on statistics provided by IFA (see note 1) and FAO (see note 2).

According to a wide range of studies, agricultural soils in Europe and the United States have lost, on average, 1–2 percentage points of organic matter in the top 20–50 cms.[3] This figure may well be an underestimate, as most often the point of comparison is the organic matter level in the early twentieth century, when many soils had already been subjected to industrialised processes, and could have already lost large amounts of organic matter. Some soils in the agricultural mid-west in the USA contained 20 per cent carbon in the 1950s, and are now down to a mere 1–2 per cent.[4] Studies in Chile, Argentina,[5] Brazil,[6] South Africa,[7] and Spain[8] report losses of up to 10 percentage points. Data provided by researchers of the University of Colorado indicate that the world average for organic matter loss in cultivated land is 7 percentage points.[9]

The climate calculation

Let us suppose, as a conservative estimate, that soils around the world have lost, on average, 1–2 percentage points of organic matter in the top 30 cm since the beginning of industrial agriculture. This would amount to some 150,000–205,000 million tonnes of lost organic matter. If we were to manage to put this organic matter back into the soil, we would take 220,000–330,000 million tonnes of CO_2 from the air. This represents a remarkable 30 per cent of the current excess CO_2 in the atmosphere. Table 1 summarises the data.

In other words, actively recovering SOM would effectively cool the planet, and the cooling potential is significantly higher than that presented in these figures, as many soils could store – and benefit from – a larger amount of organic matter than the 1–2 percentage point recuperation rate used in this example.

Can it be done? Bringing organic matter back into the soil

The industrialisation of farming that has destroyed SOM has been going on for more than a century in industrialised countries. The global process, however, really started with the Green Revolution in the 1960s. So the question is: how long would it take to counteract the effects of, say, 50 years of soil deterioration? Recovering one percentage point of SOM means that around 30 tonnes of organic matter per hectare would have to enter the soil and remain there. But, on average, around two thirds of organic matter added to agricultural soils will be decomposed by soil organisms (and the resulting minerals will feed the crops), so in order to add permanently 30 tonnes of SOM, a total of 90 tonnes of organic matter per hectare would be needed. This cannot be done quickly. A gradual process is required.

What is the realistic amount of organic matter that farmers throughout the world could incorporate into the soil? The answer will vary widely from place to place, from cropping system to cropping system, and from one ecosystem to another. A production system that relies exclusively on annual, non-diversified crops can provide 0.5–10 tonnes of organic matter per hectare per year. If the cropping system is diversified, and pastures and green manures are incorporated, that amount can easily be doubled or tripled. If animals are added, the amount of organic matter will not necessarily increase, but it will make the cultivation of pastures and green manures economically feasible and profitable. Moreover, if trees and wild plants are also managed as part of the cropping system, not only will crop production increase but additional organic matter will also be produced. As organic matter increases in the soil, soil fertility will

Table 1: Capturing carbon dioxide by building soil organic matter (SOM)

CO_2 in the atmosphere[1]	2,867,500 million tonnes
Excess CO_2 in the atmosphere[2]	717,800 million tonnes
World's agricultural land[3]	5,000 million hectares
World's cultivated land[4]	1,800 million hectares
Typical reported SOM loss in cultivated land	2 percentage points
Typical reported SOM loss in prairies and non-cultivated land	1 percentage point
Amount of organic matter lost from the soils	150,000–205,000 million tonnes
Amount of CO_2 that would be sequestered if these losses were recuperated	220,000–300,000 million tonnes

1 See Carbon Dioxide Information Analysis Center, http://cdiac.ornl.gov/pns/graphics/c_cycle.htm
2 Calculations based on concentration changes over time.
3 Information from FAOSTAT, http://faostat.fao.org/site/377/default.aspx#ancor
4 Ibid.
Source: GRAIN calculations

3 R. Lal and J.M. Kimble, "Soil C Sink in U.S. Cropland", http://tinyurl.com/muurmc P.Bellamy. "UK losses of soil carbon – due to climate change?", Natural Resources Department, Cranfield University, http://tinyurl.com/l9zcjx

4 Tim J. LaSalle and Paul Hepperly, "Regenerative Organic Farming: a solution to global warming", Rodale Institute, 2008, http://tinyurl.com/mle5nq

5 I. Gasparri, R. Grau, E. Manghi. "Carbon Pools and Emissions from Deforestation in Extra-Tropical Forests of Northern Argentina Between 1900 and 2005", abstract available at http://tinyurl.com/ljrjyo J. Galantini. "Materia Orgánica y Nutrientes en Suelos del Sur Bonaerense. Relación con la textura y los sistemas de producción" http://tinyurl.com/nkjhfh

6 Carlos C. Cerri, "Emissions due to land use changes in Brazil", EU Conference on Soil and Climate Change, 12 June 2008, http://tinyurl.com/m3dmyz

7 C. S. Dominy, R. J. Haynes, R. van Antwerpen, "Loss of soil organic matter and related soil properties under long-term sugarcane production on two contrasting soils", *Biology and Fertility of Soils*, Vol. 36, No. 5, November 2002, pp. 350–56, abstract available at http://tinyurl.com/kp9gav

8 E. Noailles and A. de Veiga, "Pérdida de Fertilidad de un Suelo de Uso Agrícola", Instituto de Suelos, Argentina, abstract available at http://tinyurl.com/nc92cl

9 K. Paustian, J. Six, E.T. Elliott and H.W. Hunt, "Management options for reducing CO_2 emissions from agricultural soils", *Biogeochemistry*, Vol. 48, No. 1, January 2000, pp. 147–63, abstract available at http://tinyurl.com/nlzekf

Box 3: The NPK mentality – poor soils, poor food

We now know that plants absorb 70–80 different minerals from a healthy soil, while most chemical fertilisers add no more than a handful. In the mid-nineteenth century, German chemist Justus von Liebig conducted experiments in which he analysed the composition of plants in order to understand which elements were essential for their growth. His primitive equipment identified only three: nitrogen, phosphorus and potassium, known by their chemical symbols as NPK. Although von Liebig later acknowledged that many other minerals are present in plants, his experiments laid the foundations for a lucrative agrochemical industry, which sells NPK fertilisers to farmers with the promise of miraculously increased yields. NPK fertilisers have certainly revolutionised agriculture, but at the cost of a tragic degradation of the quality of the soil and our food.

In 1992, the official report of the Rio Earth Summit concluded "there is deep concern over continuing major declines in the mineral values in farm and range soils throughout the world". This statement is based on data showing that, over the last 100 years, average mineral levels in agricultural soils had fallen worldwide, by 72 per cent in Europe, 76 per cent in Asia and 85 per cent in North America. Most of the blame lies with the massive use of the artificial chemical fertilisers instead of more natural methods of promoting soil fertility. Apart from the direct depletion that the NPK mentality provoked, chemical fertilisers also tend to acidify the soil, thus killing many soil organisms that play a role in converting soil minerals into chemical forms that plants can use. Pesticides and herbicides can also reduce the uptake of minerals by plants, as they kill certain kinds of soil fungi that live in symbiosis with plant roots (called mycorrhiza). The micorrhiza symbiosis give plants access to a vastly greater mineral extraction system than is possible by their roots alone.

The net result of all of this is that most of the food we eat is mineral-deficient. In 1927, researchers at the University of London's King's College started to look into the nutrient content of food. Their analyses have been repeated at regular intervals since, giving us a unique picture of how the composition of our food has changed over the last century. The table summarises their alarming results: our food has lost 20–60 per cent of its minerals.

Reduction in average mineral content of fruit and vegetables in the UK between 1940 and 1991

Mineral	Vegetables	Fruit
Sodium	–49%	–29%
Potassium	–16%	–19%
Magnesium	–24%	–16%
Calcium	–46%	–16%
Iron	–27%	–24%
Copper	–76%	–20%
Zinc	–59%	–27%

A new study published in 2006 shows that mineral levels in animal products have suffered a similar decline. Comparing levels measured in 2002 with those present in 1940, the iron content of milk was found to have declined by 62 per cent, while calcium and magnesium in Parmesan cheese had each fallen by 70 per cent, and copper in dairy produce had plummeted by a remarkable 90 per cent.

From: Marin Hum, "Soil mineral depletion", in *Optimum nutrition*, Vol. 19, No. 3, Autumn 2006.

improve and more organic matter will become available. When they start converting to organic farming, many farmers incorporate fewer than 10 tonnes per hectare per year, but they may end up after a few years producing and adding up to 30 tonnes of organic matter per hectare.

So, if proactive agricultural policies and programmes were drawn up to promote the widespread incorporation of organic matter into the soil, initial goals might have to be rather modest, but progressively more ambitious goals could be set. Table 2 gives an example of how organic matter could be incorporated into the soil.

The example is completely feasible. Today agriculture around the world produces each year at least two tonnes of usable organic matter per hectare. Annual crops alone produce more than one tonne per hectare,[10] and recycling urban organic waste and waste water could add approximately 0.2 tonnes per hectare.[11] If the recuperation of SOM became a central goal of agricultural policies, it would be perfectly possible and reasonable to set as an initial

10 Calculations by GRAIN based on world production of annual crops. Figures obtained using data provided by J.B. Holm-Nielsen (http://tinyurl.com/l4nqra) and the Oak Ridge National Laboratory of the US Department of Energy (http://tinyurl.com/t4x96) at least double the amount of annual crop residues. The same figures can be arrived at using data provided by the University of Michigan at http://tinyurl.com/38mrkw

goal the incorporation on average throughout the world of 1.5 tonnes per hectare per year. The new scenario would require a change in approach, with the use of techniques such as diversified cropping systems, better integration between crop and animal production, increased incorporation of trees and wild vegetation, and so on. Such an increase in diversity would, in turn, increase the production potential, and the incorporation of organic matter would progressively improve soil fertility, creating virtuous cycles of higher productivity and higher availability of organic matter. The capacity of soil to hold water would increase, which would mean that excessive rainfall would lead to fewer, less intense floods and droughts. Soil erosion would become less of a problem. Soil acidity and alkalinity would fall progressively, reducing or eliminating the toxicity that has become a major problem in tropical and arid soils. Additionally, increased soil biological activity would protect plants against pests and diseases. Each one of these effects implies higher productivity and hence more organic matter available to soils, thus making possible, as the years go by, higher targets for SOM incorporation. More food would be produced in the process.

But even the very modest initial goal would have far-reaching effects. As Table 2 shows, the process would start with the annual incorporation of 1.5 tonnes of organic matter in the first 10 year period, which means that 3,750 million tonnes of CO_2 would be captured each year. This is about 9 per cent of the current total annual human-made emissions.[12] Two other forms of reduction in greenhouse gases (GHGs) would simultaneously take place. First, nutrients equivalent to more than all of current world fertiliser production would be captured in the world's agricultural soils.[13] The elimination of the current production and use of chemical fertilisers would have the potential to reduce yet further GHG emissions by reducing both emissions of nitrous oxide (equivalent to approximately 8 per cent of all GHG emissions and, after deforestation, by far the most important contribution made by agriculture to the greenhouse effect) and the worldwide production and transportation of fertilisers, which is currently responsible for more than 1 per cent of world GHG emissions.[14] Second, if organic waste was returned to agricultural soils, methane and CO_2 emissions from landfills and waste water (equivalent to 3.6 per cent of total current emissions)[15] could be significantly reduced. In sum, even such a modest start would have the potential to reduce global GHG emissions by approximately 20 per cent per year.

And we are talking only about the first ten years. Table 2 shows that, if we were to increase progressively the reincorporation of organic matter into our agricultural soils, within 50 years we would increase the share of organic matter in the soil by two percentage points. This is about the same amount of time that was taken to reduce it. In the process we would have captured 450 billion tonnes of CO_2, more than two thirds of the current excess CO_2 in the atmosphere!

It can be done, but it needs the right policies

The climate crisis requires a political response, with many broad social and economic changes. Even though the recuperation of SOM is a feasible and beneficial way to cool the earth, climate change will continue to accelerate unless we have fundamental changes in our patterns of production and consumption. The process of returning organic matter to the soil will not be possible if current trends towards increased land concentration and

Table 2. Impact of the progressive incorporation of soil organic matter (SOM) into world's agricultural soils

number of years	1–10	11–20	21–30	31–40	41–50
Tonnes of organic matter incorporated (per hectare per year)	1.5	3	4	4.5	5
Total organic matter incorporated in world's agricultural land by the end of the period (cumulative, in million tonnes)	75,000	225,000	425,000	650,000	900,000
Average increase of organic matter in the soil at the end of the period (in percentage points)	0.15	0.50	0.94	1.4	2.0
Total CO_2 captured per year (in million tonnes)	3,750	7,500	10,000	11,250	12,500
Total CO_2 captured across the period (cumulative, in million tonnes)	37,500	112,500	212,500	325,000	450,000

Source: GRAIN calculations

11 Calculations based on figures provided by K.A. Baumert, T. Herzog and J. Pershing, "Navigating the Numbers: Greenhouse Gas Data and International Climate Policy", World Resources Institute, http://tinyurl.com/m5e7kb

12 Calculations based on figures provided by the Greenhouse Gas Bulletin No. 4, http://tinyurl.com/m4apxz

13 Calculations based on the following contents of nutrients in organic matter and efficiency of recovery: nitrogen: 1.2–1.8%, 70% efficiency; phosphorus: 0.5–1.5%, 90% efficiency; potassium: 1.0–2.5%, 90% efficiency.

14 See "Navigating the Numbers: Greenhouse Gas Data and International Climate Policy", World Resources Institute, http://tinyurl.com/m5e7kb

15 *Ibid.* See also http://tinyurl.com/lfrcx4

Box 4: Climate solutions from organic farming

For more than 50 years, the Rodale Institute in Pennsylvania, USA, has been carrying out research into organic farming. Nearly 30 years of Rodale Institute soil carbon data show conclusively that improved global terrestrial stewardship – including regenerative organic agricultural practices – is the most effective available strategy for mitigating CO_2 emissions. Below are some of their impressive conclusions.[1]

> "During the 1990s, results from the Compost Utilisation Trial (CUT) at Rodale Institute – a 10-year study comparing the use of composts, manures and synthetic chemical fertiliser – show that the use of composted manure with crop rotations in organic systems can result in carbon sequestration of up to 2,000 lb/acre/year. By contrast, fields under standard tillage relying on chemical fertilizers, lost almost 300 lb of carbon per acre per year. Storing – or sequestering – up to 2,000 lb/acre/year of carbon means that more than 7,000 lb of carbon dioxide are taken from the air and trapped in that field soil.
>
> In 2006, US carbon dioxide emissions from fossil fuel combustion were estimated at nearly 6.5 billion tons. If 7,000 lb/CO_2/ac/year sequestration rate was achieved on all 434 million acres of cropland in the United States, nearly 1.6 billion tons of carbon dioxide would be sequestered per year, mitigating close to one quarter of the country's total fossil fuel emissions."
>
> "Agricultural carbon sequestration has the potential to substantially mitigate global warming impacts. When using biologically based regenerative practices, this dramatic benefit can be accomplished with no decrease in yields or farmer profits. Even though climate and soil type affect sequestration capacities, these multiple research efforts verify that practical organic agriculture, if practised on the planet's 3.5 billion tillable acres, could sequester nearly 40 per cent of current CO_2 emissions."

1 From: Tim J. LaSalle and Paul Hepperly, *Regenerative Organic Farming: A Solution to Global Warming*, Rodale Institute, 2008, http://www.rodaleinstitute.org/files/Rodale_Research_Paper-07_30_08.pdf

homogenisation of the food system continue. The daunting goal of returning to the soil over 7 billion tonnes of organic matter every year will be feasible only if it is undertaken jointly by millions of farmers and farming communities. This, first and foremost, requires fundamental agrarian reforms that give small farmers – the vast majority of farmers around the world – access to land, and makes it economically and biologically possible for them to make the necessary crop rotations, covered fallow and the formation of pastures. It also requires dismantling current anti-farmer policies that drive farmers off the land, such as laws that foster the monopolisation and privatisation of seeds, and regulations that protect corporations but kill off traditional food systems. The global growth of hyper-concentrated industrial animal production – which creates mountains of manure and lakes of slurry that spew millions of tonnes of methane and nitrous oxide into the air – must be reversed and replaced by decentralised animal husbandry integrated with crop production. As we show in other articles in this issue of *Seedling*, the current international food system, one of the central drivers of climate change, requires nothing short of a complete overhaul. If this is done, then the climate crisis has a possible solution: the soil.

Box 5: Building organic matter: fungi at work

> "Researchers are fleshing out the mechanisms by which soil carbon sequestration takes place. One of the most significant findings is the high correlation between increased soil carbon levels and very high amounts of mycorrhizal fungi. These fungi help to slow down the decay of organic matter. Beginning with our Farming Systems Trial, collaborative studies by the USDA's Agriculture Research Service (ARS), led by Dr David Douds, show that the biological support system of mycorrhizal fungi are more prevalent and diverse in organically managed systems than in soils that depend on synthetic fertilisers and pesticides. These fungi work to conserve organic matter by aggregating organic matter with clay and minerals. In soil aggregates, carbon is more resistant to degradation than in free form, and thus more likely to be conserved. These findings demonstrate that mycorrhizal fungi produce a potent glue-like substance called glomalin that stimulates increased aggregation of soil particles. This results in an increased ability of soil to retain carbon."[1]

1 From: Tim J. LaSalle and Paul Hepperly, *Regenerative Organic Farming: A Solution to Global Warming*, Rodale Institute, 2008, http://www.rodaleinstitute.org/files/Rodale_Research_Paper-07_30_08.pdf

Until now, agriculture has been largely excluded from global carbon markets, but this is set to change in December 2009 at the Copenhagen conference. Agribusiness companies are lobbying hard to make a range of farming activities eligible for future funding under the Clean Development Mechanism (CDM). As a result, billions of dollars will almost certainly be invested in agriculture, mainly livestock production and plantations. What makes this prospect so alarming is that this huge investment, carried out in the name of mitigating the climate crisis, will be channelled largely to big agribusiness. And it is precisely their approach to farming and food production that has created so many of the problems we face today.

* This is a version, shortened and edited by GRAIN, of part of "Agriculture and climate change: real problems, false solutions" – preliminary report by the Grupo de Reflexión Rural, Biofuelwatch, EcoNexus and NOAH–Friends of the Earth Denmark", http://www.econexus.info/pdf/agriculture-climate-change-june-2009.pdf

The agribusiness lobby arrives in Copenhagen

GRUPO DE REFLEXIÓN RURAL, BIOFUELWATCH, ECONEXUS, NOAH–FOE DENMARK*

In 2008 a record 4.9 billion tonnes of carbon dioxide equivalent (CO_2e) emission reductions were traded on global carbon markets. Overall, carbon trading increased by 83 per cent in just one year.[1] This trading, however, has not led to a reduction in emissions: since the Kyoto Protocol came into force in 2005, global CO_2 emissions have continued to rise.[2] The growing carbon markets have not even led to emission reductions in the so-called Annex 1 countries, that is, the industrialised nations that are committed to reducing their greenhouse gas emissions under the Kyoto Protocol. Instead, the world is now on course for the worst emissions scenario predicted by the Intergovernmental Panel on Climate Change (IPCC), or perhaps one that is even worse than that.[3] Peter Atherton of Citigroup, which is strongly involved in carbon trading, admitted in 2007 that, while the parties involved had found the activity highly profitable, the world's biggest carbon market had failed in its basic objective: "The European Emissions Trading Scheme has done nothing to curb emissions."[4]

Photo: Asian Peasant Coalition (APC)

Protesters outside UN climate talks, the Philippines, September 2009

1 "Carbon Market Up 83% In 2008, Value Hits $125 Billion", *Environmental Leader*, 14 January 2009, http://tinyurl.com/lodm9m

2 According to the Netherlands Environment Assessment Agency, global CO_2 emissions increased from 22.5bn tonnes in 1990 to 31.5bn tonnes in 2008. http://tinyurl.com/kmsh4r

3 "Key Messages from the Congress", International Scientific Congress – Climate Change: Global Risks, Challenges & Decisions, University of Copenhagen, 12 March 2009, http://tinyurl.com/acne8f

4 Citigroup Global Markets (2007), quoted in L. Lohmann, "Governance as Corruption", presentation, Athens, November 2008, http://tinyurl.com/lvlzso

Photo: Practical Action

A Maasai herdsman leads his animals to find water. The Maasai Mara region of Kenya has not had proper rains – which usually occur in April and October – for several years.

The Clean Development Mechanism (CDM) is an arrangement under the Kyoto Protocol that allows Annex 1 countries[5] to invest in projects that reduce emissions in developing countries as an alternative to more expensive reduction of emissions in their own countries. The CDM plays a crucial role within the carbon markets because CDM credits can be traded on other carbon markets, including the European Emissions Trading Scheme, which accounts for two thirds of all carbon trading. The only exception is CDM credits for "afforestation and reforestation", which cannot at present be traded under the European scheme. The CDM has come under sustained criticism: for funding projects that are not "additional" and would have gone ahead anyway; for "being routinely abused by chemical, wind, gas and hydro companies who are claiming emission-reduction credits for projects that should not qualify";[6] and for funding projects which actually increase greenhouse gas emissions, such as hydro dams.[7] Nonetheless, the great majority of proposals for a post-2012 climate change agreement involve a major expansion of the CDM and a further weakening of existing safeguards.

Before the Kyoto Protocol came into force, a decision was taken not to include soil "carbon sinks" under the CDM, largely because of the uncertainties involved in, for example, measuring carbon dioxide fluxes and nitrous oxide emissions linked to no-till monoculture. Only around 6 per cent of CDM credits have gone to agriculture, with almost all of the funded activities outside mainstream farming. Significant funding has been channelled to biomass energy projects in the farming sector: the big winners have been livestock manure management (including biogas from swine manure), heat generation from palm-oil effluents and the use of agricultural residues for biomass. In 2007, for example, 90 per cent of all approved CDM projects in Malaysia benefited palm oil companies; in Mexico half of all CDM projects are pig farms. This arrangement has meant, however, that big agribusiness firms like Monsanto have so far obtained very little funding through carbon markets and none through the CDM, despite a long-standing lobbying campaign for no-till GM monocultures to be classified as a way of sequestering carbon and reducing emissions. At the moment, there is no CDM methodology for calculating the possible reductions in greenhouse gases stemming from no-till farming as such. So far, only one large carbon trading scheme, the Chicago Climate Exchange, has included agriculture and specifically no-till farming. In Saskatchewan, a pilot project was set up in 2005 which allowed trading in credits from no-till farming, but this was later abandoned.

For similar reasons, CDM credits for soil carbon sequestration from cropland or forest management

5 Most Annex 1 countries (but not the USA) ratified the Protocol, thus committing themselves to reducing their emissions of six GHGs by at least 5% below 1990 levels over the period 2008–12.

6 J. Vidal, "Billions wasted on UN climate programme", Guardian, 26 May 2008.

7 J. Langman, "Generating Conflict", Newsweek International, 13 September 2008.

8 See James Jacob, "The Kyoto Protocol and the Indian natural rubber sector", paper available at http://tinyurl.com/nxbqtm

9 Bronwyn Herbert, "Opposition supports biochar research", The 7.30 Report, Australian Broadcasting Corporation, 26 January 2009, http://tinyurl.com/mu5yf6

10 UNFCCC, "Use of charcoal from planted renewable biomass in the iron ore reduction process through the establishment of a new iron ore reduction system", http://tinyurl.com/lpbmbl

were ruled out in 2003.[8] Only the Chicago Climate Exchange and a few carbon offsetting companies and schemes, such as C-Lock Technology Canada, provide carbon credits for soil carbon sequestration. Carbon Farmers of Australia have set up the Australian Soil Carbon Grower Register and are lobbying for carbon credits for soil, but as yet these are not being traded. Moreover, the Australian government has reacted sceptically to calls by opposition politicians to support carbon credits for biochar and other soil carbon sequestration methods, saying that the technology is as yet unproven.[9] Nor has the agrofuel industry profited from carbon trading as yet. So far, no agrofuel CDM project, using biomass from crops and trees grown for this purpose or from vegetable oil (other than waste vegetable oil) has been approved. This could soon change, however: the Brazilian company Plantar has just had a new methodology approved for using charcoal made from eucalyptus plantations to produce pig iron.[10] Local communities and human rights organisations have long opposed Plantar's plantations for the damage they have caused to people, biodiversity and freshwater resources, but their concerns have been ignored because of the allegedly more pressing need to combat global warming.[11]

Photo: GRAIN

Onshore fishers contemplate a morning's meagre catch, Kerala, south India, 2008.

Much bigger role for agriculture

In the negotiations under way for the 15th Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC), to be held in Copenhagen in December 2009, the idea that industrial agriculture has an important role to play in both mitigation (that is, measures to deal with the causes of climate change) and adaptation (that is, measures to tackle its effects) is being strongly promoted.[12] Leading bodies, including both the International Food Policy Research Institute (IFPRI) and the United Nations Food and Agriculture Organisation (FAO), believe that the exclusion of agriculture should be lifted in the new Copenhagen treaty. Earlier this year FAO issued a press release saying it "has urged policy makers to include agriculture in negotiations for a new climate change treaty".[13] It observes that "soil carbon sequestration, through which nearly 90 per cent of agriculture's climate change potential could be realised, is outside the scope of the Clean Development Mechanism", and claims that, if this were changed, "millions of farmers around the globe could also become agents of change helping to reduce greenhouse gas emissions."[14] Proposals for mitigation include the practice of no-till farming, a move to a "bioeconomy" (where all types of fossil fuel use are increasingly replaced with biomass, including second-generation agrofuels, large-scale wood burning, bioplastics, and so on),[15] and the further intensification of the livestock industry to reduce its greenhouse gas emissions. Proposals for adaptation are largely focused on the development and cultivation of a new generation of genetically modified crops that are "climate ready". At the same time, the United Nations Convention to Combat Desertification (UNCCD), supported by a number of African countries and Belize, is promoting biochar for carbon sequestration and as a soil additive.[16] Biochar, which is fine-grained charcoal applied to soils, is a by-product of technology which processes biomass into bioenergy which can be refined further into so-called second-generation agrofuels. Making biochar eligible for funding under the CDM would thus be warmly welcomed by the companies that have developed this technology.

As a result of this lobbying, it is now being proposed that:

- agriculture should be fully included in the negotiations for the new climate treaty;
- agriculture should be paid for its environmental services, mainly through carbon markets and possibly through inclusion into REDD-plus (Reducing Emissions from Deforestation and Degradation-plus);
- special emphasis should be given to carbon sequestration in the soil, including CDM status for biochar.

FAO sees the inclusion of agriculture in the climate treaty as hugely positive, freeing up resources for the "massive investments in agriculture" needed "to change unsustainable production methods, to train farmers in climate change mitigation practices and

11 See "The Carbon Connection", Carbon trade watch, http://tinyurl.com/bzgyjn

12 See IPCC (2001): Climate Change 2001: Mitigation. Annex II Glossary. http://tinyurl.com/nl54rv

13 "Climate change talks should include farmers", FAO media centre press release, 2 April 2009, http://tinyurl.com/kn29eb

14 *Ibid.*

15 Crop plants used as fuels are often described as "biofuels". In this article we use the term "agrofuel" to make it clear that we are referring to agricultural crops grown as fuel and produced for the market. For details on the relationship between agrofuels and climate change, see also Chapter 1 of *Agrofuels: towards a reality check in nine key areas*, a report published by Biofuelwatch and other organistions in June 2007, http://tinyurl.com/mjkl5o

16 Submission by the United Nations Convention to Combat Desertification, 5th Session of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA 5), Bonn, Germany, 29 March–8 April 2009, http://tinyurl.com/mlvvrb Submission of African Governments (The Gambia, Ghana, Lesotho, Mozambique, Niger, Senegal, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe) to the 5th Session of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA 5), Bonn, Germany, 29 March -April 2009, http://tinyurl.com/ktu7px

Photo: Practical Action

Severe flooding in Bangladesh

to improve overall access to credit". FAO goes on: "These investments will make agriculture more resilient to climate change and at the same time will improve agricultural productivity and sustainability, thus contributing to better food security and poverty reduction."

Carbon market bubble

The view espoused by FAO ignores a swathe of problems. To begin with, the measuring and certification of the reduction in emissions from agricultural practices and the regulation of such a market will be a big challenge in itself. A large number of agricultural activities could potentially benefit, and it is impossible to predict how much money would be raised. More importantly, the very existence of such a market will free the industrialised countries and their industries from their obligation to reduce their own emissions. In other words, trading schemes in agriculture will not address the fundamental problem of the world continuing to promote a model of permanent economic growth on a planet that has finite resources. Having just experienced the impact of the sudden collapse of a subprime property market, we now run the risk of building a carbon market bubble, the existence of which would have the devastating impact of diverting resources away from the funding of meaningful responses to the climate crisis.[17]

The most worrying impact of all of these proposals is that they will further promote industrial farming. Very often companies argue that they can isolate single elements of very specific traditional or indigenous farming methods and then scale them up and integrate them into industrial farming. Biochar is cited as an example. The companies claim that, by doing this, they will increase yields and thus reduce pressure on fragile ecosystems. But as the climate crisis gains momentum and the world faces growing problems of drought, heat waves, soil erosion and extreme weather, this assertion seems increasingly far-fetched. It is much more likely that industrial farming will continue along its present course, or perhaps move even faster, destroying the very biodiversity and ecosystems that are crucial if we are to have any hope of stabilising climate, producing enough food to feed ourselves and leaving a habitable planet for future generations. As is argued elsewhere in this *Seedling* (*see* "Earth matters", p. 9), agriculture can certainly play a key role in combating climate change, but it is biodiverse, agroecological, non-chemical farming that is needed, a far cry from the kind of farming promoted by FAO.

In 2000 the US proposed that under the Kyoto Protocol an unlimited percentage of the total emission reductions should be allowed to come from tree plantations and agricultural practices, instead of reducing emissions from other sources, such as industry and transport. This was rejected by the EU and many other parties as undermining attempts to address the causes of climate change. Now the US is once again arguing that the CDM should be altered to cover new technologies, such as carbon capture and nuclear power, and that the rules should be changed to make it easier to gain funding for other allegedly "environmentally-friendly" technologies. At present, a maximum of 1 per cent of total credits can come from sequestration in forests (with the term "forests" including tree and shrub plantations) and no CDM credits for carbon sequestration in soils are permitted. Now UNCCD, in particular, is calling for an increase in the 1 per cent limit and for inclusion of carbon sequestration in soils, as well as for changes to the rules by which carbon sequestration projects have to be shown to be "additional" to what would have happened without CDM funding.

Unless the lobbyists can be stopped, the big winners will be agribusiness, particularly US-based corporations. In the US, the proposed climate change legislation includes provisions for agriculture and forestry to provide carbon offsets,[18] and these sectors are expected to provide the vast majority of domestic offsets. Yet, taking carbon trading to a new level of absurdity, the emissions created by the activities providing the carbon offsets will not be capped. In other words, the US is close to introducing legislation by which emissions from "capped sectors" (that is, sectors where limits have been placed on emissions) will be offset by methods not yet shown to be effective in uncapped sectors. These proposals, as well as others which would further boost agrofuel production and industrial wood bioenergy, have been drawn up

17 Friends of the Earth (2008), *Subprime Carbon? Rethinking the world's largest new derivatives market*, http://tinyurl.com/mhpt57

18 A carbon offset is a financial instrument aimed at a reduction in greenhouse gas emissions. Offsets are typically achieved through financial support through the carbon-trading markets of projects that are said to reduce the emission of greenhouse gases in the short or long term.

largely through the efforts of a lobby group called the 25x'25 Coalition. This is made up of leading figures in the US soya and maize lobby together with representatives of the forestry companies. In all, the 25x'25 Coalition predicts that, as a result of climate change legislation, "the [US] agriculture and forestry sector could realise over US$100 billion in additional annual gross revenue" – 50 per cent of the total value of US agriculture.[19]

Conclusion

Our analysis, outlined above, calls into question the effectiveness of the proposed measures relating to agriculture. Agrofuels[20] and other forms of bioenergy from monoculture, probably combined with biochar, no-till GM plantations and industrial livestock, are likely to attract a large part of future carbon credits for agriculture. This means that most of the funding will go into further agricultural intensification and more plantations, which are seen as effective means of reducing greenhouse gases by, for example, the IPCC and by the UNFCCC Secretariat.[21] The idea is that pressure on ecosystems will be reduced by increasing yields. But this is very unlikely to happen. Greater demand for agrofuels and other types of bioenergy, as well as a new, fast-growing market for biochar, if its proponents have their way, will create an unlimited new market for agricultural and forest products. Even if yields can be raised, which is by no means guaranteed, as droughts and floods are becoming more common and soil and freshwater are becoming depleted, demand for bioenergy will grow faster, which means that higher yields will translate into greater production and higher profits, thus creating even more incentives for companies to expand their agricultural activities. This dashes any hope that higher yields will result in less pressure on ecosystems.

Non-industrial, biodiverse farming by small-scale farmers is unlikely to benefit from the proposed climate deal. As Larry Lohmann from Corner House states: "The CDM's market structure biases it against small community-based projects, which tend not to be able to afford the high transaction costs necessary for each scheme."[22] As a result, no effective response to climate change is likely: on the one hand, the large-scale inclusion of agriculture and soil carbon sequestration into carbon trading as offsets will further weaken any incentives to reduce fossil fuel emissions, and, on the other hand, the main beneficiaries of the proposals are likely to be industries, such as South America's soya industry (because of its use of no-till farming) and companies that own tree plantations. These industries are likely to continue large-scale deforestation and other ecosystem destruction, thus accelerating climate change, causing greater pollution of the air, soil and water, and further displacing indigenous communities, small farmers and other communities.

There are alternative models for the future of agriculture, but they are currently neglected in the UNFCCC process. They include biodiverse ecological agriculture and agroforestry, which can increase food production and reduce the climate footprint of agriculture, as well as play a major role in ecosystem restoration and maintenance. Agriculture should be recognised as a multifunctional activity: it not only produces food, medicine, materials, fibres, and so on, and effectively recycles waste into soil restoration, but also does a lot else. This includes not only protecting biodiversity, soils and water sources but also satisfying people's cultural, landscape, and well-being needs, over and above their requirement for food. Finally, it is a repository for knowledge built up over generations that we lose at our peril. As long as the UNFCCC relies on carbon trading from agriculture and other sectors to resolve the climate crisis, it will not reduce emissions.

Messages like these come, for example, from farmers themselves, as in La Via Campesina's report on how small-scale sustainable farmers are cooling down the earth[23] and in Practical Action's paper on biodiverse agriculture for a changing climate.[24] The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) report, written by 400 scientists in a cooperative process between a wide range of UN institutions and approved by 57 governments prior to publication, also notes: "A powerful tool for meeting development and sustainability goals resides in empowering farmers to innovatively manage soils, water, biological resources, pests, disease vectors, genetic diversity, and conserve natural resources in a culturally appropriate way."[25] Great caution is needed about adopting new agriculture practices and techniques for climate change mitigation. Policy makers should not assume that solutions to climate change are essentially technical; the most important are social and cultural. We urgently need to shift our focus away from the promise of future technological fixes to the readily available knowledge, experience and resourcefulness of local communities.

19 25x'25, *Agriculture and Forestry in a Reduced Carbon Economy: Solutions from the Land, A Discussion Guide*, 1 April 2009, http://tinyurl.com/n79mg2

20 Many authors now believe that the production of agrofuels is intensifiying the climate crisis. See, for example, J. Fargione *et al.*, "Land Clearing and the Biofuel Carbon Debt", *Science*, Vol. 319, No. 5867: 1235–8; T. Searchinger *et al.*, "Use of US Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change", *Science*, Vol. 319, No. 5867: 1238–40.

21 See UNFCCC, Workshop on opportunities and challenges for mitigation in the agricultural sector, 4 April 2009, http://tinyurl.com/m3r2n2

22 L. Lohmann (ed.), *Carbon Trading: A critical conversation on climate change, privatisation and power*, Dag Hammarskjöld Foundation, Durban Group for Climate Justice and The Corner House, 2006. http://tinyurl.com/2e7fgq also available as *Development Dialogue*, No. 48, Dag Hammarskjöld Foundation, http://tinyurl.com/2g97dt

23 Via Campesina, "Small scale sustainable farmers are cooling down the earth", background paper, 9 November 2007 (accessed 20 May 2009), http://tinyurl.com/ncp7a2

24 Practical Action, *Biodiverse agriculture for a changing climate*, 2009, http://tinyurl.com/lqg2yd

25 IAASTD, Executive Summary of the Synthesis Report, Island Press, Washington DC, 2009, http://tinyurl.com/nrv8ou See also Practical Action, GM Freeze and Friends of the Earth, *New Labour and the International Assessment of Agricultural Knowledge, Science and Technology (IAASTD) – Meeting the Challenge*, Special Briefing, 2009, http://tinyurl.com/n7zqcp

Geoengineers are gambling with Gaia

ETC Group*

What is geoengineering? According to geoengineering's advocates, climate chaos is accelerating beyond all predictions; critical "tipping points" might already have passed; governments don't have the political will to take unpopular decisions, especially in a worldwide financial depression. Humanity urgently wants a technological fix, even one that is profoundly regrettable and known to be hazardous. With the after-effects of the industrial revolution as "proof of principle" that geoengineering "works", a current bright idea is that technology got us into this and so technology can get us out. Geoengineering – intentional, strategic manipulations of terrestrial, aquatic and/or stratospheric regions – could solve our problems or buy us time. Among the technologies are: (1) Ocean fertilisation – dumping iron nanoparticles into the ocean to stimulate algal blooms to sequester CO_2 (though a dozen experiments have failed to prove its effectiveness); (2) Stratospheric sulphates – blasting a continuous aerosol sulphate stream to block sunlight and turn down the thermostat without reducing greenhouse gas (GHG) emissions; (3) Cloud whitening – "albedo" enhancement (increasing reflectivity) to reduce heat absorption, which will rise as darker seas replace Arctic ice; (4) Biochar – burning crop "waste" to sequester carbon and apply it to soils; (5) Synthetic trees – large land areas covered by giant "goal posts" to suck up CO_2; (6) "Climate-ready" crops – vast, genetically uniform and Terminator-protected (i.e. sterile) food crops and agrofuel plantations with enhanced stress tolerance and (theoretically) CO_2-fixing capacity.

At what scale? When? The scale could not be bigger and the time is now. Each year global warming is already seriously affecting 300 million people and causing US$125 billion-worth of damage. Since the last report of the Intergovernmental Panel on Climate Change (IPCC) and the dire warnings of the UK's Stern Report, technological fixes once considered off the wall are suddenly on the table for governments and industry. After decades of denial, industry sees a silver lining to the climate's storm-clouds, and governments see an escape route from tough decisions, and a way to stimulate their economies. In the lead-up to the Copenhagen climate conference in December, the White House, the US National Science Foundation and the UK's Royal Society (among others) are testing the waters to judge public acceptance of geoengineering. An added attraction for policymakers: unlike negotiating UN accords on GHG emissions, where everyone has to be on the same page for anything to work, a single superpower or a "coalition of the willing" can regauge Gaia without intergovernmental consensus. Just as the Cold War made atmospheric and deep-sea nuclear testing possible (at least for a time), the panic that is building over climate chaos may give the G8 carte blanche to try to rejig the barometer.

Geoengineering's impact on the environment? The scheme has to be massive. Solar screens or whitened clouds must deflect a lot of sunlight; artificial forests must displace a lot of flora and fauna; ocean fertilisation must cover a lot of sea. The problems that these will create for biodiversity – and food security – would be huge, and (possibly) intractable.

On health? Geoengineering will present its own risks to health, whether from sulphate pollution in the air or from major land-use changes, with diseases possibly migrating or mutating.

On human rights? Geoengineering is a high-stakes gamble. The truth may be obfuscated and dissent terminated. Even successful interventions will have unexpected consequences, and allies will be exposed to "friendly fire". The Pentagon has already declared climate change a threat to national security. Civil rights and human rights could be early victims.

On governance? Even though geoengineering violates basic UN principles and contravenes its binding Environmental Modification (ENMOD) Treaty, ratified by all major powers, it won't go away because there is money to be made. In effect, geoengineering may lead to a unilateral environmental WTO, with countries heavily penalised if they stand in its way and powerless to evade its impacts.

Players: While still sending up trial balloons, some wealthy countries are encouraging their scientific and military institutes to investigate. Scientific conferences are held and reports trickle out; more are expected before and after Copenhagen. Rogue philanthro-capitalists, and aerospace, energy, chemical and agri-businesses see lucrative opportunities.

Fora: The first global skirmishes have taken place through the UN Convention on Biological Diversity (CBD), and a showdown is certain when the CBD's 192 members meet in Japan late in 2010. More immediately (and importantly), geoengineering may spring from obscurity to become a *cause célèbre* in Copenhagen. Researchers want the UNFCCC's green light, as well as government grants for real-world experiments. In the US, Republican efforts from 2005–6 to establish environmental modification legislation may be born again in this Congress.

The bottom line: Geoengineering is the wrong response to climate change. The only valid approach is for OECD states to make immediate, drastic, measurable reductions of CO_2 emissions at source. No market – compliance or voluntary – should grant carbon "offsets" for any geoengineering technique. Geoengineering must not be undertaken unilaterally by any nation. The UN must reaffirm (and, if necessary, expand) the ENMOD Treaty, recognising that any unilateral modification of climate is a threat to neighbouring countries and, very likely, the entire international community.

* By Kathy Jo Wetter, a researcher with ETC Group, an international civil society organisation based in Ottawa, Canada.

Three activities – no-till agriculture, biochar and more intensified livestock farming with reduced methane emissions – are likely to benefit from increased funding because of their alleged role in combating global warming. What is the evidence that these activities can reduce greenhouse gas emissions? What will happen to the world's biodiversity and the global climate if these sectors are hugely expanded? And who is likely to benefit ?

* This is a version, shortened and edited by GRAIN, of part of "Agriculture and climate change: real problems, false solutions" – preliminary report by the Grupo de Reflexión Rural, Biofuelwatch, EcoNexus and NOAH–Friends of the Earth Denmark", http://www.econexus.info/pdf/agriculture-climate-change-june-2009.pdf

Real problems, false solutions

GRUPO DE REFLEXIÓN RURAL, BIOFUELWATCH, ECONEXUS, NOAH–FOE DENMARK*

No-till agriculture

Non-tillage agriculture (NT), also known as no-till and conservation tillage, is a cultivation method which avoids soil disturbance. Modern development of NT began in 1955, when the chemical company ICI discovered the herbicide paraquat, and it became possible to get rid of weeds without ploughing. Before then, it had been assumed that tillage was necessary both to control weeds and to improve water infiltration. NT is often recommended for eroded and depleted soils, with the argument that it prevents the soil from being exposed and thus being made vulnerable to further erosion. NT is also said to improve soil-aggregate formation and microbial activity, as well as water infiltration and storage. NT was not originally developed with genetically modified crops in mind, but it clearly lends itself to the farming of crops that are tolerant to a herbicide. NT requires little labour: herbicide, fertiliser and seed can all be applied by a large machine at a single pass. This favours large, wealthy farmers and monoculture farming on a huge scale. As a result, it is massively embraced by farmers of GM crops.

As yet, there is no certainty as to the impact of NT farming on the soil. The IPCC 2006 Greenhouse Gas Inventory Guidelines suggest that the conversion from conventional tillage (CT) to NT leads to a 10 per cent increase in the estimated sequestration of carbon in the soil.[1] The IPCC's more recent Assessment Report 4, however, is much more cautious:

> Since soil disturbance tends to stimulate soil carbon losses through enhanced decomposition and erosion, reduced- or no-till agriculture often results in soil carbon gain, but not always. Adopting reduced- or no-till agriculture may also affect nitrous oxide (N_2O) emissions but the net effects are inconsistent and not well-quantified globally.[2]

Indeed, recent studies make it clear that there is, as yet, little understanding of how tillage controls soil respiration in relation to N_2O emissions and denitrification.[3] Furthermore, new studies have cast doubt on the carbon sequestration claims. In a review of studies on carbon sequestration in NT systems, Baker *et al.* found that the sampling protocol produced biased results.[4] In the majority of the studies they reviewed, soils were sampled to a depth of only 30 cm or less. The few studies they examined that had sampled deeper soils found that NT showed no consistent build-up of soil organic carbon. Indeed, other studies involving deeper sampling generally show no carbon sequestration

1 With a 5 per cent uncertainty factor.

2 P. Smith *et al.*, "Agriculture", in IPCC (eds), *Climate Change 2007: Mitigation, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, chapter 8, http://tinyurl.com/2e9c9b

3 X.J. Liu *et al.*, "Dinitrogen and N_2O emission in arable soils: Effect of tillage, N source and soil moisture", *Soil Biology and Biochemistry*, Vol. 39, No. 9, September 2007, pp. 2362–70.

4 J.M. Baker *et al.*, "Tillage and soil carbon sequestration – what do we really know?", Agriculture, Ecosystems and Environment Vol. 118, Nos. 1–4, January 2007, pp. 1–5.

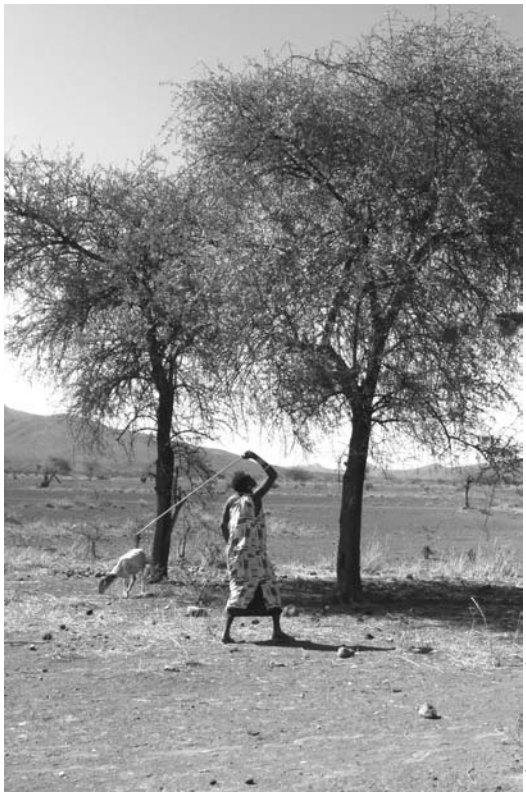


Photo: Practical Action

A woman collects leaves to feed her goat, Maasai Mara, Kenya.

advantage for conservation tillage and, in fact, often find conventionally tilled systems to contain more carbon.

Despite the current uncertainty, international bodies are calling for NT farming to be considered a carbon sink activity and for carbon offsets to be permitted for it. In August 2008 FAO included NT in a submission to the UNFCCC in which it proposed approval of a number of practices to reduce the rate of CO_2 released through soil respiration and to increase soil carbon sequestration.[5] This was followed in October 2008 by the publication of a briefing titled "Framework for Valuing Soil Carbon as a Critical Ecosystem Service" by FAO and the Conservation Technology Information Center (CTIC). As the biotech industry is well represented on the CTIC board of directors, with Monsanto, Syngenta America and Crop Life America all having seats, it is scarcely surprising that the briefing called for a wider use of conservation agricultural systems and recommended the inclusion of carbon offsets from conservation agriculture.[6]

Biochar

Biochar is a term coined by Peter Read, a lobbyist for this technique (who strongly supports industrial tree planations), to describe fine-ground charcoal when it is applied to soil. Charcoal generally is a by-product of pyrolysis, which is a type of bioenergy production in which biomass is exposed to high temperatures for short periods, with little or no oxygen. Fourteen governments, as well as the United Nations Convention to Combat Desertification (UNCCD), are formally calling for biochar to play a significant role in a post-2012 climate change agreement and in carbon trading. They are working with the International Biochar Initiative (IBI), a lobby largely made up of biochar entrepreneurs and scientists (many of them with close industry links), that is active at UNFCCC meetings.[7] The IBI argues that applying charcoal to soil creates a reliable and permanent "carbon sink", thus mitigating climate change. It also claims that biochar makes soils more fertile and permits more water to be retained in them, thus helping farmers to adapt to climate change.

However, scientific studies, including ones by leading IBI members themselves, point to high levels of uncertainty regarding all those claims. Indeed, it is interesting to examine in some detail the main claims made for biochar:

a) that its production is "carbon negative"

Biochar lobbyists say that the process of producing bioenergy from biochar absorbs more carbon than it produces. This is based on two arguments. The first is that biomass burning is carbon neutral or close to it; that is to say, it results in no significant greenhouse gas emissions since emissions during combustion are supposedly offset by new growth. Given that the advocates propose that biochar plantations should be created on a massive 500 million hectares, which is the amount of land needed if biochar is to have the "climate change mitigation" effect recommended by its proponents,[8] this argument is highly dubious. The impact on the climate of converting ecosystems into plantations for biochar production, with all the associated forest and soil degradation, would be colossal, making it impossible to consider the biomass burning carbon neutral, or even close to it.

The second assertion is that the carbon contained in biochar would remain permanently in the soil and that the technology can therefore be considered carbon negative because it would sink CO_2 from the atmosphere. This argument is to a large extent based on *terra preta*: highly fertile soils rich in black carbon – the type of carbon found in charcoal. These soils were created between 4,500 and 500 years ago by indigenous farmers in Central Amazonia, who applied a large variety of biomass residues, including compost, river sediments, manure, fish bones and

5 FAO, Submission by Food and Agriculture Organisation of the United Nations, 3rd Session of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA3), Accra, 21–27 August 2008, accessed 26 May 2009, http://tinyurl.com/m9lh73

6 FAO, *Soil Carbon Sequestration in Conservation Agriculture: A Framework for Valuing Soil Carbon as a Critical Ecosystem Service*, 2008. Summary document derived from the Conservation Agriculture Carbon Offset Consultation, West Lafayette, USA, 28–30 October 2008, http://tinyurl.com/mjk648

7 For membership of the IBI Board and Science Advisory Committee, see http://tinyurl.com/ql94wj

8 A. Ernsting and D. Rughani, *Climate Geo-engineering with "Carbon Negative" Bioenergy*, Biofuelwatch, updated version, December 2008, http://tinyurl.com/ll3nhq

9 For more information, see FAO, Terra Preta – Amazonian Dark Earths (Brazil), http://tinyurl.com/nndnwt

10 J. Lehmann *et al.*, "Nutrient availability and leaching in an archaeological Anthrosol and a Ferralsol of the Central Amazon basin: fertilizer, manure and charcoal amendments", *Plant and Soil*, Vol. 249, No. 2, February 2003, pp. 343–57; C. Steiner *et al.*, "Long term effects of manure, charcoal and mineral fertilization on crop production and fertility on a highly weathered Central Amazonian upland soil", *Plant and Soil*, Vol. 291, No. 1–2, February 2007, pp. 275–90. These two articles are based on the same field experiment near Manaus.

11 Chih-Hsin Cheng et al., "Oxidation of black carbon by biotic and abiotic processes", Organic Geochemistry, Vol. 37, No. 11, November 2006, pp. 1477–88.

12 J. Lehmann *et al.*, "Stability of black carbon/biochar", presentation at SSSA Conference, October 2008, http://tinyurl.com/o9nq4p

turtle shells, as well as charcoal, to their soils.[9] The charcoal in *terra preta* has been shown to interact with fungi, which help to maintain soil fertility over long periods. Charcoal residues from wildfire and other sources have been found in soils which date back thousands of years, for example in the North American prairies, Germany and Australia. It is therefore certain that some carbon in charcoal can – under certain circumstances – be retained in soils for thousands of years. Eventually, however, it will be released as CO_2 and warm the atmosphere. Moreover, the fact that some carbon from charcoal remains in the soil does not mean that all or even most of it will. Most of the studies on which claims about the properties of biochar are based have been done in laboratories or greenhouses, some of them with sterile soils. There are very few field studies, and only one peer-reviewed field experiment, which looks at (short-term) impacts on both soil fertility and soil carbon.[10] This still remains the case seven years after the first biochar company, Eprida, was founded. By analogy, this would be like releasing a new pharmaceutical product without clinical testing.

Carbon in charcoal is certainly more stable than soil organic carbon because it is mostly unavailable to soil organisms and thus does not nourish the soil. While carbon in charcoal can remain in soil for long periods, however, it can also be lost within decades, a few years, or even faster. Black carbon, the type of carbon contained in charcoal, can be degraded and turned into CO_2 either through chemical processes or by microbes, and some types of carbon within charcoal are degraded far more easily than others.[11] Johannes Lehmann, Chair of the IBI Board, claims that only between 1 per cent and 20 per cent of the carbon in charcoal will be lost this way in the short term and that the remainder will stay in the soil for thousands of years.[12] But another study, about the fate of black carbon from vegetation burning in Western Kenya, suggests that 72 per cent of the carbon was lost within 20–30 years.[13] One study about a global "black carbon budget" shows that the sums do not add up: a lot more black carbon is produced through wildfires every year than is found in soils or marine sediments, suggesting mechanisms for losses which are not fully understood.[14] Another open question is the possibility that biochar has different impacts on different soil types.

There is some evidence that the types of carbon in charcoal which degrade fastest might be those which can increase plant yields in the short term when used together with fertilisers.[15] In other words, there could be a trade-off between biochar that raises soil fertility and biochar that sequesters carbon, although the lack of field studies makes it impossible to be certain. Moreover, soil microbes have been found which can metabolise black carbon and thus turn it into CO_2.[16] Conceivably, if biochar was applied to large areas of land, these microbes might multiply and break down black carbon more easily than currently occurs.

Another question is whether adding biochar to soil can cause pre-existing soil organic carbon to be degraded and emitted as carbon dioxide. This possibility was suggested by a study in which charcoal in mesh bags was placed into boreal forest soils and significant amounts of carbon (apparently, soil organic carbon) was lost. The authors suggest that the biochar could have stimulated greater microbial activity, which degraded soil organic carbon and caused it to be emitted as carbon dioxide.[17] This is further supported by a laboratory study by Rogovska *et al.* (2008) which showed that adding charcoal to soil increased soil respiration and thus CO_2 emissions.[18]

b) that biochar improves soil fertility

Ash, which accounts for a proportion of fresh biochar, contains nutrients and minerals that can boost plant growth – the main reason for slash-and-burn farming. Soils treated in this manner, however, are depleted after one or two harvests. Biochar proponents recognise that nutrients and minerals are quickly depleted, but maintain that biochar can improve yields none the less, because it enhances the uptake of nutrients from other fertilisers, improves water retention and encourages beneficial fungi. This has proved to be the case for *terra preta*, but the evidence for modern biochar is, yet again, inconclusive. In some cases, biochar can inhibit rather than aid beneficial fungi.[19] Furthermore, the lack of long-term field studies

13 Binh Thanh Nguyen *et al.*, "Long-term black carbon dynamics in cultivated soil", *Biogeochemistry*, Vol. 89, No. 3, July 2008, pp. 295–308.

14 C.A. Masiello, "New directions in black carbon organic chemistry", *Marine Chemistry*, Vol. 92, No. 1–4, December 2004, pp. 201–13.

15 J.M. Novak *et al.*, "Influence of pecan-derived biochar on chemical properties of a Norfolk loamy sand soil", presentation at SSSA Conference, October 2008, http://tinyurl.com/o4vvlw

16 U. Hamer *et al.*, "Interactive priming of black carbon and glucose mineralization", *Organic Geochemistry*, Vol. 35, No. 7, July 2004, pp. 823–30.

17 D.A. Wardle *et al.*, "Fire-Derived Charcoal Causes Loss of Forest Humus", *Science*, Vol. 320, No. 5876, 2 May 2008, p. 629; see also the comment by J. Lehmann & S. Sohi, and the authors' response, Science, Vol. 321, No. 5894, 5 September 2008, p. 1295 http://tinyurl.com/mjtaxv

18 N. Rogovska *et al.*, "Greenhouse gas emissions from soils as affected by addition of biochar", presentation at SSSA Conference, October 2008, http://tinyurl.com/pdycee

19 See, for example, D.D. Warnock *et al.*, "Non-herbaceous biochars (BC) exert neutral or negative influence on arbuscular mycorrhizal fungal (AMF) abundance", presentation at SSSA Conference, October 2008, http://tinyurl.com/pqs9e9

Biochar

Photo: Practical Action

Constructing riverbank reinforcements to act as flood defences, Nepal

means that there is little information on what happens beyond the initial period when charcoal still retains nutrients and minerals. Moreover, it has been shown that, even during this initial period, charcoal can in some cases reduce plant growth, depending on the type of biochar and the crops on which it is used. Perhaps most worryingly of all, studies which result in (short-term) increases in soil fertility involve much larger quantities of biochar than can be obtained from charring residues from that same land, let alone from charring only some of the residues so that sufficient are left for the soil. It is evident that either large areas of land have to be stripped of all biomass to make another smaller piece of land more fertile, or industrial monocultures are required.

Where biochar does increase yields – at least in the short term – it appears to do so mainly by working in conjunction with other materials, such as chicken manure or nitrogen fertilisers.[20] Hence companies such as Eprida are seeking to produce not just charcoal but a combination of charcoal with nitrogen and other compounds scrubbed from flue gases of coal power plants. Such a technology bears little resemblance to *terra preta*, however; instead, it relies on burning fossil fuel and using fossil-fuel based fertilisers in industrial agriculture.

Black carbon, tilling and global warming

Although black carbon is being promoted as a carbon sink while it remains in the soil, airborne black carbon is a major cause of global warming. Although not a greenhouse gas, black carbon reduces albedo – that is, it makes the earth less reflective of solar energy. The small dark particles absorb heat, and contribute to ice melting in the Arctic and elsewhere. Over a century, black carbon has proportionally a global warming impact that is 500–800 times greater than that of CO_2.[21] There is a serious risk that, during biochar production, some of the more finely powdered charcoal will become airborne. It is difficult to see a way out: on the one hand, tilling biochar deep into soils would minimise biochar losses, but tilling can damage soil structures and cause breakdown of pre-existing soil carbon; on the other hand, laying biochar near the soil surface will result in more exposure to erosion and oxidation and could ultimately add significantly to airborne black carbon. This latter problem is well illustrated in pictures from a study commissioned by the biochar company Dynamotive,[22] which show large clouds of charcoal dust during transport and application. The researchers report that 30 per cent of the charcoal was lost in this manner. The significance of airborne particles is also indicated by the fact that dust carried from the Sahara is routinely deposited in the Amazon basin. Even if a small percentage of the biochar becomes airborne, it would mean that biochar would make global warming worse, irrespective of any carbon sequestration.

Large-scale biochar?

It is almost inevitable that a large new demand for biomass would compete with existing and already unsustainable demands on land and would further increase pressure on natural ecosystems, on community lands and on food production. Biochar advocates claim that they do not advocate deforestation for biochar plantations. However, the large quantities of biochar under discussion – with 1 billion tonnes of carbon sequestration per year quoted as a "lower range" – make further pressure on ecosystems inevitable. Johannes Lehmann (IBI), for example, states that dedicated crops and trees have the greatest biochar potential,[23] and a discussion at the 2008 IBI Conference suggested that plantations would be required for scaling up biochar.[24] This is the main concern expressed in a declaration titled "Biochar: A new big threat to people, land and ecosystems", signed by over 150 organisations in spring 2009.[25]

To sum up: there is no unequivocal evidence that biochar "works" at any level, including small-scale. Instead, there are some indications that biochar could accelerate global warming and soil depletion, even if we ignore the inevitable pressures on land and ecosystems that would be created if biochar were to be produced on a huge scale. As well as stripping soils and forests of vital organic residues, the resultant industrial tree plantations would lead to the widespread displacement of traditional

20 See, for example, K.Y. Chan *et al.*, "Agronomic values of greenwaste biochar as a soil amendment", *Australian Journal of Soil Research*, Vol. 45, No. 8, 2007, pp. 629–34.

21 See T.C. Bond and H. Sun, "Can Reducing Black Carbon Emissions Counteract Global Warming?", Environmental Science & Technology, Vol. 39, No. 16, 15 August 2005, pp. 5921–6; and J. Hansen et al., "Climate Change and Trace Gases", Philosophical Transactions of the Royal Society, Vol. 365, No. 1856, 15 July 2007, 1925–54.

22 B. Husk, *Preliminary evaluation of biochar in a commercial farming operation in Canada*, study by BlueLeaf Inc. http://tinyurl.com/kqaex9

23 J. Lehmann et al., "Biochar Sequestration in Terrestrial Ecosystems – a review", Mitigation and Adaptation Strategies for Global Change, Vol. 11, No. 2, March 2006, pp. 395–419.

24 IBI 2008 Conference, Session D, "Biochar and bioenergy from purpose-grown crops and waste feedstocks: Relevance for developed and developing countries?", http://tinyurl.com/7zsr2u

25 "Declaration: 'Biochar', a new big threat to people, land, and ecosystems", Rettet den Regenwald, 26 March 2009, http://tinyurl.com/cabtlu

communities and indigenous peoples, with the destruction of food production and livelihoods, as well as the depletion and pollution of freshwater.

Livestock

Livestock farming is a huge producer of greenhouse gases: out of total human-related emissions, it is responsible for 9 per cent of the carbon dioxide, 65 per cent of the nitrous oxide (mainly from manure), 37 per cent of the methane and 64 per cent of the ammonia. It is responsible for nearly 80 per cent of all agriculture-related emissions and has a larger share (18 per cent) in total emissions than transport (14 per cent). These figures include the emissions caused by the production of animal feed, with a third of cultivated land being used to grow grain for livestock,[26] but they exclude the high carbon emissions that stem from clearing forests and other ecosystems to raise livestock. So livestock's real contribution to greenhouse gas emissions is even higher than official figures suggest.

As a result, it is scarcely surprising that considerable efforts are being made to reduce the greenhouse gas footprint of livestock farming. With CDM funding, biogas digesters are being built to reduce methane emissions from factory farms. Nitrification inhibitors[27] are being propagated that could inhibit nitrous oxide, although they are far from efficient, practical or affordable. Endeavours are being made to lower the feed conversion ratio – that is, the amount of feed required to produce meat, eggs and milk. Indeed, faster livestock growth and better use of feed have been achieved over recent decades. Proponents of industrial farming are now claiming that traditional, extensive livestock keeping is harming the climate and a further intensification of the industry inside industrial installations is the best – and perhaps the only – way of saving the planet. But is this credible?

Photo: Practical Action

Flood defences in place, Nepal

Livestock production has been revolutionised over the last few decades.[28] Through massive subsidies and favourable regulations, the developing countries have followed the example of the developed world and created their own industrial livestock production. Asia has become a larger producer of milk than Europe. In 2004 Brazil overtook the USA to become the world's largest meat exporter. In factory farms compound food, manufactured in feed mills from resources that compete with food and transported over long distances, has

Box 1: Time for a sea change

Fishing was once the most efficient way of providing food without emitting greenhouse gases (GHGs). Industrial fishing has reversed the equation. According to Seas at Risk and the North Sea Foundation, not only does today's commercial overfishing make already depleted fish stocks less resilient to the impact of climate change, but large-scale commercial fisheries are a significant source of global GHG emissions. Consider the following:

- for each ton of live-weight landed fish product, 1.7 tons of CO_2 are emitted;
- global fisheries burned almost 50 billion litres of fuel in the year 2000, to land about 80 million tons of marine fish and invertebrates;
- global fisheries account for at least 1.2 per cent of the global oil consumption, an amount equal to that of the Netherlands, the world's 18th largest oil consuming country;
- the energy content of the fuel burned by global fisheries is 12.5 times as great as the edible protein energy content of the resulting catch.[1]

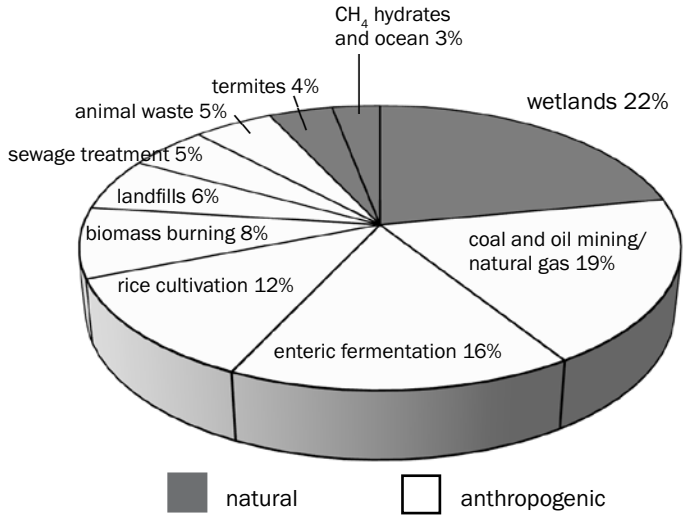
1 Seas at Risk/North Sea Foundation, www.seas-at-risk.org/1mages/Carbon%20footprint%20brochure%20final%20final.pdf

26 90% of soya is used to produce animal feed.

27 Plants can use both the ammonium and nitrate forms of nitrogen, but the nitrate form is more susceptible to leaching and thus enters groundwater more readily. Nitrification inhibitors are chemicals designed to slow the process by which bacteria convert ammonium forms of nitrogen into nitrate forms.

28 See special issue of *Seedling* on livestock, January 2008, http://tinyurl.com/qbod9s (http://www.grain.org/seedling_files/seed-08-01.pdf)

Figure 1: Methane sources



Source: Harvey Augenbraun, Elaine Matthews and David Sarne, "The Global Methane Cycle", Goddard Institute for Space Studies, http://icp.giss.nasa.gov/education/methane/intro/cycle.html

replaced locally available feed, such as grass, other roughage and nutrient-rich waste from farms and households. From the beginning, industrial livestock farming has caused serious water, soil and air pollution, and seriously compromised animal health and welfare. These problems remain largely unsolved. Aquaculture will add to the headaches, as it is increasingly turning to the same feed resources as livestock. In the North, 70 per cent of fish farms require fishmeal and fish oil. Depletion of small pelagic fish for fishmeal and fish oil has fundamentally disturbed the oceans' food web. Because fish are running out (and feeding fish to fish seems crazy, even to some industrialists), more and more fish farms are using grains. In Asia, where 80 per cent of global aquaculture production takes place, compound feed use is increasing. (For the implications of industrial fishing for GHG emissions, *see* Box 1 on p. 27.)

Intensification as a mitigation approach is just a call for more of the same in policy terms: those who have only a hammer will look only for nails, as Dennis Meadows, an author of the Club of Rome's "Limits to Growth" put it. The new biotechnologies for selection seek increased uniformity within even shorter time periods. They are aiming at higher selection intensity (for example, DNA marker-assisted selection), shorter generation intervals (for example, selection from embryo, not adult animals), more females than males in cattle and pigs ("sexed semen") and replication of the same animals (clones). The result of such livestock biotechnologies is predictable: increased genetic uniformity, greater dependency on a few genetics corporations, greater vulnerability to diseases, more demands for subsidies, more pressure on animal welfare, more environmental pollution and more climate change. In sum, more of the same problems that are already an implicit part of the production system.

A similar high-tech approach is being taken to the problem of methane emissions. Ruminants (which are cud-chewing, hoofed mammals such as cattle, sheep and goats) produce methane through enteric fermentation – that is, fermentation that takes place in their rumen, their special stomach that enables them to eat tough plants and grains. Indeed, enteric fermentation is calculated to be responsible for about 16 per cent of the world's production of methane, both natural and anthropogenic. This is less, incidentally, than the amount produced by coal, gas and oil mining (*see* Figure1). A range of technical solutions are being investigated. Vaccines are being developed that would prevent ruminants from producing so much methane. Efforts, including by gene transfers, are being made to modify the methanogenic bacteria in the animals' rumen so that they change their 80 million year-old habit of producing methane. The leading research into these ideas is currently taking place in New Zealand and Australia, whose efforts to reduce their greenhouse gas emissions are being hampered by their simultaneous, contradictory desire to increase exports of meat and milk.

Industrial livestock farming has created a range of new problems that did not exist in the past. Manure deposited on fields and pastures, or otherwise handled in a dry form, does not produce significant amounts of methane, but this has changed with the large-scale industrial production of livestock in factory farms and feedlots. Producing manure in liquid form, these units release 18 million tonnes of methane annually.[29] At present, these emissions amount to only 3 per cent of global anthropogenic methane emissions, but they may double, as China, where half of the world's pigs are reared, is currently replacing smallholder systems with factory farms. Another problem is nitrogen emissions. Animals in general are inefficient nitrogen users, and the nitrogen excretion of ruminants is high. When they are fed roughage, however, and their excreta return to the soils, their nitrogen inefficiency has no negative impact on the environment.[30] Factory farming has changed this: nitrogen emissions from factory farms, together with emissions of phosphate, potassium, drug residues, heavy metals and pathogens, have become a major problem. Animals are also fed on crops grown with chemical fertiliser, and half of the synthetic nitrogen used on

29 H. Steinfeld *et al.*, *Livestock's long shadow: Environmental issues and options*, Rome, FAO, http://tinyurl.com/7yzdoy

30 *Ibid.*

the fields is not being absorbed by the plants, so the excessive nitrogen is polluting ecosystems.

There seems no way of escaping the conclusion that the consumption of an unlimited amount of meat, milk and eggs cannot be a development goal in times of changing climate and should not be supported by tax breaks, subsidies, externalised cost and favorable regulations. In any case, contrary to widespread belief, animal products are not essential for a healthy diet, and FAO has never recommended a minimum intake. Indeed, there is no doubt that consumption is far too high in most industrialised countries and is a major cause of the so-called "diseases of civilisation". The world needs to reduce its consumption of all kinds of meat, and to move away from the current unsustainable methods of industrial production in which livestock are fed on grain (which could be fed to people) instead of on roughage or waste, and in which the "productivity" of poultry, pig and cattle has been increased to such an extent that their genetics are depleted, their health depends on "biosecurity"[31] and antibiotics, and their overall welfare has been compromised to a level that is unacceptable to most people. The excessive number of livestock today means that it is impossible to keep the climate cool (and people healthy, as is attested by the one billion obese people).

Traditional systems of livestock production help to conserve ecosystems as well as to reduce greenhouse gas emissions. The roots of plants in pampas, prairies and tundra are a major CO_2 sink. Indeed, grasslands are believed to account for 34 per cent of the carbon absorbed by carbon sinks.[32] Animals and ecology work in harmony in a system that they have both helped to create. It is a mutually beneficial system, for ruminants like cattle, goats, sheep, buffaloes and camels need grass to turn into food, while seasonal grazing clearly contributes to biodiversity conservation.

It is a virtuous circle: biodiversity is conserved, a major CO_2 sink is maintained and a valuable food is created. Traditional pastoralists have, at times, been accused of over-grazing but now major environmental organisations, including IUCN,[33] are challenging this assertion and are calling for better regulatory support for mobile systems of grazing, such as pastoralism and transhumance. But these systems are in the process of being annihilated: grasslands that have evolved to co-exist with livestock are being turned into cropland for more feed for ever more livestock. This destruction must end. Removing between half and three quarters of the animal products from the Northern diet has become an imperative, not an option.

31 A term coined by the livestock industry for provisions (structural or organisational) to keep disease out of factory farms. Biosecurity forms an increasing part of production costs.

32 T. Tennigkeit and A. Wilkes, *An Assessment of the Potential for Carbon Finance in Rangelands*, ICRAF Working Paper no. 68, 2008, http://tinyurl.com/oxtwga

33 IUCN, "Misconceptions surrounding pastoralism", 21 November 2008 (accessed 20 May 2009), http://tinyurl.com/l5b253

Photo: Practical Action

Family members take refuge on their roof during severe flooding in Bangladesh. The perennial hazard is made much worse by climate change

In June 2009 Davi Kopenawa Yanomami, a shaman from one of the communities of the 16,000 Yanomami Indians who live in the north of Brazil, near the frontier with Venezuela, travelled to Europe to talk to politicians and the press. He wanted to ensure that an indigenous voice was heard in the run-up to the Copenhagen conference in December 2009. The following are extracts from some of the interviews he gave.

Davi Yanomami

Photo: Survival International

Have you noticed the climate changing in the Brazilian Amazon?

We who live in the Amazon forest are seeing the smoke from pollution. It is coming into our land. The rain is arriving late and the sun is behaving strangely. The world is ill. The lungs of the sky are polluted. So this climate change you talk about is dangerous for us, dangerous for us all. We know it is happening. We are shamans and we care for the sun and the moon, the light and the darkness, and all that exists in the universe. Our shamans know that the planet is changing, and this is dangerous for us all. If you carry on killing people and you continue to destroy nature to take out all the oil, the minerals and the wood, our planet will become ill and we will all die, burned or drowned.

Why do you think people from outside are doing so much damage to the forests?

The white man has strong roots in the city. He cannot change. He is driven mad with desire for land. He always wants to take out more and more from the land so that the city can grow. He thinks only of things under and on the ground: oil, gold, minerals; roads, cars, trains. He cannot be happy. The Yanomami are different. We think and we speak with the soul of the land, the water, the rivers, the mountains, the moon, the stars and the sun.

In 1992 the Yanomami won a big victory. The Brazilian government threw out the 20,000 gold-panners who had invaded Yanomami land, and declared that land a large reserve for the Yanamomi, covering 9.4 million hectares. What is the situation of the Yanomami today?

Since President Lula took over in 2002, he has done nothing for the Yanomami or the other Indians. He promised to do things and he hasn't done them. I think he has forgotten us. We have 3,000 gold-panners back on our land. And he has done nothing. It is the responsibility of the government to get them out. We have rights. We are the owners of the land, and the federal police must remove the miners.

White politics is difficult for us Indians, and for you *napë* (non-Indians) as well. What has politics done for you *napë*? What do you know about the political parties, deputies and senators? Only they know about themselves. And they are charlatans, they use politics to get their hands on the land.

Do you have other enemies today?

The soya farmers have arrived. They began their attack on the land of our relatives in the Xingu National Park. They have caused a lot of destruction there. They have put an end to the forests. They are doing the same elsewhere. But they haven't so far dared to plant soya on our land. And we will stop them. At the moment, our enemies are still the big cattle companies and the gold-panners.

Do you have any other problems?

We are worried about the big mining companies. Governors, senators and deputies are trying to get a new mining law through Congress and to have Lula sign it. They are claiming mining rights on 60 per cent of the land that lies under our forest. That's why we're furious with Lula. But perhaps our biggest problem of all now is health. The government isn't doing enough. The government doesn't want to improve our health care, and there are lots of corrupt people stealing money which is meant for us and for our health. The health equipment, the medicines and the medical teams stay in the city and don't reach the Yanomami.

What can be done to stop the destruction?

We must make an alliance, all the indigenous people struggling together against mining. And not just indigenous people. This union would be very weak with just indigenous people. We must come together with leaders of other people, non-Indians, to hold a huge meeting to fight against the mining companies that invade us. Unity is what will make us strong. We will fight, not with the force of arms or of money, but of nature.

What is your message to the world on climate change?

There are about to be global talks about climate change. The error of the *napë* is that they take out the riches from the land. They cannot do this. Why? Because the land is sacred. You cannot destroy it because the heart of our Yanmami *urihi* (forest) is the lungs of the world. It is very important for the governments of the world to listen to us, the indigenous people who have lived on the planet for thousands of years. We have to help the world when it is crying out, when there is no rain, or when they is a lot of thunder and too much rain. The *shapiripë* (shamanic spirits) know how to help the world. They have defended nature for a long time, not just for the Yanomami but for the whole world, for the planet. Everybody, the politicians and the UN, have to listen to and respect the earth and stop destroying it by taking out the riches.

GOING FURTHER

http://www.survival-international.org/tribes/yanomami

http://www.socioambiental.org

Photo: Fiona Watson/Survival International

Davi Kopenawa Yanomami, indigenous leader and shaman, surrounded by children in Demini, Brasil

N Ndiogou Fall
O Sharif Omar
P João Pedro Stédile
Q Darrin Qualman
R Ramón Vera
S Daycha Siripatra
T Tim Lang
U Ulrich Oslender
V Valentina Hemmeler Maiga
W Melaku Worede
X Xue Dayuan
Y Davi Yanomami

The climate crisis adds another dimension of urgency in dealing with the world's dwindling agricultural biodiversity. The seeds of today will have to be adapted to changes in climate and the ensuing changes in ecosystems. Such adaptation can only be based on the wealth of agricultural biodiversity that farmers have created. Farmers' seeds and seed systems have never been more important to humanity, and yet never have they been more threatened. A growing array of laws and regulations spreads around the world to prevent farmers from working with seeds, while new technologies, such as GMOs, put these seeds at risk of contamination and destruction. Meanwhile, the handful of seed corporations that now dominate the global seed market want unfettered access to the seeds that have been taken from farmers and stored in the world's gene banks.

In this context, the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture held its third session on 1–5 June 2009 in Tunis. Guy Kastler, the European delegate to La Via Campesina's Biodiversity Commission, and representative of the Réseau Semences Paysannes of France, explains what he sees as the failures of the Treaty and the opportunities and spaces for action emerging from Tunis.

Farmers' rights or fools' bargain?

GUY KASTLER

Guy Kastler has a small organic farm in southern France. He is coordinator of the Réseau Semences Paysannes (Peasant Seed Network), a member of the Confédération Paysanne (Peasant Confederation) and European representative in the Biodiversity Committee of Via Campesina.

There has always been a core tension in the negotiations for the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR). On one side, the multinational seed industry wants a multilateral system that gives it open access to the world's genebanks and farmers' fields, unrestricted by national sovereignty. On the other side are farmers and indigenous peoples, who insist that their historic role in creating the world's agricultural biodiversity, and their need for support to continue doing this work in the face of increasing criminalisation and marginalisation of their seed systems, be recognised. Absolutely central to this recognition is stopping the privatisation of communities' knowledge and material resources. In the Treaty negotiations, this tension has played out in a loose division between rich countries, where the seed markets are dominated by transnational corporations (TNCs), and poor countries, where farmers' seeds and public breeding programmes are more important. In the text of the Treaty, the division has evolved into a murky compromise between access and intellectual property rights (IPRs) on the one hand, and benefit-sharing and farmers' rights on the other.

The Treaty, like all international agreements, is a reflection of power politics, with the industry getting pretty much everything it wants in terms of IPRs and access, and farmers getting nothing of

substance on farmers' rights or benefit-sharing. The negotations during the third session of the Treaty's Governing Body in Tunis were hardly an exception. Although the rich countries have had no problems finding billions of dollars to bail out their banks this year, they refused to cough up the relatively meagre amount needed for the Secretariat to carry out its mandated programmes for the development of farmers' rights and the sustainable use of plant genetic resouces. Some start-up money was made available to a benefit-sharing fund, but there was still no agreement on a mechanism that would force the seed industry to contribute its rightful share or that could put the "benefits" in farmers hands. And despite efforts from civil society and some governments of the South, the Treaty still imposes no obligations on parties to enforce farmers' rights. Brazil, supported by all the countries of the South, proposed a draft article that would require member countries to bring their national legislation into conformity with farmers' rights. But Canada was able to water down the proposal to make it non-binding. Similarly, Canada succeeded in making the organisation of regional workshops on farmers' rights conditional on the availability of funds, which always depends on the good will of rich countries.

Nevertheless, the final resolution adopted in Tunis lays out some important principles that could be used as a powerful lever for food sovereignty if farmers and civil society seize the opportunity to obtain their comprehensive implementation.

The final resolution "invites parties to consider reviewing and, if necessary, adjusting national measures affecting the realisation of farmers' rights, and encourages parties and organisations to submit views and experiences on the implementation of farmers' rights." The resolution also states that the Governing Body "appreciates the involvement of farmers' organisations in its further work" and "requests the Secretariat: to convene regional workshops on farmers' rights, subject to agreed priorities and to the availability of financial resources, aiming at discussing national experiences on the implementation of farmers' rights; and to collect parties' views and the reports of the regional workshops for consideration [at its next session]".

However restrictive the final document is, it is now an official document unanimously approved by the Governing Body that explicitly recognises that many national laws are obstacles to farmers' rights. Such recognition provides an important basis from which farmers' organisations and civil society can challenge their governments and force them to respect the Treaty to which they are a party. In Tunis, we could see some important space open up in this direction.

At the outset of the meeting, the International Planning Committee for Food Sovereignty (IPC), which is composed of NGOs and organisations of farmers, pastoralists and indigenous peoples, announced that, if the Governing Body of the ITPGR could not guarantee the collective rights of farmers, it would call for the formation of a coalition of countries willing to do so immediately. Also at the opening plenary, Via Campesina declared that corporate seeds, which cannot be freely reproduced by farmers, are the main cause of the disappearance of crop biodiversity and a significant cause of the food crisis. Under no circumstances, they stated, can such seeds be a solution to the crisis. Via Campesina called for a tax on all industrial seeds

Box 1: The ITPGR and farmers' rights

According to Article 9.2 of the ITPGR:

The Contracting Parties agree that the responsibility for realising Farmers' Rights, as they relate to plant genetic resources for food and agriculture, rests with national governments. In accordance with their needs and priorities, each Contracting Party should, as appropriate, and subject to its national legislation, take measures to protect and promote Farmers' Rights, including:

a) protection of traditional knowledge relevant to plant genetic resources for food and agriculture;

b) the right to equitably participate in sharing benefits arising from the utilisation of plant genetic resources for food and agriculture;

c) the right to participate in making decisions, at the national level, on matters related to the conservation and sustainable use of plant genetic resources for food and agriculture.

Nothing in this Article shall be interpreted to limit any rights that farmers have to save, use, exchange and sell farm-saved seed/propagating material, subject to national law and as appropriate.

that cannot be saved in order to generate funds for local community-managed seed banks and participatory breeding.

These declarations from civil society were supported by almost all of the delegations from the South and, at the explicit request of some of them, were annexed to the Governing Body's official report. Many countries from the North also stood in support of greater recognition of farmers' rights, at least when it comes to farmers in the South (not in their own countries!). Norway demanded that farmers' representatives should be allowed to speak and, alongside Switzerland and Italy, worked hard to persuade the most reluctant delegations to accept the declaration on farmers' rights. Only Canada, France, Germany and Australia fought tooth and nail to protect the interests of the transnational seed companies.

Efforts to advance farmers' rights will have to confront directly plant breeders' rights legislation and the patenting of genes within plant varieties, promoted globally through the International Union for the Protection of New Varieties of Plants (UPOV). The negotiations in Tunis underscored how rich countries – France in particular – are unwilling to recognise any contradiction between PBRs and farmers' rights. There is reason to believe that the seed industry, even in the United States, is increasingly turning to PBRs as a way to maintain strong patent-like protection over seeds while side-stepping benefit-sharing (since PBRs, unlike patents, do not require holders to disclose the origin of the varieties).

The treaty can never be implemented as long as patents and PBRs are not redefined in such a way as to respect farmers' rights. The ITPGR came into being after UPOV, and it is therefore for UPOV to conform to the treaty and not the reverse. A world information campaign is necessary to denounce the system of biopiracy based on the combined use of PBRs on varieties and patents on genes, the charade of benefit-sharing schemes, and the incoherent position of governments that have ratified the treaty with one hand while holding the pen with which they ratified UPOV and TRIPS in the other.

The Treaty's regional workshops on farmers' rights are potential spaces for advancing farmers' rights. But the Treaty secretariat will organise these workshops only if there is money to do so. The funds will not be raised without strong mobilisation by farmers' organisations and civil society. The discussions are bound to be intense, given the positions of the governments of those countries that are home to the multinational seed companies, but, in the end, their cynicism cannot stand up to public scrutiny. If the Treaty proves incapable of pursuing its work on the collective rights of farmers, the coalition of governments and civil society organisations interested in the immediate implementation of these rights, which began to take shape in Tunis following the declaration of the IPC, needs to be quickly established, country by country, region by region and, ultimately, at a global level. This coalition could be autonomous or could be established under the authority of an international organisation other than the Treaty. Latin America's experience with ALBA, a coalition of governments trying to develop trade relations on a basis that breaks away from the neoliberal model, could be inspirational in this effort.

The international debates that will take place on the food crisis at the FAO in Rome in November and then at the Climate Convention in Copenhagen in December, and the regional conferences of the food sovereignty collectives (2010 in Hungary, in the case of Europe) are places where such a coalition or coalitions can consolidate. The collective rights of farmers and indigenous peoples to their seeds must be included on the agenda of these meetings as an essential contribution to realising food sovereignty and solving the overlapping food and climate crises.

Going Further:

IPC, "A Sizeable Step Towards a Real Commitment to Farmers' Rights at the FAO?" press release, 8 June 2009, http://www.viacampesina.org/main_en/index.php?option=com_content&task=view&id=738&Itemid=1

IISD, "Summary of the Third Session of the Governing Body of the ITPGR", IISD, Earth Negotiations Bulletin, Vol. 9, No. 471, 8 June 2009, http://www.iisd.ca/vol09/enb09471e.html

GRAIN, "The FAO seed treaty: from farmers' rights to breeders' privileges," 2005, http://www.grain.org/seedling/?id=411

Website of the ITPGR: http://www.planttreaty.org/

On ALBA, see: http://www.bilaterals.org/rubrique.php3?id_rubrique=153

West Africa is extremely vulnerable to climate change, in part because its agriculture is essentially rain-fed. Deeply disturbing alterations in the climate are already being noticed, and worse can be expected. If cataclysmic upheavals are to be avoided, the region needs urgently to find ways of conserving precious ecosystems and of supporting peasant farmers and other groups to use their traditional knowledge to adapt to far-reaching changes.

Climate change in West Africa

the risk to food security and biodiversity

OFEDI* and GRAIN

For some years now, there have been signs that the climate is changing significantly in West Africa. Almost every country in the region has experienced a year-by-year reduction in rainfall. In the northern part of the Sahel, rainfall in the 1970s and 1980s was half the rainfall of the 1950s and 1960s. The whole water cycle was affected, with serious consequences for agriculture and food security. There has been an alteration in the pattern of rainy seasons, and the number of natural disasters has been rising. In 2008 torrential rain led to the flooding of vast cultivated areas and the loss of life, especially in Togo and Ghana. The *harmattan*, the dry, cold, north-easterly trade wind that blows along the coast of West Africa has weakened, particularly in Benin and Côte d'Ivoire. The increasing disruption of agricultural calendars is wreaking havoc on agricultural planning. Government help still goes no further than vague and incoherent statements, and farmers and extension workers are left to cope as best they can.

Prospects for West Africa are grim. At a world level, climate change could increase yields in temperate regions, perhaps compensating in part for declining yields in tropical regions. But this will be of little help to West Africa, which, along with many other low-income regions, has only a limited capacity to increase exports and thus to earn the foreign currency needed to boost imports. It will remain highly dependent on domestic food production, and it will be difficult for the region to make up for the decline in local supplies. Unless the peasant class (farmers, fishers, livestock breeders, and so on) can find ways of adapting to the effects of climate change, West Africa's food security and well-being will be severely compromised.

Biodiversity is essential for humankind, for it supplies the raw materials and the genes that make possible the emergence of the new plant varieties and the new animal species on which farmers and others depend. Biodiversity at all levels (genetic, specific and ecosystemic) increases resilience to stresses and to changes in environmental conditions. This is why it is so important to have genetically varied populations and species-rich natural and agricultural ecosystems. Climate change threatens biodiversity and damages the normal functioning of the ecosystem. By the end of this century, huge losses in biodiversity can be expected. These losses and the associated disruption (droughts, fires, pests, the acidification of the oceans, and so on) will severely test the resilience of ecosystems, notably those that are important for food production. Genetic resources that do not adapt to the new constraints will perish.

* **OFEDI** is the Organisation des Femmes pour l'Environnement et le Développement Intégré / Women's Organisation for the Environment and Integrated Development

Confronting the climate crisis: preparing for Copenhagen and beyond

We, the leaders of various people's movements, Community Based Groups, Academia, NGOs and Civil Society Organisations meeting in Nairobi under the banner of People's Movement on Climate Change (PMCC) to discuss strategies to confront the climate change crisis for Copenhagen and beyond, 27–28 August 2009,

Do hereby affirm that:

Irresponsible and unaccountable consumption concentrated in the Industrialised North and some countries of the South has cost and continues to cost Africa by creating an ecological crisis;

The people of Africa, as well as other developing nations, are creditors of a massive ecological debt;

This ecological debt continues to accrue today through the continued plunder and exploitation of Africa's resources, its people, labour, and economies;

The groups most affected by climate change are indigenous peoples and women, especially poor women in the rural areas, noting that the phenomenon has a connection with resources such as land or water, and related farming and business activities that they are specifically engaged in;

The negative effects of climate change are sharply felt on agriculture and food sovereignty. This is manifested through soil degradation, deforestation, intensified food insecurity, super weeds, desertification, cultural shock, identity loss and forced consumption of unsafe, untraceable food;

Imposed false solutions (GMOs, agro-fuels, synthetic fertilisers, agrochemicals) deepen these effects and perpetuate food aid dependency;

The current unbalanced global trade relations and policies between the industrialised North and the global South contribute to the negative ecological effects of climate change.

Our Calls:

We reject the principle and application of carbon trading, which is a false solution based on inventing a perverse property right to pollute, a property right to air;

We demand that human rights and values be placed at the centre of all global, national and regional solutions to the problem of climate change;

We call on colleagues in the social and economic justice movement globally to rigorously campaign against the undemocratic corporate-led agendas which will dominate the deliberations and processes at COP 15;

We emphasise that ecological, small holder, agro-biodiversity based food production can ensure food and seed sovereignty and address climate change in Africa.

We support the call by African leaders for reparations on climate change and support the initiative of the upcoming African Union ministers of environment meeting and call for African governments to embrace more people-centred alternatives for the African peoples.

We urge African governments to engage civil society groups positively and to collaborate with them to build common national and international responses to the problems of climate change;

Our strategies:

To activate existing networks and resources within our ranks immediately, and to build each other's capacities to engage meaningfully on pro-people solutions to the crisis of climate change;

To launch a call to action for a coordinated global response to climate change, based on solidarity and practical collaboration between affected peoples of the industrialised North and the global South;

To create synergy of platforms, networks and initiatives amongst African communities most affected by climate change and henceforth to use any appropriate political space to articulate their concerns;

To ensure that such political spaces include the annual continental, regional and national social forum spaces, as well as the parallel People's Summit of the people of Southern Africa amongst others;

To facilitate dialogue of women directly affected by climate change to engage with policy-makers at local, national, regional and global levels;

To organise and to mobilise communities for action towards food sovereignty-based food self-sufficiency through research, articulation of issues and capacity building for informed engagement and alternatives;

To mobilise agricultural, pastoral, fisher folks and other affected communities to have a common face and voice in Copenhagen;

To reform unbalanced global trade relations and policies urgently, with specific focus on Economic Partnership Agreements (EPAs) and their ecological effects on Africa;

To continue our engagement on ecological debt, to call for reparations for the climate crisis and to seek alternative modes of channelling such resources to the people of Africa;

To support African governments' calls for reparations and increased space for negotiations for a progressive deal that does not impoverish Africa further;

To commit ourselves to a coordinated follow-up on any outputs from Copenhagen.

We the undersigned: Africa Peoples Movement on Climate Change (A-PMCC), Nairobi, Kenya, 30 August 2009

C/o IBON Africa, Kirichwa Road, Off Arwings Kodhek, P.O.Box 5252-00100, Nairobi, Kenya, Tel: 254 20 3861590
www.iboninternational.org

What can be done? Adapt sensibly or perish

Climate change is not new to West Africa, and human systems and ecosystems have in the past been resilient enough to adjust. Now, however, climate change is occurring with great intensity, and the socio-economic system, imposed on the region from outside, has accentuated the vulnerability of farmers, livestock rearers and others dependent on the climate and natural resources. If these vulnerable groups do not receive outside aid to help them to adapt, the socio-economic and cultural systems that underlie rural and even urban communities in West Africa could be eroded or completely destroyed. Initiatives are needed to help small farmers and other vulnerable groups to protect and promote agricultural production. Simple, inexpensive actions could be taken, such as setting up an effective system of meteorological alerts, improving agricultural extension services so as to increase yields, and establishing local, independent networks of information exchange between communities across the region.

Almost everywhere in West Africa, farmers have the ability, through careful observation, to predict the climate without the help of a weather station. In several countries in the region – Benin, Mali, Togo and Burkina Faso, for example, – farmers are able to pick up changes in the behaviour of plants and animals (changes in colour, shape, bearing, period of maturation, migration, reproduction, nesting places, and so on) that tell them whether the rainy season will be early, or short, or whether a drought will be severe or mild. Systems could be set up through which families, collectives and communities could share this information. They could then prepare by selecting short-cycle varieties, for example, or planting on low-lying land if a drought is predicted.

There are also pitfalls associated with climate change. Farming families must be wary of easy so-called "solutions" that come from outside. In particular, they must be suspicious of "improved" seeds of non-controlled origin that are allegedly "resistant" to drought, pests and other climatic stresses because they have been genetically modified. These "climate" or "survival" seeds are distributed, initially at a low cost, to peasant communities by companies or organisations with their own vested interests. Despite the environmentally friendly rhetoric, these crops are highly damaging: the way they are cultivated and their impact on the ecosystem means that they will have a very serious and possibly irreversible impact on biodiversity, which is already under enough threat.

Conclusion

Both technical and policy measures are urgently needed to combat climate change. At a technical level, priority must given to measures that promote the adaptation of cultural practices to the new climate, the prioritisation of traditional knowledge developed locally in each region, a reliable water supply, and the use of direct traditional sowing wherever possible. It is important, too, to be aware that traditional knowledge can have an exciting new role in helping to develop new techniques, such as rainwater collection in areas of low rainfall. With regard to policy measures, it is necessary to mainstream adaptation to climate change, making sure it is systematically integrated into new projects focusing on biological diversity and into local, national and regional agricultural policies. Farmers, scientists and policy makers, moreover, must work together in a climate of mutual trust to develop the sustainable use of the region's biological resources.

Sandy Gauntlett is an environmental activist of Maori descent. He lectures in indigenous resource management at the indigenous university of Te Wananga O Aotearoa in New Zealand. He also chairs the Pacific Indigenous Peoples Environment Coalition and the Pacific Regional Focal Point for the Global Forest Coalition.

Pacific communities face cultural genocide

GRAIN interviews SANDY GAUNTLETT

How is the climate crisis affecting life in your part of the world?

The impacts of climate change vary from country to country in the Pacific region, with the low-lying islands being particularly badly affected. In some of the worst affected communities fresh water is becoming scarce as the local supplies get salinated from seawater leaching into the supply areas. In the islands of Kiribas [Kiribati] and Tuvalu, in particular, king [spring] tides now wash straight into people's homes and lands, and it is not unusual during these tides to see the roads under water and at times even the airport runway. You have to remember that these are long and extremely narrow islands with a maximum altitude of two or three metres above sea level. There is no natural protection against the ravages of nature except the coral reefs surrounding the islands, and these reefs are deteriorating as a result of climate change. In other areas (like New Zealand), the impacts of climate change have been much less obvious, but what we are experiencing as a region is devastating.

Photo: International Institute for Sustainable Development

Sandy Gauntlett

How are the Pacific indigenous communities reacting to the climate crisis?

Governments in both Kiribas and Tuvalu have been calling for far more radical reductions in greenhouse gas emissions than are being considered under the climate convention. And these reductions are absolutely necessary if we are to avoid what will amount to cultural genocide. To suggest that people abandon their lands, territories, culture and countries so that the first world can continue to enjoy a lifestyle based on exploitation of the planet and its resources is, of course, a gross breach of human rights. Yet that is exactly what we are suggesting if we accept the premise that developed nations can continue to buy their way out of their responsibilities to the rest of the world.

Many small, isolated communities do not understand why the storms are getting worse or more frequent, and serious resources must be invested in capacity building in these nations so that decisions are made on the basis of complete understanding. This is not meant as a criticism of the small islands' leadership, by the way. Their representatives at the climate convention have at times been heroic in their attempts to address climate justice. It is simply a statement of fact that more money is spent on underwriting new methods of introducing the market into the equation than on

Nuku Alofa declaration*

From 29 to 31 July 2009, over 15 participants from 8 different countries in the Pacific/Oceania region, from Indigenous peoples, civil society and governments, gathered in Tonga to discuss global issues that severely impact our region on a daily basis: climate change, forest protection, and the role of Indigenous peoples and local communities.

Preamble

We [Indigenous peoples of the Pacific] are deeply alarmed by the accelerating climate devastation brought about by unsustainable development, and we are experiencing profound and disproportionate adverse impacts on our Pacific cultures, human and environmental health, human rights, wellbeing, traditional livelihoods, food systems and food sovereignty, local infrastructure, economic viability and our very survival as Indigenous peoples.

Consumer nations must adequately address the issue of ecological debt to the global south and not shift liability for their own unsustainable production and consumption to those nations not responsible for the high level of climate emissions.

We remind the parties that Indigenous peoples are on the front line of climate change, whether they are from "developed" nations or not, and do not automatically have access to the benefits of a developed economy.

Call for Action

We are concerned that in its current form REDD is misleading and is a false solution to climate change, erodes Indigenous land rights and fails to account for the long term and ongoing conservation and land management of forested areas by Indigenous peoples and forest dependent communities.

We call for all nations in the Pacific to sign on to the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).

We call for any agreement on forests to fully and explicitly uphold the rights under UNDRIP, the Convention on Biodiversity (CBD), and the United Nations Framework Convention on Climate Change (UNFCCC).

All rights under UNDRIP must be included in the CBD and UNFCCC, and the customary and territorial land rights of Indigenous Peoples and forest-dependent communities must be recognised and enforced by any international agreement on forest policy.

We call for the suspension of all REDD initiatives in Indigenous lands and territories until such a time as Indigenous peoples' rights are fully recognised and promoted, and community consent has been obtained.

The linkage of REDD to markets risks allows Annex-1 countries to avoid responsibility for reducing emissions in their own countries and could even increase net carbon emissions. Carbon offsetting and the inclusion of REDD credits in carbon markets will do nothing to address the underlying causes of climate change, nor will carbon offsetting and market mechanisms provide the predictable and reliable funding required for addressing deforestation.

We demand that forests not be included in carbon trading schemes, and call on all governments to halt deforestation and keep fossil fuels in the ground; not trade one for the other. Forests need to be protected, but they must be protected by strengthening and enforcing forest legislation, not using market mechanisms.

We support the call for binding emissions reductions targets for Annex 1 countries of at least 45% below 1990 levels by 2020, and at least 95% by 2050. Annex 1 countries must therefore deliver on their commitments to making real and effective emission reductions.

We call for real and genuine solutions to climate change, not false solutions like ocean fertilisation, REDD, biofuels and monocultures for plantations that erode and violate the rights of Indigenous peoples and forest-dependant communities, and destroy biodiversity.

Any definition of forests must strongly differentiate between plantations and natural forests to incorporate fundamental Indigenous understandings of forests and account for the vast differences in carbon storage capacity.

We call for accurate carbon accounting on forests, and for ANY funding for the reduction of emissions from deforestation and degradation, and appropriate technology transfer to be prioritised for community-based forest management schemes, managed through strengthened mechanisms within the UNFCCC. Donor nations should not fund international financial institutions like the World Bank to implement projects that support flawed solutions to climate change.

* This is an edited version of the Declaration

Photo: Greenpeace/Jeremy Sutton-Hibbert

Pita Meanke watches a "king tide" crash through the sea wall into his family's property, Betio village, Kiribati.

reducing in real terms and at source the emissions that are creating the problem.

What is the Maori perspective on the issue?

There is no single Maori perspective on climate change, but those Maori who are engaged at the international level are very concerned about what is happening in our region. Partly because we are not yet being affected so badly as a country and partly because the reality of what is happening in our region is so horrible to contemplate, there is right now a lack of real understanding of what is happening. There are some Maori who are working on getting developed nations to accept their responsibilities in terms of climate emissions, while others work on recognising that we share common ancestors with some of the communities in the Pacific and should thus work closely together.

There is currently a lot of discussion about the Copenhagen climate conference in December. In your opinion, how important are its outcomes and discussions for groups on the ground?

I cannot really answer this question until I know what the outcomes are. If, as many of us now fear, no real commitment is made to massive emission reductions, then that is literally a death sentence for some people, and we need to hold the consumer nations responsible for what they are doing. If, as we all hope, there is agreement on large-scale and extensive reductions in emissions, then this might help to safeguard the future of the worst-affected communities. Copenhagen is, of course, hugely important in terms of achieving a commitment to real change for all of us, but for communities living on small, vulnerable islands, time is running out, and there is nowhere to run if or when a disaster occurs.

What real solutions can help to address the problem?

We need a full-scale halt to logging indigenous forests. We need a commitment to remove all inner-city car parking and to introduce energy-efficient, eco-friendly transport systems in every major city in the world. We need a cancellation of third-world debt so that developing nations are able to fund real savings in their own emissions. We need a reduction in the amount of waste and exploitation in development, especially in the consumer nations of the global North, and we need to make politicians accountable for the decisions they make, decisions that could result in mass deaths from climate disasters.

For those of our readers who may be less familiar with your part of the world, are there instances of community adaptation that you might like to share?

For the smaller island nations, adaptation is not something that can easily be achieved, as their emissions are not a major contributing factor. It is more a case of them having to adapt to the result of other nations' greed. But in some communities in the larger nations, there are schemes where people are leading their governments by example. In New Zealand, we are adapting our lifestyles to an extent and encouraging walking and cycleways as an alternative to the motor car. New Zealand has larger *per capita* car ownership than California, and much could be done in terms of transport and energy policies to reduce our emissions. But again, in order to ensure that these improvements have large-scale impact, we need our governments to lead the way and to increase in real terms the level and nature of public participation and decision-making, as well as putting large funds into improving public understanding. In a famous recent incident we had one of our celebrities call on the Prime Minister to commit to 40 per cent reductions in our emissions and his reply was that she should stick to acting. This type of arrogance can no longer be tolerated from our politicians, and if there is a high level of misunderstanding of climate change (which there is), then there is a responsibility on the part of our government to improve the capacity building programmes in our country (which they committed to under the Convention on Biological Diversity). There needs to be a commitment to funding NGOs so that the information on climate change that reaches the public comes from a wide range of sources.

The Ecological Revolution – Making Peace with the Planet

John Bellamy Foster

Monthly Review Press, New York, 2009, 288 pp, ISBN: 978-1-58367-179-5

review by GRAIN

This book, written by the editor of *Monthly Review*, is in essence a collection of articles, all of which (except for the introduction) have already been published. Such a format is often annoying, as it makes it difficult for the author to develop a carefully crafted central argument that gains force through the length of the book. In this case, however, the format works well, apart from a tendency to repetition, and the occasional article (such as the one on peak oil) that adds little to what is already well known. What makes the book powerful and fascinating is the strength of his central message, which Foster presents succinctly in the introduction:

> Capitalism as a world economy, divided into classes and driven by competition, embodies a logic that accepts no boundaries on its own expansion and its exploitation of its environment. The earth as a planet, in contrast, is by definition limited. This is an absolute contradiction from which there is no earthly escape.

Foster provides a strong theoretical framework for many of the arguments made in this issue of *Seedling*. Time and again *Seedling*'s writers point to the tendency of big corporations to squeeze out extra profits by destroying ecosystems whose biodiversity and capacity to absorb greenhouse gas emissions are urgently needed if life on this planet is to survive in anything like its present form. The short-sightedness of such actions beggars belief. In a cogently argued section, Foster points to one of the factors that accounts for this: with the exploitation of natural resources, there is no equivalent to the business cycle in the economy, so no internal (or external) mechanism which causes the system to re-organise. Just as happened with the inhabitants of Easter Island, unrestrained capitalism will go on destroying natural resources until the last tree has been felled.

Foster makes it absolutely clear that in his view capitalism cannot, by its very nature, resolve the deepening climate crisis. There is no possible technological fix, he says. This is perhaps the most important message of the book, for many active environmentalists still hope against hope that all we need to do to solve the ecological crisis is to make capitalism "sustainable", that is, to make technology clean, while allowing capitalism to continue expanding unabated. Foster points out that the classical political economists, from David Ricardo to John Stuart Mill, writing in the 19th century, were well aware that capitalist accumulation could not continue indefinitely, largely because land and other natural resources would run out.

Foster draws attention particularly to the British economist William Stanley Jevons, who, writing in the mid-19th century, elaborated what has become known as Jevon's Paradox. Jevons looked at the improvements that were being made in the use of coal to generate energy for the booming English industrial revolution, and concluded: "It is a whole confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth." In fact, it is not difficult to understand what lies behind the paradox: more efficient use of a resources allows, in the first instance, greater profits, which encourages greater investment in that activity and thus greater overall production and greater use of that resource; and so on and so on.

So is there a way out of the crisis? Foster, also author of *Marx's Ecology*, quotes a passage from volume 1 of *Capital* that is particularly relevant to the issues covered in this *Seedling*:

> All progress in capitalist agriculture is progress in the art, not only of robbing the worker but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress towards ruining the more long-lasting sources of that fertility.... Capitalist production, therefore, only develops the techniques and the degree of combination of the social progress of production by simultaneously undermining the original sources of all wealth – the soil and the workers.

This systematic robbing of the land of its natural fertility leads to what Marx calls in volume 3 of *Capital* a "metabolic rift":

> Large landed property reduces the agricultural population to an ever decreasing minimum and confronts it with an ever growing industrial population crammed together in large towns; in this way it produces conditions that provoke an irreparable rift in the interdependent process of the social metabolism. A metabolism prescribed by the natural laws of life itself. The result of this is a squandering of the vitality of the soil, which is carried by trade far beyond the bounds of a single country.

Foster believes that the only answer to capitalism's ecology of destruction is to revolutionise our productive relations in ways that allow for a metabolic restoration. But this, he says, will require a break with capitalism's own system of "socio-metabolic reproduction" – that is, the logic of profit. Foster points out that today we face a global ecological crisis: every major ecosystem on earth is in decline. "The planetary ecological crisis is increasingly all-encompassing, a product of the destructive uncontrollability of a rapidly globalising capitalist economy, which knows no law other than its own drive to exponential expansion." Any attempt to solve one of these problems (for example, climate change) without addressing the others, he says, is likely to fail, since these ecological crises, though distinct in various ways, typically share common causes.

Foster has no blueprint for the future, but he is emphatic that to avert ecological catastrophe capitalism must be overthrown or severely restrained. He states his position clearly in the opening sentence of the preface: "We have reached a turning point in the human relation to the earth: all hope for the future of this relationship is now either revolutionary or it is false." And again later in the book: "socialism is ecological, ecologism is socialist, or neither can truly exist." He suggests indirectly that the most powerful movements for revolutionary change will emerge in the global South – and, indeed, are already beginning to do so. Beyond that, he is unwilling to elaborate.

Combating the climate crisis, US-style

In the run-up to the vote on climate-change legislation in the US House of Representatives in June, no fewer than 1,150 different organisations and companies were in Washington, promoting their vision of how the nation should tackle climate change.[1] This means well over two lobbyists per representative. The huge increase in the number of lobbyists – there were only about 155 in 2003 – reflects the widespread recognition that Barack Obama means business. "With George Bush sitting in the White House, nobody thought there was going to be a bill passed", said Deborah Sliz, from the lobbying firm Morgan Meguire.

Most of the lobbyists represent special corporate interests so, not surprisingly, the original 648-page draft has already ballooned into a 1,428-page monster, with many amendments. It is difficult to judge whether the main goal – to reduce the nation's greenhouse gas emissions by 17 per cent by 2020 – has remained intact after such a hammering. And more changes are expected before December, as the bill makes its way through the Senate.

Industrialists, power companies and the oil and gas industry still dominate the lobby, but the farm sector has been increasingly flexing its muscles. A group of agriculture giants, including Cargill, Tyson Foods and General Mills, has formed a coalition and are working closely together. Even though they won important concessions in the negotiations prior to the vote in the House, including an exemption from having to cap most greenhouse gas emissions from farms (see page 20), they are pressing for further changes. Showing a hitherto unsuspected concern for the poor, they claim that in its present form the bill will have "adverse impacts on food security" and will harm "low-income households struggling with rising food prices".

United States Capitol, Washington DC

Although their interests often coincide, there is some tension between the farm giants and the biofuels lobby, which is anxious to maintain maize subsidies. In 2007 POET Biorefining from South Dakota overtook agricultural giant Archer Daniels Midland (ADM) as the country's leading producer of ethanol from maize. POET only recently joined the lobbyists and has been mainly active through a new interest group, Growth Energy, which it created with other ethanol manufacturers. Reflecting the close corporate–military nexus, retired four-star general and former NATO commander Wesley Clark is the group's public face.

1 Marianne Lavelle, "Tally of interests on climate bill tops a thousand", Center for Public Integrity, 10 August 2009, http://tinyurl.com/krb8tu

Biopiracy of climate-resistant crops

Some readers, particularly in the USA and Europe, will have seen the advert. A sophisticated picture in pink, orange, black and white of blurred people on the move, and above in large letters: "9 billion people to feed. A changing climate. NOW WHAT?" Below, more text: "Experts say we'll need to double agricultural output by 2050 to feed a growing world. That's challenge enough. But with a changing climate, the challenge becomes even greater." The solution? "Providing abundant and accessible food means putting the latest science-based tools in farmers' hands, including advanced hybrid and biotech seeds.... That's a win-win for people and the earth itself."

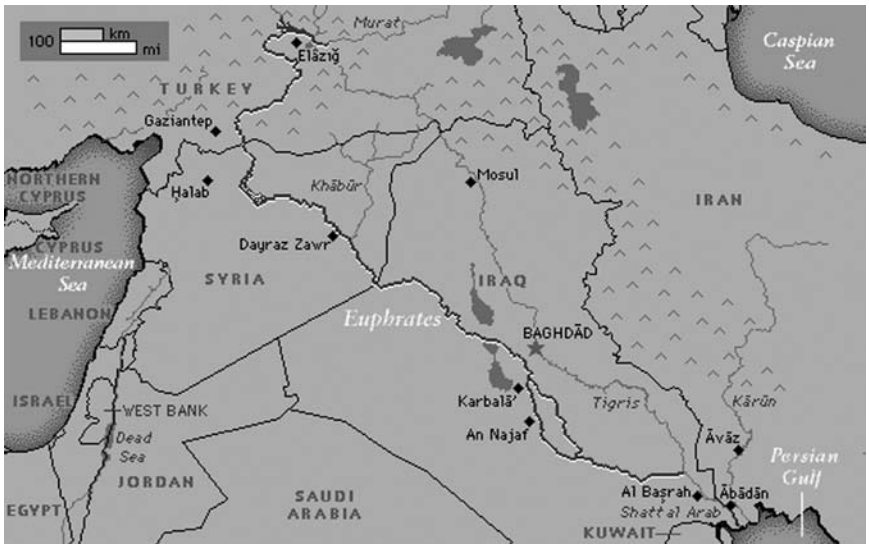
In recent months, biotech companies (in this case, it's Monsanto) have been carrying out a big publicity drive to present themselves as benevolent, environmentally aware suppliers of the only technology that can feed the world as the climate crisis escalates. But behind this façade is another, harsher reality: a race to patent the crops that are resistant to extremes of weather. Earlier this year Navdanya, a non-governmental organisation founded by the Indian scientist and environmental activist, Vandana Shiva, published a report entitled "Biopiracy of climate-resistant crops: gene giants steal farmers' innovation of drought resistant, flood resistant and salt resistant varieties". The report said that four companies – BASF Bayer of Germany, Syngenta of Switzerland and the US-based Monsanto and Du Pont – had taken out hundreds of patents on climate-resistant crops developed and saved by Indian communities.

Dr Vandana Shiva

Vandana Shiva told IPS that the biotech companies were piling "one disaster upon another" by looking at the climate crisis as a business opportunity. "On the basis of this new form of biopiracy, the biotech industry is positioning itself as the climate saviour and making governments and the public believe that, but for them, there will be no climate-resistant seeds", she said. "By making broad claims on all crops and all traits, the industry is closing future options for adaptation to climate change." In the report, Navdanya said that the response to the climate crisis lay not in patented seeds but "in the hands of millions of farmers conserving, improving and breeding hundreds of thousands of varieties of climate-resilient crops that are specifically adapted to local conditions and a changing environment".

Leaving the land in Syria

In 2007 and 2008 some 160 villages in northern Syria were abandoned by their inhabitants because of a serious drought, which climatologists believe could recur with increasing frequency. According to a report published by the International Institute for Sustainable Development (IISD), "climate change



The River Euphrates, from its source in the mountains of Turkey, runs though Syria and Iraq to the Persian Gulf

[in Jordan, Israel and the occupied Palestinian territories] threatens to reduce the availability of scarce water resources, increase food insecurity, hinder economic growth and lead to large-scale population movements". The IISD predicts that even modest global warming would lead to a 30 per cent drop in water in the Euphrates, which runs through Turkey, Syria and Iraq.

Oli Brown, who wrote the report with Alec Crawford, said: "Climate change itself poses real security concerns to the region. It could lead to increased militarisation of strategic natural resources, complicating peace agreements. Israel is already using climate change as an excuse to increase their control over the water resources in the region."

Agro-ecological farmers weather the storm

As in many other parts of Brazil, farmers in the Planalto Norte region in the state of Santa Catarina faced difficult weather conditions in the 2008–9 farming year. First, at the beginning of planting season in October, it rained very heavily, causing flash flooding. Then, after many of the farmers had been forced to replant, there was an extended period of drought until the end of December. According to a field study carried out by AS–PTA, an organisation of small-scale, agro-ecological farmers, conventional farmers lost R$762 (about US$416) per hectare. In contrast, farmers in the region who were in the process of converting to agro-ecological farming, had a profit of R$980 (US$534) per hectare, largely because their costs were only one-tenth of those incurred by conventional farmers. The study shows that even in the short term, when farmers are still learning how to farm without chemical inputs, they are often in a much better position than other farmers to deal with the unpredictable weather stemming from climate change.

Photo: Dan Baron-Cohen

Tending crops on an agro-ecological school farm, Santa Catarina

Gone but not forgotten

In the last issue of *Seedling*, we reported that the authorities in Egypt had taken advantage of the swine flu epidemic to order the wholesale slaughter of the 300,000 or so pigs reared by small producers. They had taken this drastic measure even though swine flu is widely known to be transmitted by humans, not pigs, and no case of the disease had been reported in the country. The government said that it was a hygiene measure to rid the country of "unsanitary pig farming conditions" and to make way for "cleaner" European-style factory farms.

The measure, however, has had a side-effect that is far from hygienic: the proliferation of rubbish in the streets. Ramadan Hediya, 35, who makes deliveries for a supermarket, lives in Madinat el Salam, a low-income community on the outskirts of Cairo. She told the *New York Times*: "All the pathways are full of rubbish. When you open your window to breathe, you find heaps of rubbish on the ground." The problem should not have come as a surprise. Indeed, public health experts criticised the pig massacre at the time as "misguided", and warned the authorities that the city would be overwhelmed with rubbish.

What the measure did, in fact, was completely disrupt Cairo's rubbish collection system, without providing a proper replacement. For more than half a century, people from the *zabaleen* community of Coptic Christians who live on the cliffs on the eastern edge of the city, collected the rubbish, sold the recyclables and fed the organic waste to their pigs – which provided their community with pork. "They killed the pigs, so let them clean the city," said Moussa Rateb, a former rubbish collector and pig owner.

According to some social commentators, the crisis has exposed the failings of a government where power is concentrated at the top, where decisions are often carried out with little consideration for their consequences, and where follow-up is often non-existent. Killing all the pigs, all at once, "was the stupidest thing they ever did," said Laila Iskandar Kamel, chairwoman of a community development organisation in Cairo.

Pigs in the back yard of a house in a zabaleen *community, Cairo, before the cull*

Food rebellions! Crisis and the Hunger for Justice

Eric Holt-Giménez and Raj Patel

Pambazuka Press, Cape Town, Dakar, Nairobi and Oxford, 2009

review by GRAIN

In this book, two leading critics of the world food system analyse the food crisis, seeing it rooted in an industrial economy that generates huge profits for a few while disregarding the needs of the many. It is important, they say, that control over our food systems be wrested away from unregulated global markets, speculators and monopolies and handed back to family farmers, rural women and communities around the world who have resisted the destruction of their native seeds and worked hard to diversify their crops, protect their soils, conserve their water and soil, and run community-based food systems.

The authors then provide information for those who want to help in the struggle to regain control over our food systems. Drawing on examples from Latin America, Africa, and Europe, they draw a picture of numerous inspiring grassroots movements that are gradually beginning to coalesce at a regional and international level. It is becoming a race against time: "Unless we transform our food systems to make them more equitable, democratic and sustainable, they will not be able to withstand the waves of environmental and financial shocks rocking the planet. Our food systems will break down and food will routinely be both expensive and in short supply, puttting it increasingly out of the reach of the world's poor, leading to more food riots, political and environmental instability, and suffering."

Let them eat junk! – how capitalism creates hunger and obesity

Robert Albritton

Pluto Press, London and New York, 2009

review by GRAIN

Over the last few years there has been a flurry of books about junk food and the junk farming and food processing systems that produce it. What makes this book different is the Marxist framework in which the analysis is couched. Albritton argues that capitalism is intrinsically incompatible with environmentally sound farming practice and the production of nutritious food. In a book chock-a-block with facts, Albritton takes a broad look at the food industry, from the expansion of industrial farming in the developing world to conditions for the workers in food processing factories to the impact of junk food on the people who eat it.

Although the book contains a great deal of useful information, it disappoints. Albritton is not an elegant writer, and he has the annoying habit of summarising what he is about to say, saying it and then summarising what he has just said. Moreover, his analysis is often crude and simplistic. But despite its imitations, the book is a compelling indictment of current food production, which is ruining our health and destroying the environment. Like many others, Albritton is not very clear as to what can be done to stop the powerful food industry from propelling the world towards destruction. Referring briefly at the end of the book to "large and significant movements for change based in the global South", such as Via Campesina, he hopes that revolutionary change will come: "As the failures of our capitalist economy become ever more obvious to more people, chances are that the rivulets of transformation that exist now will flow together into powerful rivers of change and then into an international upsurge."

GRAIN's latest publication

"CGIAR joins global farmland grab" – *Against the grain*, September 2009

The international agricultural research establishment has got caught up in the current scramble for land being waged by a number of governments and corporate investors to secure food supplies abroad. GRAIN has identified over 100 such deals, most of them triggered late last year by the food and financial crises. In the middle of this year the International Food Policy Research Institute (IFPRI) estimated that 15–20 million hectares, mostly in Africa and Asia, had recently been leased, bought up or were under negotiation to produce food for foreign shores. The World Bank has plunged into a major study on the issue, to be finalised by the end of 2009. Land grabbing has even become a feature of most official food security policy discussions at the highest political levels this year, including the G8, the African Union and the UN General Assembly.

For the full text, go to: **http://www.grain.org/articles/?id=52**

GRAIN maintains a resource page on land grabbing, with links to documents, websites, various initiatives and other materials: **http://www.grain.org/landgrab/**

Daily news about the land grabbing trend and people's resistance to it are available at **http://www.farmlandgrab.org**. The site provides a weekly email service that you can subscribe to.

GRAIN is governed by a Board composed of dedicated individuals acting in their personal capacities. We do not tend to put them much in the spotlight, but they do play a crucial role in giving direction to GRAIN's work and organisation. There is regular rotation and renewal of Board members. Recently we uploaded on to our website brief interviews with each of our current Board members, to give an idea of where they come from and what motivates them. Here we present each of them one by one (clockwise in the picture, starting at the top left). You can find these interviews at www.grain.org/about/?board

Photos: GRAIN

GRAIN's Board

Paul Nicholson works in Spain for EHNE, a rural trade union, which was a founder member of La Via Campesina. "My main interest is food sovereignty, which we are building from the local level", he says. "It's going to be a process of accumulation through alliances at the local, national and international levels. That's the focus of most of my political work today."

Maria Fernanda Vallejo comes from Ecuador. She works for an organisation called the Heifer Foundation, active in four continents. "My work is basically strengthening indigenous and peasant organisations in the Central Andes of Ecuador", she says. "The region is largely inhabited by Quechua indigenous groups. "

Cathy Holtslander is from Saskatoon, Saskatchewan, Canada. "I work with organic farmers through Beyond Factory Farming", she says. "It is an organisation that works with sustainable livestock production." She is also on the board of the Saskatchewan Organic Directorate and active in the movement to protect seeds from genetic contamination by GMOs.

Assetou Samaké [inset] comes from Mali. She works for IRPAD (Institut de Recherche et de Promotion des Alternatives en Devéloppement), which promotes alternative development in the area of agriculture. "Many such solutions exist in Africa but they are not taken into sufficient account by the authorities", she says

Meriem Louanchi, from Algeria, lectures in plant pathology at the National Institute for Agriculture, in Algiers. "I'm also active in an organisation called the Association for Reflection, Exchange and Action for the Environment and Development", she says. "In the beginning the organisation was involved in environmental education, but very quickly, since 1999 at least, we've been leading actions around GMOs."

Supa Yaimuang is from Thailand, where she works for the Alternative Agriculture Network. "We do research to support farmers, particularly in the area of seasonal agriculture", she says. "We help them to save seeds, to process their crops and to develop food sovereignty." The Network also helps farmers to operate community radios.

Silvia Ribeiro works for the ETC Group in Mexico. "Generally, the ETC Group works on the impact of new technology on society", she says. "But in Mexico we have been focusing particularly on the issue of seeds, and how genetically modified seeds are affecting crops, people's rights and their livelihoods."