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World Trade and the Regeneration of Agriculture

by Wolfgang Sachs and Tilman Santarius

with contributions from
Sophia Murphy and
Daniel De La Torre Ugarte

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moderated by
Wuppertal Institute for Climate, Environment and Energy

Contacts:

Heinrich Boell Stiftung, Hackesche Hoefe, Rosenthaler Str. 40/4, D-10178 Berlin
T: ++49-(0)30-285-34-187
E-mail: haas@boell.de

Misereor, Mozartstr. 9, D-52064 Aachen
T: ++49-(0)241-442-192
E-mail: kolmans@misereor.de

Wuppertal Institute for Climate, Environment and Energy, Doeppersberg 19, D-42103 Wuppertal
T: ++49-(0)30-28095493
E-mail: wolfgang.sachs@wupperinst.org
tilman.santarius@wupperinst.org

About the authors:

Wolfgang Sachs is an author, university teacher, and journal editor. From 1966–73 he studied theology and social sciences in Munich, Tübingen, and Berkeley. In 1975 he received a PhD from the University of Tübingen. Since 1993 he has been a Senior Fellow at the Wuppertal Institute for Climate, Environment, and Energy. He is the head of research on globalization and sustainability. He is also a regular lecturer at Kassel University and Schumacher College, England. From 1993–2001 he was Chair of the Board of Greenpeace Germany. He is a member of the Club of Rome. His recent books in English are: *Planet Dialectics. Explorations in Environment and Development*, London: Zed Books, 1999. *The Jo'burg Memo. Fairness in a Fragile World* (ed.), Berlin: Heinrich Boell Foundation, 2002. *Fair Future. Resource Conflicts, Security and Global Justice* (ed. together with T. Santarius), London: Zed Books, 2007.

Tilman Santarius joined the Wuppertal Institute in 2001. In the institute's Berlin office, he is Senior Research Fellow working in the fields of trade, climate policy, and globalization. His primary research area is the interface between trade and environmental policy. From 2002–04 he served as coordinator of the key project on globalization and sustainability at the Wuppertal Institute. Together with Wolfgang Sachs, he is lead author of the book *Fair Future. Resource Conflicts, Security, and Global Justice. A Report of the Wuppertal Institute*, London, 2007. Tilman is active in both the environmental movement and the movement for an alternative globalization. He holds a master's degree in sociology, anthropology, and economics.

Preamble

This paper is written as a discussion paper within the framework of the project "EcoFair Trade Dialogue: New Directions for Agricultural Trade Rules" (http://www.ecofair-trade.org).

The EcoFair Trade Dialogue is an international project carried out by the Heinrich Böll Foundation in cooperation with MISEREOR and facilitated by the Wuppertal Institute. The overall aim of this project is to enrich the debate on the reform of the current regime of global agricultural trade through the development and advancement of forward-looking guidelines and instruments, taking the concepts of "food sovereignty" and "sustainable agriculture" as reference points. Since the beginning of 2005, the EcoFair Trade Dialogue has brought together a group of 11 "experts" on agriculture and trade issues from around the world, the so-called Expert Panel, to exchange views, work intensively together, and make innovative and feasible proposals for a profound reform of the international agricultural trade regime. During 2006 a series of stakeholder dialogues in different regions of the world were conducted to bring additional expertise to the process, and to ground the group's proposals in local and regional experiences. A concrete and coherent reform proposal that responds to the twenty-first century's social and ecological challenges for global agriculture is envisaged as the outcome of the project.

The EcoFair Trade Expert Panel has identified the industrialization of farming and the food system as one of the obstacles for the emergence of a fairer and more ecologically sound market in agricultural goods. This paper looks at the relationship between world trade and industrial agriculture, and investigates trade rules' possible role in the ecological regeneration of agriculture.

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Executive Summary

Recounting the history of the twentieth century, the British historian Eric Hobsbawm described at length the ruptures and revolutions, the wars and massacres of this, as he calls it, “Age of Extremes.” Yet in his view, the most far-reaching sea change that occurred in that century, the one which forever separates the modern world from the past, is the worldwide death of the peasantry (Hobsbawm 1994: 289). For the second half of the twentieth century marked the end of several thousand years of cultural evolution when the overwhelming majority of the human race lived by growing food, raising livestock, or harvesting the sea as fishers. After the peasants of rural Europe and Japan had more or less stopped tilling the land by the 1960s, Latin America, large tracts of Asia, and North Africa followed suit in the following decades. Only three regions of the globe remain essentially dominated by their villages and fields: sub-Saharan Africa, South and continental Southeast Asia, and China (ibid.: 291).

As peasant cultures vanished across the globe, agriculture was profoundly transformed. In the course of this transformation, enormous numbers of people fled the countryside to migrate to ever-growing cities. Farming retreated from mountainous or arid land to be concentrated in fertile plains, and agriculture turned from a way of life into a business producing commodities for distant markets. Vast expanses of wheat fields in Iowa, valleys of green rolling hills of vineyards in Chile, endless stretches of cotton fields along irrigation channels in Punjab: The ecology and economy of farming and livestock raising has been revolutionized during the last half century by the advent of industrial agriculture. What distinguishes this form of agriculture from all previous practices? How widespread is industrial agriculture in today’s world? What is its impact on the biosphere? What strategies and concepts are available to overcome its environmental problems? And how does its place in the natural world determine the WTO negotiations on agriculture—or how should it? These are the kind of questions this paper attempts to address in six chapters, structured as follows:

Setting out from nineteenth-century guano imports, shipped from Latin America to Europe, chapter 1 describes how external-input agriculture came on the rise. To this day, world trade has contributed much to—if not spurred the industrialization of—agriculture, that is, a way of farming which relies more and more on external inputs, such as fertilizers, pesticides, medicine, seeds, or the latest information technologies.

Today those countries leading in agricultural exports, such as the United States, the European Union, Brazil, and others, have highly industrialized farm systems. Thus, a significant share of agricultural world trade is derived from industrial agriculture. Most of the processed products from industrial agriculture serve the transnational consumer class in the North and South, while large parts of staple foods go into concentrated animal feed operations for industrial livestock production (chapter 2).

Industrial agriculture generates severe environmental impacts. In fact, the impacts mark the intersection of some of the most urgent global environmental problems, such as climate change, land degradation, water shortage, and loss of biodiversity. These impacts in turn destabilize the livelihoods of farmers worldwide who depend on a sound environment for economic, social, and cultural reasons (chapter 3).

Various strategies to de-industrialize agriculture and regenerate it with ecological cycles, such as Resource-Conserving Agriculture, Agroecology, or Certified Organic Agriculture, have contributed to making farming practices less environmentally harmful. However, these strategies mark only the beginning of an ecological reform of the food system. Because they have so far merely focused on farming practices in the field, they leave environmental impacts from later stages in the food system out of sight. Moreover, they risk being outrun by increasing prices and competition pressures from a newly globalized market for organic produce, and the increasing power of food companies (processors, retailers, distributors, etc.) in the trade arena (chapter 4).

The WTO—as the organization dealing with world trade and setting the framework conditions for the global market—has so far left these issues at the wayside. Environmental impacts of trade liberalization have not been sufficiently considered in trade talks and policies. Negotiators have not addressed environmental problems of industrial agriculture—not to mention that they would need to consider how trade rules could make the food system more environmentally sound, and push for the transition toward sustainable agriculture (chapter 5).

As the free play of market forces does not sufficiently ensure the coproduction of the private and common good, such as the protection of the biosphere, it needs to be embedded in a larger institutional context that is designed to secure the public interest. Environmental trade policies in agriculture may be designed in three arenas (chapter 6):

First, in the arena of national politics. Multilateral trade policies should leave sufficient policy space for governments to be flexible in their choice of adequate policies and measures that stimulate the sustainable transformation of farming practices, and that protect farmers from excessively strong price pressures. Furthermore, national policies must retain policy space to implement sustainability processes and production standards; for locally developed standardization schemes have the greatest potential to accommodate the broad diversity in ecological and social conditions around the globe, and thus can best generate standards that are most appropriate for the respective environmental and socio-cultural conditions. In addition, based on proven implementation of those standards at the national level, countries must retain the opportunity to qualify access to their markets by imposing these same standards on imports.

Second, in the arena of multilateral trade policy. Global standards for internationally traded goods are required in order to create a truly least-cost playing field. However, these standards should come in the form of meta-standards, because harmonization of actual quality norms at the global level does not prove sustainable. Meta-standards do not define the actual quality norms, but rather the process in which standards are developed. In particular, they delineate criteria for open, participatory, and democratically legitimized standard setting processes. Moreover, meta-standards will require the development of such norms, which in turn, will establish an important quality standard in international trade while respecting the diversity in the world.

Third, in the arena of multilateral tax policy. Fees charged for the use of common resources, such as air space and the seas, aim to reduce adverse environmental effects from energy-intensive, long-distance transportation related to global trade. They would establish a disincentive for sourcing from or relocating to regions where standards are low, thus helping to re-regionalize the entire food system in order to make it more environmentally sound.

1 What is Industrial Agriculture?

Ever since the invention of agriculture some 8,000 years ago, humans have grown crops and raised animals. However, what makes modern agriculture stand out by comparison is its formidable capacity to produce higher and higher yields with fewer and fewer people on roughly the same amount of hectares. The leap in agricultural productivity achieved in the past century was unheard of before; the productivity rise in the last decades of the twentieth century—as Paul Bairoch claims—even surpassed the progress accumulated over the prior nine hundred years. Thanks to this leap in productivity, the world production of food per capita has increased by 25 percent over the course of 40 years, despite the fact that the global population has grown by 90 percent. Moreover, this feat was accomplished while the land area under cultivation increased only by 10 percent and the number of laborers working the land diminished dramatically by about 40 percent (Bairoch 1993). Food production has expanded faster than the population on roughly the same land area while at the same time ceasing to be mankind's primary occupation. This extraordinary success can be seen as the hallmark of industrial agriculture.

However, it would be off the mark to associate higher productivity levels in agriculture with industrial farming. Indeed, historians reserve the term "agrarian revolution" for a wave of innovations that gave a boost to agricultural productivity in Europe between 1750 and 1850. It was during this period that continuous cultivation was introduced, replacing the customary three-field system where fields lay regularly fallow for certain intervals. This practice—among other practices, such as terracing and crop sequencing—helped farmers to cope with the perennial problem of declining nutrients in the soil. But soil recovery no longer implied a loss in cultivated land, as leguminous plants and forage plants were introduced into the cycle of crop rotation. For these plants, for example clover, lupines, and beans, not only enriched the soil, but also provided fodder for animals that made both dung and traction force available (Bevilacqua 2002: 4). Interlinking fields to pastures and pastures to fields made uninterrupted cultivation possible at a higher level of nutrition recovery. New plants, more complex rotation patterns, and the combination of animal raising and crop cultivation thus led to an unprecedented rise in productivity already prior to the invention of industrial agriculture.

What makes industrial farming different from the earlier agrarian revolution is its reliance on external inputs for improvement. While the reforms in the eighteenth and nineteenth centuries increased productivity through re-linking and reinforcing nutrient cycles on the farm, twentieth-century industrial agriculture drove up productivity through breaking these cycles and shifting both the input end and the output end off-farm. In effect, breaking the nutrient cycle on-farm was first made possible by importing fossilized animal waste from abroad. In the latter half of the nineteenth century, a rush broke out in Peru to mine guano—petrified excrements built up by seabirds over centuries. Indeed guano proved to be a highly effective fertilizer; its spread permitted European farmers to produce higher yields without exhausting their fields. But the arrival of guano constituted a systemic rupture in the history of agriculture (Bevilacqua 2002: 21). For the first time, the regeneration of soil fertility depended on sources outside the farm and outside the rural economy, for guano was not part of the materials used for the regenerative cycles in agriculture. To be sure, guano was a natural fertilizer, but its introduction nevertheless changed the practice and perception of farming. With fertilizers available from outside the rural world in apparently inexhaustible quantities, farming ceased to be an activity inscribed into the regenerative cycles of an ecosystem and instead became inscribed in the cycle of global trade. From then on, it was no longer important to keep complex cycles of regeneration at work by maintaining a balance between fields and pastures (Radkau 2000: 223). External inputs have substituted an internal nutrients deficit ever since, a shift that was soon to substitute for deficits in pest protection as well.

Much of the further progress in twentieth-century agriculture has been based on the increasing range and effectiveness of external inputs available to the farmer. Purchasing new varieties of seeds substituted for on-farm selection, mineral and synthetic fertilizers replaced organic inputs, chemical substances were brought into action for pest protection, tractors and harvesters made human labor redundant, and irrigation works were stepped up to secure stable water supplies over longer distances. The rise of industrial agriculture, first in the United States, then in Europe, and subsequently the "Green Revolution" in Southern countries, turned both the economic and the ecological position of farmers in the food supply chain upside down; economically, farmers who once had been producers now became consumers of a broad range of external inputs. And ecologically, farms that once had operated through layers of feedback cycles now became transit sites for material throughput on its way from extraction to dispersion. The most recent developments in agricultural technology continue this trend; both genetic engineering and satellite-based informatics, promoted as "precision farming," turn farming from a self-reliant activity on the land into a function of technological means provided by industry.

The term "industrial agriculture" thus refers to farming systems that use a high amount of external inputs. For basic farming activities—such as fertilizing the soil, protecting crops, feeding animals, powering human labor, and reproducing plant and animal species—can be done with inputs originating either on-farm or off-farm. Industrial agriculture largely relies on external inputs that substitute for natural control processes and resources. As Jules Pretty (1995: 9) put it: “Pesticides have replaced biological, cultural and mechanical methods for controlling pests, weeds and diseases; inorganic fertilizers have substituted for live stock manures, composts and nitrogen-fixing crops; information for management decisions comes from input suppliers, researchers and extensionists rather than from local sources, and fossil fuels have substituted for locally generated energy sources.” In the process, once-valued internal resources have turned into useless products that add to the waste stream. Since external inputs are generally products of industrial manufacturing processes, high external input crop and livestock production is called industrial agriculture.

Moreover, the industrialization of farming also left its imprint on the socio-economic character of agriculture. High reliance on external inputs usually implies farming systems that are commercially oriented, of a certain scale, and driven to be monocultures. For there are consequences high-input farming cannot escape. First, the purchase of inputs requires capital for investment. Just like in factories, access to capital is the primary prerequisite for production, otherwise there will be no truckload of fertilizers, no combine harvester, no irrigation system. High-input farms, therefore, are likely to be run as commercial enterprises. Moreover, advancing capital is economically viable only if returns are high and sufficiently stable for recovering investment and capital costs within a reasonable period of time. Since large profits are best obtained by operations of a considerable size that take full advantage of the available economies of scale, high external input farms tend to be of a larger size. Economies of scale come into play in particular with regard to machinery that can be used more efficiently on larger fields and with higher volumes. Finally, cropping patterns, too, are likely to be affected by the imperative of efficient allocation. Maximizing yields calls for concentrating farm work on a few crops, if not one single crop—a strategy that has become possible because reliance on external inputs makes on-farm diversity unnecessary.

For these reasons, industrial agriculture typically implies large-scale monocultures that cater to distant markets and are sustained by an investment package of high-yielding seeds, synthetic fertilizers and pesticides, irrigation schemes, and machinery. Similarly, as industrial agriculture includes both crop cultivation and livestock production, also animal farming usually implies external inputs of semen, feedstuff, medicines, energy, and machinery, just as it is oriented toward efficient meat production of one animal species in high densities and close confinement. The industrial style of farming, which is responsible for most of the productivity increases over the past decades, has come to dominate agricultural production in Northern as well as in Southern countries. Indeed, some 1.2 billion people are supported by high external input farming in the industrial world, and some 2.3–2.6 billion people in the countries of the South (Pretty 1995: 2)—figures that suggest that not less than 60 percent of the world population actually depends on industrial agriculture.

2 Size, Scope, and Trade Links of Industrial Agriculture

As the industrialization of agriculture continuously spread around the globe, it made up ever-larger parts of those agricultural products and commodities traded in the international market. Already today, industrial systems generate about 74 percent of the world's poultry products, 50 percent of all pork, 43 percent of beef, and 68 percent of eggs (Nierenberg 2006: 26). Historically, industrial countries dominate industrial agricultural production. However there are stark differences in the degree of industrialization among them. And developing countries are rapidly expanding and intensifying industrial agricultural production, with Asia having the fastest-developing industrial livestock sector. How industrialization of agriculture has spread over the past decades can be gleaned by looking at indicators, such as degree of mechanization, input-intensity of fertilizer, concentration of livestock per hectare, and the diffusion of genetically modified seeds as indicators.

Table 1: Distribution of agricultural land and intensity of agricultural inputs in selected regions and countries (Source: FAO 2005)

Region/Country	**Agricultural land (1000 ha) 2002**	**Fertilizer (kg/ha) in 2001**	**Mechanization (tractors per 1000 ha) in 2001**
Argentina	35,000	24.6	8.6
Australia	48,600	47.1	6.2
Brazil	66,580	102.9	12.1
Canada	45,879	53.6	16.0
China	153,956	227.6	7.2
European Union	113,994	50.2	28.8
India	170,115	102.1	9.0
New Zealand	3,372	267.2	22.5
Russian Federation	125,300	12.7	6.2
Sub Sahara Africa	182,680	11.4	1.3
United States	178,068	110.7	27.1
Developed Countries	**635,324**	**79.9**	**30.5**
Developing Countries	**904,850**	**98.6**	**8.3**

As table 1 shows, in developed countries the level of mechanization is nearly four times higher than in developing countries—not withstanding the fact that in principle, the number of tractors is higher in small farm systems compared to large-scale farm systems, as tractors are usually owned by the farmers irrespective of the sheer size of their farms. Still, the European Union and the United States mark the highest level of mechanization in the world, with 28.8 and 27.1 tractors per 1000 hectares, while these regions cover just roughly one-fifth of the global cropland. Argentina, Brazil, and India appear to be more mechanized than the average of developing countries, while China, Russia, and countries in Sub-Saharan Africa, Central America, and the Caribbean remain below. Interestingly, the picture changes with respect to fertilizer use. On average, more fertilizer is brought onto the fields in the South than in the North. Most of all China, but also countries like Brazil and India show a higher fertilizer consumption than the European Union. The figures suggest that the industrialization of agriculture does not necessarily come as a package; while the richer farmers in the world can afford to enlist the help of fuel and engines, less well-off farmers are constrained to resorting to fertilizers—and presumably pesticides—only. In other words, the chemicalization of farming reaches much further than its mechanization.

The extent of genetically modified organisms in farming ("GMO-farming") can serve as another indicator for industrial farming systems. The largest areas under GMO-farming are located in regions of the major agricultural land owners: United States (49.8 million ha / 28 percent of its arable land), Argentina (17.1 million ha / 62 percent of its land), Brazil (9.4 million ha / 15 percent of its arable land), Canada (5.8 million ha / 12 percent of its arable land) and China (3.3 million ha / 2 percent of its arable land). Today the total area of cultivable land of GMO crops spans about 90 million ha, which are distributed among 21 different countries. Besides maize and cotton, mainly soybeans are cultivated (ISAAA 2005). This does represent 0.8 percent of the world's arable land in production. Soybeans, corn, and cotton represent 95 percent of the genetically engineered plants in the world.

Finally, the concentration ratio of livestock may serve as an indicator of industrialization, measured, for example, by animal per hectare for extensive animal production. Livestock concentration, according to the FAO in 1960, was on average 0.64 animals per hectare of pasture if only cattle, sheep, and goats are considered. In 2003 this average increased to 0.93 animals per hectare. This world average increase represents an almost 45 percent increase in the livestock per hectare. The major concentrations have taken place in a few countries for all major livestock productions, mainly in agriculturally developed and transition countries. Pork production doubled over the last four decades, with China representing 73 percent of that increase followed by the European Union with 15 percent. Chicken production increased by 200 percent during the last 40 years. Of this, 30 percent is represented by China, 10 percent each by Brazil and the United States. Broilers in most developed agricultural countries are now almost completely industrialized. Cattle livestock increased 50 percent during the same period, of which 33 percent took place in Brazil and 16 percent in China.

What is grown and where does it go? Two case studies

One of the details not often highlighted in analyses of global food production is how much of the food grown is actually feed destined for livestock rather than people. This is especially true for grains, which are among the most internationally traded commodities. The following overview of wheat and soybeans illustrates the situation.

As for wheat, the top five wheat exporters are the United States, France, Canada, Australia, and Argentina—countries that are marked by highly industrialized agricultural systems. If all EU wheat exports are included, about 75 percent of world exports in wheat from 2006 through to 2015 will be produced by high-input farming (Vocke, Allen, and Ali 2005), because production in all the top wheat producer countries is industrialized, although fertilizer and tractor use per hectare of arable land is much lower in the former USSR than in the other countries. No one is using genetically engineered wheat varieties as of yet.

Wheat, of course, is still primarily a food and not a feed grain. Animals consume an estimated 19 percent of total global wheat produced, and up to 30 percent of that produced in the United States (Clay 2004: 378). However, in the constant search for new markets and new ways to sell the still-rising output of grains, wheat for animal feed has provided a growing market. The money to be made from supplying meat to wealthy consumers is much greater than the profits available from selling grains to people living in poverty—people who get half or more of their daily calories from grains. Besides, wheat is too expensive to grow for animal feed alone; feed is a by-product of processing wheat into flour for people to eat. Whole wheat yields about 70 percent white flour, leaving 30 percent as a by-product (a mix of bran, germ, and aleurone) (FAO 2006). These by-products are often fed to animals.

As regards the production and trade in soybeans, the picture is even more pointed. Globally, there are 74.1 million hectares devoted to soybean production, producing 161.2 million metric tons. Fifty-seven percent of this production is traded internationally, which is a very high percentage relative to most agricultural commodities. Between 1961 and 2000, soybean production increased 6-fold while international soybean trade increased almost 16-fold. The price dropped by about half (53 percent) (Clay 2004: 173, 186). In just the 10 years, trade in soybeans has increased by 45 percent, with the European Union and China both being huge importers. Yet while EU imports are steady, Chinese imports have increased four and a half times since the late 1990s (Ash, Livezey, and Dohlman 2006).

Soybean production is extremely concentrated, although according to the FAO, soy is grown in some 82 different countries. Yet the top five producers—the United States, Brazil, Argentina, China, and India—account for about 90 percent of both the land in soy cultivation, and of total production. The United States sells about a third of its soy exports unprocessed (as beans), while Argentina and Brazil do more processing first. Brazil and Argentina process 80–85 percent of their crop and then export most of it (Clay 2004: 176, 182). Soybeans are processed by crushing, which yields about 19 percent oil and 74 percent meal. The oil is mostly used in processed foods, while the meal is mostly fed to animals. Still, in sum, a staggering 98 percent of US soy meal production is fed to animals. In fact, the use of soy meal to feed animals in the United States made confined chicken and pork operations financially viable. The synergy between the two sectors has in turn driven an expansion of industrial soy production in the United States, where it has become the main crop grown in rotation with corn (Ash, Livezey, and Dohlman 2006).

3 Environmental Impacts

Environmental problems have probably occurred ever since humans settled and started to sow wheat, or plant pumpkins. There is enough historical evidence to show that long before the industrialization of agriculture, less intensive farming systems have failed, and that, for example, parts of the Andes, North Africa, the Middle East, and elsewhere were at times over-farmed to the point of degradation. Even today, small farmers account for significant environmental problems, such as the deforestation of tropical forests from Brazil to Indonesia and its associated environmental impacts, as they are forced to farm new land to earn a living (Clay 2004).

What is new, however, is the extent to which modern practices systematically overexploit natural resources and pollute the environment. As artificially bred “high-response varieties” are grown in monocultures, irrespective of local conditions and everywhere in the world, they require agrichemicals, use large amounts of fertilizers, and sometimes consume much more water for irrigation than traditional farming could ever manage. In the meantime, impacts well reach global levels. In fact, industrial agriculture marks the intersection of a number of global environmental crises. Taking a closer look at four of these crises, this chapter analyzes the impacts of industrial agriculture on climate change, land degradation, water shortage, and loss of biodiversity.

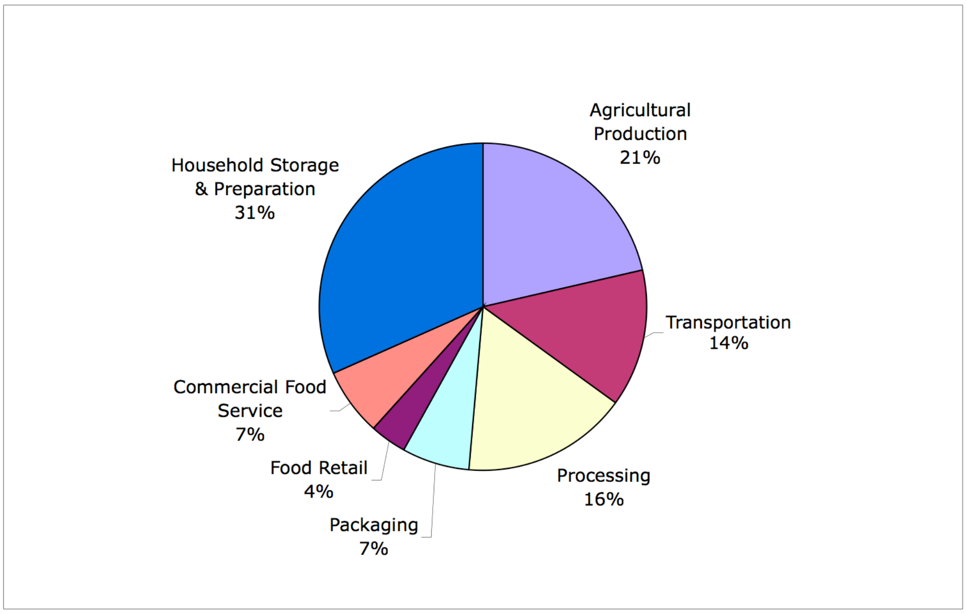
Climate Change

Climate change is considered to be one of the most severe environmental threats to humanity in the coming decades. Increasing concentrations of greenhouse gases in the atmosphere, such as carbon dioxide, methane, nitrous oxide, and others, capture the heat in the atmosphere and cause global temperatures to rise. Global warming has already resulted in an increase of global average mean temperature by 0.8 degrees Celsius compared to pre-industrial levels. However, it is expected to rise by as much as 6.4 degrees Celsius by the end of the twenty-first century, if business as usual continues (IPCC 2007). Obviously the planet is not just getting warmer. Coupled with the rise in temperatures in certain regions and the drop in temperatures in others, impacts include such diverse effects as a rise in sea level, increased frequency of extreme weather events, such as storms, increased flooding, or irregularities in monsoon patterns, as well as the melting of snow covers and ice caps, or the weakening of ocean thermohaline circulation (IPCC 2007).

Most of the human-induced greenhouse gas emissions are caused by the burning of fossil fuels. However, land-use changes in agriculture and forestry as well as emissions from farming and livestock play a significant role as well. It is estimated that agriculture alone—not considering the entire food system—contributes about 20 percent to global greenhouse gas emissions (IPCC 2001c) releasing in particular carbon dioxide, methane, and nitrous oxide. Even in the European Union, which as a region is responsible for the world's highest emissions from transport, industry, and households, agriculture is responsible for 10 percent of all greenhouse gas emissions (EEA 2006). What is particularly emission-intensive is the conversion of tropical forests and savannahs into agricultural land, primarily through the burning of biomass that originally occupied the land, and the release of organic carbon stored in soils (Steffen et al. 2004: 170). Next in terms of the severity of impact is livestock production. Approximately 25 percent of anthropogenic methane emissions come from livestock, while their warming potential is about 20 times more powerful than carbon dioxide. With animals moving from pastures to intensive stall-feeding, and the number of farmed cattle, pigs, and poultry steadily increasing to meet the growing number of meat-based diets, more methane is released from enteric fermentation and animal waste. Grass-fed animals emit less methane than livestock that is fed on a high protein diet (Saunders 2004; Kotschi and Müller-Sämann 2004). In addition, a significant share of methane emissions are produced from the expansion of flooded rice paddies, as well as large amounts of nitrous-oxide emissions, which are generated from the breakdown of fertilizer, as well as manure and urine from livestock—all of which are threatening the global climate system.

The food system at large contributes much more to anthropogenic climate change than actual farming and livestock raising. Greenhouse gases are emitted through the production and use of agro-chemicals, farm machinery, and pumped irrigation, all of which account for more than 90 percent of the total direct and indirect energy used in agriculture. As farm inputs are very energy-intensive to produce, a ton of cereals or vegetables farmed by means of industrial agriculture requires 6 to 10 times more energy than by traditional or more sustainable agricultural methods (Saunders 2004). In addition, downstream operations, such as transportation, processing, packaging, and retailing, require even more energy than agricultural production itself. For example in the United States, they require more than twice as much energy than farming in the field. And nearly 75 percent of agricultural products in the United States are processed in some way, which consumes one-quarter to one-third of the whole energy used in food systems (Hendrickson 2004: 6). Finally, in a rapidly globalizing agricultural market, emissions from food miles are constantly on the rise. Each item of food today travels on average 50 percent more than it did in 1979, with modern airfreight travel emitting much more carbon dioxide than travel by ship or road. As consumers now embrace a year-round "dietary summer," the total distance traveled by imported vegetables purchased weekly by just one family can easily amount to a distance equivalent to several journeys around the equator (Millstone and Lang 2001; Horrigan et al. 2002; Lang and Heasman 2004). When considering all of the different impacts that agricultural practices contribute to the global climate change crisis, it can safely be said that the industrialization of agriculture as a whole, as well as long-distance distribution and industrial processing, has emerged as a major driver of the climate chaos.

Graph 1: Energy use throughout the food system of the United States (Heller and Keoleian 2000)



As we have witnessed in recent years, the global climate is now beginning to strike back with enormous ferocity. Climate change will rebound on agriculture in a variety of ways. Crop cultivation will be most impacted by a change in temperature and precipitation, greater vulnerability to diseases, insects and pests, increased vulnerability to the degradation of soil and water resources, and pressure on native biodiversity. Scenarios for cereal crops reveal that in some temperate areas, yields will potentially increase with small increases in temperature, but decrease with larger temperature changes. In most tropical and subtropical regions, however, yields are projected to decrease with even minimal increases in temperature, as they already grow at their thermal optimum (IPCC 2001a; Parry et al. 2004). Where large decreases in rainfall are expected to occur—especially in subtropical and tropical dry land and rain-fed agricultural systems, such as in the Sahel, the African Horn, the Chilean Andes, or parts of Central Asia, East Asia, and South Africa—crop yields will be even more adversely affected. However, water damage to agriculture is not only associated with decreasing precipitation, but also with increased runoff. A comparative study of five major agricultural regions—northeast China, Brazil, the US Corn Belt, the Danube Delta, and Argentina—indicates that excess water as well as altered timing of the water supply could have even greater impacts than drought (Rosenzweig et al. 2004). In light of the tremendous impacts that are associated with climate change, for those regions that will be disproportionately impacted, the climate chaos may well unleash a socio-economic chaos within entire agricultural communities.

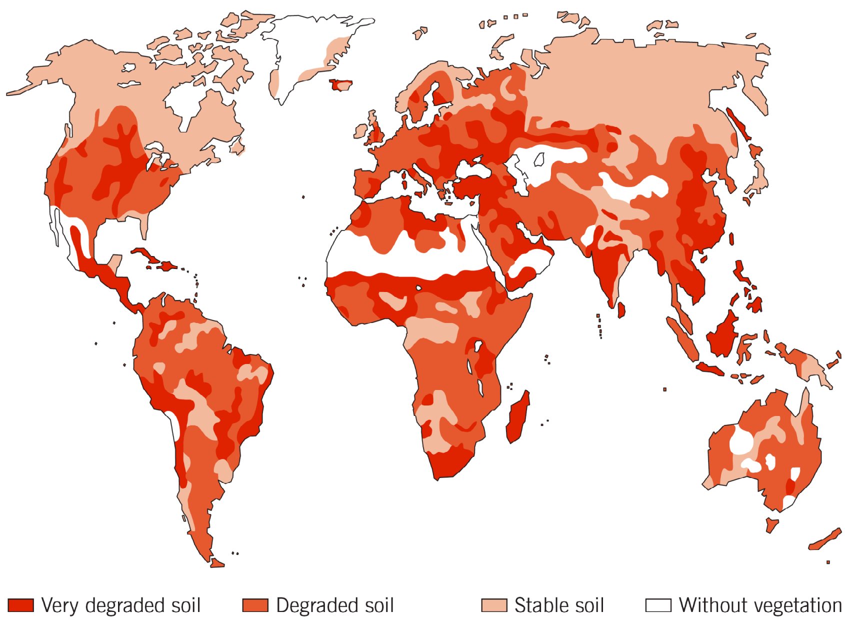
However, agriculture is not only a victim of climate change, but can be part of the solution to the problem. Agriculture not only releases greenhouse gas emissions, it can—practiced in the right way—provide important carbon sinks. Studies prove, for instance, that a shift from conventional industrial practices to organic farming significantly contributes to the mitigation of climate change, both through less emissions from inputs and farming practices, and through increased carbon storage in the soil (Kotschi and Müller-Sämann 2004; Stolze et al. 2000). At the same time, diversified sustainable farm systems are less vulnerable and offer the best potential for adapting to changing climatic conditions. Even more importantly, however, agriculture can provide the basis for the post-carbon economy in the future. Through farming, biomaterials can substitute for minerals and fossil-fueled transport systems, and can also help to retire resource-intensive industrial products and processes. In particular, the provision of bio-gas for industry and household use, as well as bio-fuels for transportation, are important solutions for making societies more climate-friendly. However, agriculture in a solar economy would have to generate other environmental qualities than just protection of the global climate. Indeed, environmentally friendly production practices must ensure that the production of bio-energy and material does not undermine the carrying capacity of soils and ecosystems.

Land Degradation

Land degradation is currently the most obvious threat to agriculture, as it has severely progressed over the past decades. Around 2 billion hectares of soil, equal to 15 percent of the Earth's land cover, are now classified as degraded due to human activities (graph 2). Roughly one-sixth of these lands are very degraded, with soils so badly damaged that they cannot be restored. Main types of soil degradation are erosion by water (56 percent) and wind (28 percent), chemical deterioration (12 percent), and physical compaction or structural damage (4 percent) (UNEP 2002). These impacts frequently lead to reductions in yields.

Soil erosion is the key factor in land degradation. The intensification of agriculture, which is mainly due to pressure from population growth as well as the switch from traditional to industrial farming practices, has severely aggravated erosion throughout the world. For example, this can be observed in Bafou, a village in the West-Cameroon highlands: Until 20 to 30 years ago, ecosystems in Bafou were relatively stable, and farmers mostly cultivated the very bottom of small valleys. Yet population growth forced the farmers to cultivate the slopes of nearby mountains, which were used for timber and pastures before. At the beginning of the raining season, when plants emerge to establish a canopy, farmers started to plow fields using industrial techniques. Raindrops now detach soil particles, creating surface runoff through hills and gullies. Tons of topsoil are lost through water erosion from the fields. The erosion reduces crop yields, and because the slopes being intensively tilled were the source of numerous rivers, runoff also dries out wells used for drinking water for the village (Tematio and Olson 1997).

Graph 2: Estimated global soil degradation (UNEP 2002)



Where land is irrigated, salinization is an important cause of land degradation. All irrigation water contains dissolved salts, as even rain water contains some salts. Although salts are generally in very low concentrations in the water itself, evaporation of water from the dry surface of the soil leaves the salts behind. Thus salinization is particularly acute in semi-arid areas, which use lots of irrigation water, are poorly drained, and never get well flushed, as for example in parts of the US Midwest and California, in China's North Plain, or in Central Asia. About 20 percent of the world's irrigated acreage is estimated to be affected by salinization, with salt concentrations high enough to decrease yields significantly. Globally, salinization is reducing the existing area under irrigation by 1–2 percent per year (FAO 2002).

In addition, mono-cropping requires high levels of pesticide and fertilizer applications. The absence of biodiversity impoverishes the soil, reducing its ability to retain nitrogen, which in turn increases the likelihood that nitrogen will run off. Monocultures also take livestock out of crop systems and concentrate them in confined areas, creating a surplus of manure which is then often over-applied on land surrounding the livestock factories. Furthermore, the use of heavy machinery in the field often leads to soil compaction. But compaction impedes root growth and limits soil drainage, which in turn may result in runoff, more frequent flooding, increased erosion, and the transfer of pollutants to surface waters.

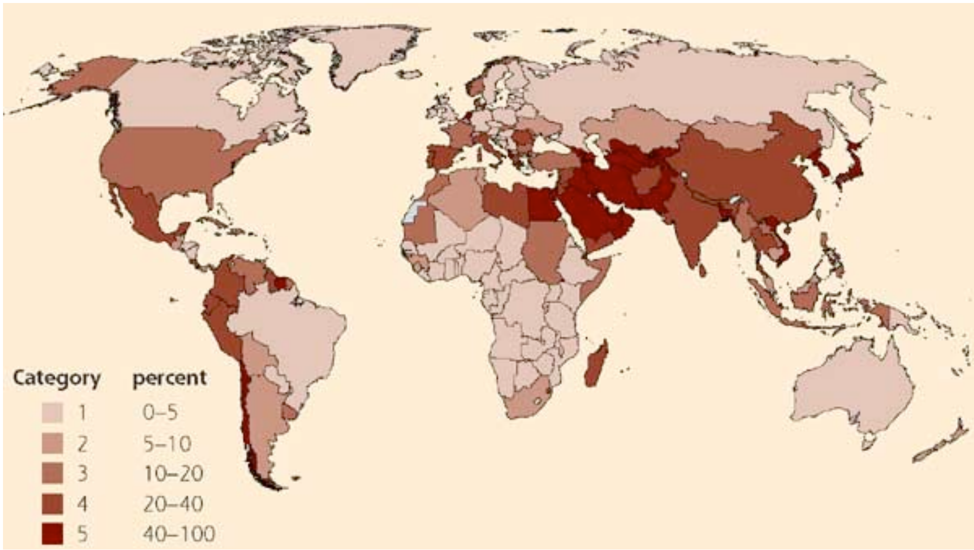
Water Shortage

Water makes life possible on Earth. Yet 97 percent of the world's water is seawater. Of the remaining 3 percent, roughly two-thirds is locked in the polar ice caps, and much of the groundwater on land is too deep to be exploitable. Thus only about 0.3 percent of global water resources are available for use. This share is highly unevenly distributed, with roughly 20 percent of the world's people not having adequate access to safe drinking water, and about 40 percent suffering from water scarcity. As scenarios for the year 2050 are projected, at best 2 billion, at worst 7 billion people will suffer as a result of water scarcity (UNESCO 2003). In all regions except Europe and North America, agriculture is by far the biggest user of water, being responsible for approximately 69 percent of global freshwater consumption. And more water will be used in the future, as world food production increases and intensifies. Agriculture can affect water resources in two ways: through the withdrawal of water for irrigation, and through water pollution.

Today, irrigation systems cover about 20 percent of the world's cropland (graph 3). Conventional irrigation (surface and sprinkler irrigation), which is currently practiced on most of the irrigated lands, consumes much more water than rain-fed agriculture. Yet the area under irrigation is likely to expand in the future, although both environmental and economic arguments do not suggest doing so. The real costs of irrigated food production are far from being internalized in the production costs, which in fact makes irrigation one of the most subsidized activities in agriculture.

If groundwater is withdrawn for irrigation, aquatic and wetland species are affected when ecosystems dry out due to the lowering of the water table—although long-established or "leaky" irrigation systems can create new wetland areas. In many parts of the world, irrigation is depleting underground aquifers faster than they can be recharged; in some cases, agriculture even depends upon "fossil aquifers" that mostly contain water from the last ice age and receive little or no recharge (Horrigan et al. 2002). Where water is withdrawn from rivers, lakes, or springs, watersheds sometimes completely die out. For example, the Colorado River often does not contain anymore water by the time it enters into Mexico, and many days in the year the river does not reach its mouth (Stockle n.d.).

Graph 3: Area equipped for irrigation as a percentage of cultivated land (FAO 2002)



Besides depleting water resources, intensive irrigation can increase runoff and thus aggravate water pollution with nutrients and pesticides, particularly where it is used to support relatively high-value crops such as horticulture, salads, and soft fruits, and especially when these are grown year-round under glass. Such pollution is also associated with intensively managed staples and industrial crops, like cotton, sugar beet, tobacco, or maize (Dwyer et al. 2000). Water pollution is especially severe with regard to concentrated animal farm operations, better known as factory farms. The 2.5 million pigs and cattle raised worldwide excrete more than 80 million tons of waste nitrogen annually—while, in comparison, the entire human population produces just about 30 million tons. Nitrate contamination of groundwater from manure mostly takes place when stock densities are high, posing serious risks for ecosystems and the public health of communities (Kirschenmann 2002).

Finally, trade flows may significantly affect the water used in domestic agriculture. The concept of “virtual water” calculates the total amount of water that has been used to provide a given product or service. Depending on the respective climatic conditions, for example, the production of one kg of wheat uses between 1,000 to 2,000 liters of water, one kg of cheese uses 5,000 to 5,500 liters, and one kg of beef consumes up to 16,000 liters of water (Hoekstra 2003). Trade in virtual water can have positive and negative impacts on a nation’s water resources. Countries with water scarcity may import goods rich in virtual water from countries of water abundance, thus being able to decrease pressure on overused water resources. Botswana, for example, now shows a high level of reliance on virtual water imports, as the quantity of imports is higher than local production, with most staple foods coming from outside the country (Earle 2001). However a number of countries export crops with high virtual water content despite domestic water scarcity. Important virtual water exporters are the United States, Canada, Australia, Argentina, and Thailand, while for instance Japan, Sri Lanka, Italy, South Korea, and the Netherlands are large net importers (Chapagain and Hoekstra 2003).

Loss of Biodiversity

“Biodiversity” includes genetic resources as well as species and ecosystem diversity. The planet’s biological diversity is considered to be deserving of its own merit, to be preserved for its intrinsic value. Moreover, it plays a significant role for the functioning of ecosystems, including important features for agriculture, such as the stabilization of climate and atmosphere, functioning of the hydrological cycle, assimilation and recycling of biomass, pollination of crops, or ecosystem-inherent pest and insect control. Humans are fundamentally—and to a significant extent irreversibly—changing the diversity of life on Earth, and most of these changes represent a loss of biodiversity. Over the past few hundred years, humans have increased the species extinction rate by as much as 1,000 times over rates typical in the planet’s history. Among the activities most impacting biodiversity are land-use changes that convert diversity-rich areas, like tropical or subtropical forests, into less diverse areas, such as farmland or urban areas (Weigel 1997; Millennium Ecosystem Assessment 2005).

More specifically, industrial agricultural production systems tend to diminish biodiversity in two ways: through farming practices, and through the type of crops grown. Farming in monocultures, which only grow one single crop on a given field, is especially harmful to biodiversity; in fact, monocultures are the "antithesis to diversity" (Shiva 2002). They require large amounts of fertilizers and pesticides, fungicides, and herbicides in order to keep yields high and to control insects and pests. And runoff of pesticides can result in a loss of biodiversity in aquatic communities. Equally crucial is the loss of cultivated crops due to industrial agriculture. Over several millennia, farming systems have formed their own fauna and flora. Farmers have selected seeds from better-performing crops and thus have created thousands of crop varieties. With the industrialization of agriculture, this biodiversity shrank to bio-uniformity. Today just nine crops account for three-quarters of the plants consumed by humans. Thousands of individual varieties that had evolved are now reduced to barely a handful of seeds used for industrial farming everywhere in the world; approximately 97 percent of the vegetables available in 1900 have become extinct today (Kimbrell 2002).

Industrial agriculture not only reduces the number of varieties, it creates its own types through hybridization and genetic engineering. "High-response varieties" are bred with the goal of making them more productive, for example by increasing their response to chemical use, and locally adapted crops are replaced. As it turns out, chemicals applied are quickly becoming ineffective as pests and diseases develop tolerance and resistance, making ever more amounts or new types of chemicals necessary. Genetic engineering transfers the genetic material from one plant, bacterium, or animal to a different species in order to extract some economic gain. Biotech researchers have, for example, engineered human growth genes into fish and livestock to make them larger and grow faster, or fish genes into tomatoes so that they can be stored at lower temperatures. Most of the plants genetically modified thus far have traits that increase either resistance to herbicides, allowing for ever-greater use of broad-spectrum herbicides. Other modifications enhance insect resistance, mostly through the introduction of a bacterium toxic to insects, or improve salt and draught tolerance. Advocates argue that genetically modified insect-resistance reduces the need for chemicals. However, more efficient killing of insects deprives birds and other species of their habitat and vital food source. In addition, it can become ineffective because of strong selection pressure on resistant insects, thus starting a new "arms race" between pest and pesticides, and giving rise to so called "superpests" (Berkhout 2002). Furthermore, genetically modified crops bear the danger of spreading out beyond the field and affecting the balance of ecosystems elsewhere, as has been experienced with the introduction of exotic species in many parts of the world. For example, a study found that pollen from genetically modified "Bt corn" was poisonous to the larvae of the Monarch butterfly (Mendelson III 2002).

4 De-industrializing Agriculture – Variants and Contradictions

The roots of alternative forms of agriculture go far back, at least to the beginning of the nineteenth century—the time before agriculture was so industrialized. Such diverse thinkers as Raoul Heinrich Francé, Sir Albert Howard, Franklin Hiram King, or Rudolf Steiner, recommended very different approaches, but agreed that agriculture was something much more comprehensive than delivering grains, legumes, and meat, and that it was much more than just a business or an economic sector amongst others. Rather, agriculture was reconsidered as part and parcel of the Earth system, even the cosmos as such, being embedded both in the local ecosystems and in the cultural and social contexts of a given place.

Shifts in Paradigm: from Quantity to Quality

By the early 1970s, the movement for alternative forms of agriculture gained momentum. Influenced by the rise of the environmental movement and books such as Rachel Carson's *Silent Spring*, the environmental impact of industrial agriculture moved to the center of attention of producers and consumers alike. However, critical attention was not just focused on farming practices, but on the entire food system, including the wider economic framework conditions that had led to the industrialization of agriculture. Opposing the rise of the profit motive throughout the industrial food system, critics called for the rule of "quality" instead of "quantity." Two aspects worried them particularly: First, the industrialization of agriculture created ever-larger markets with ever-longer production chains; and secondly, it constantly pressured farmers to increase yields at any environmental and social cost. In the following section, these two aspects are examined more closely, along with alternatives that have been put into practice during the past decades.

From complex and anonymous food markets...

The debate on the size and structure of markets addressed mainly economic issues. As agricultural markets grew ever-larger, at first integrating local into regional, then regional into national, and finally national into international markets, so too had competition increased. Efficiency and productivity became the main focus of farming, for in a large market all farmers need to adapt to the one that produces for the lowest cost. Farmers from regions with varying climate and soil conditions had to achieve equal profitability. The average farm size increased considerably, as farmers had the choice to "get big or get out." And many specialized in just a few crops in order to most effectively pay off machinery and facilities, and to increase competitiveness. Soon specialization not only took place between farms, but between regions. In Germany, for example, the region of Bavaria now specializes in milk while the Muensterland provides the bulk of domestic meat; in the United States, California focuses on fruits while the Midwest on corn. Furthermore, efficiency and productivity as drivers of change did not stop at the farm gate. In a similar vein they led to structural adjustments of distribution and marketing patterns in the food system. Centralized retailing systems turned out to be most efficient in distributing produce, themselves spurring the markets to grow as efficiency improves with the number of consumers serviced. Complex production chains evolved, while produce brokerages, processors, retailers, wholesalers, and supermarkets all skimmed their share of the price. At the other end of the market, consumers were alienated from the products they purchased, as personal connections from consumers to farmers got lost in large markets. To many consumers it does not make a difference where crops come from and under which circumstances they are grown. In fact, in the eyes of many, milk, legumes, and potatoes are not derived from peasants and farms anymore, but from Danone, Cargill, or Aldi. Company labels effectively replaced geographic origin and the meaning of place.

...to local markets, short production chains, and producer-consumer relations

In this sense, shifting from quantity to quality implies reducing the size of the market and the length of production chains in order to re-regionalize production, reduce competition pressure, and keep as much value as possible in the region, and on the farm. It was not a large market with cheap prices, but rather a local market with typical and traditional products that was regarded admirable and helped to reconnect the buyer to the grower. The health and value of fresh fruits and vegetables, harvested that same morning, were regarded as preferable to processed food and produce that was handled through long production chains over weeks. Numerous local initiatives started to rebuild local and regional "small-scale economies" that aimed at shortening production chains by "taking back the middle" (Pretty 1999). For example, farmers started to sell their produce on nearby farmers' markets, or directly from the farm, at times even allowing the consumer to participate in production. In the United States, "Community Supported Agriculture" projects established a partnership between producers and consumers, as consumers provide support for growers by agreeing to pay for a share of the total produce and, in turn, receive food on a weekly basis and of a guaranteed quality. Even in urban areas, change turned out to be possible, as, for example, community food cooperatives delivered food to consumers with no direct access to farms or the countryside. Also common in Europe, this model became very successful in Japan, where "sanchoku" or "tekei" schemes either directly bring food from producers to consumers or establish mutual contracts between producers and consumers. For example, the "Seikatsu Club" was set up by housewives in 1965 who wanted to avoid high milk prices and allied as a group in order to buy larger amounts of milk together directly from producers. As they are still functioning on a face-to-face relationship based on trust, today this club hosts more than 210,000 households, organized in local branches all over Japan (Pretty 1999).

However, opposition against the economic conditions of industrial food systems and the trade patterns in the market never materialized in standards that could have been generally applied, nor in political rules that would foster these approaches and systematically privilege small markets with short production chains. On the contrary, during the following decades, overall economic development continued to favor large markets, and even internationalized the food system. Today many of the alternative projects from the 1970s and 80s have been abandoned, while the overall problems prevail.

From maximum yields and intensive industrial farming…

Increasing competition could not leave farming practices unaffected. The maximum yield of one single crop rose to become the dominant indicator of efficiency in farming. This could best be achieved by planting in large monocultures, since monocultures are the easiest to manage with large machinery and intensive chemical use. In addition, harvests from monocultures and pure plantations best satisfy the interests of long production chains, since retailers and processors want homogenous crops in order to maximize their efficiency. Farmers had to grow crops that could easily be processed, that endure long-distance shipping, that remain "fresh" on shelves for weeks, and still look presentable. At the same time, the industrialization of agriculture witnessed the development of plant-breeding techniques, including practices such as hybridization, inbreeding, backcrossing, and later genetic modification, in order to develop "high-yielding varieties." As research focused on the sole issue of increasing yield per hectare, it neglected other crop characteristics, such as taste or texture. For example, fruits and vegetables may be developed to ripen fast, become big and look perfect, but they might taste better if they were smaller and more condensed, and if they ripened over an extended period of time and accumulated more sweetness. High-yielding varieties require large amounts of fertilizer and pesticide application, so as to compensate for plant deficiencies. They were correctly re-labeled as "high-response varieties," because a higher quantity of output called for higher quantities of inputs. And thus, production became more and more dependent on off-farm inputs, both regarding seeds and chemical inputs during the growth process. In addition to the associated environmental effects described in the previous chapter, it turned out that these chemicals exposed consumers to increased health risks. For example, residues of pesticides and herbicides likely increase cancer risk or even result in long-term damage to brain, nervous, and reproductive systems; salmonella or E. coli pathogens from industrial poultry and livestock production may result in food-born illnesses; and antibiotic resistance may be accelerated as broad-spectrum antibiotics are applied in factory farms (Kimbrell 2002).

…to high-quality products, environmental soundness, and human health

Regarding these problems, a shift in paradigm from quantity to quality required trading high yields for a higher-quality product. Farmers would grow crops that are locally adapted and stronger in themselves, that is, less vulnerable to pests or diseases, thus needing less chemical treatment and cause less environmental and health risks. At the same time, farmers would provide products of higher value to the market, as many consumers value good taste and wholesome ingredients, such as vitamin and mineral content, more than the actual price of the product. And on the whole, farmers would run "wholesome" farms, integrating livestock and crop production while diminishing environmental effects related to nitrogen applications. Throughout the last decades, several different strategies have been developed to de-industrialize farming practices and make them more environmentally sound. Three of them—resource-conserving agriculture, organic farming, and agro-ecology—are discussed in greater detail in the following section.

Strategies to de-industrialize Agriculture

Resource-conserving agriculture, (certified) organic farming, and agro-ecology are broad approaches to solve the environmental problems of industrial farming. While organic farming is resource-conserving, not all resource-conserving farming is organic. The principal difference between the two approaches—apart from the issue of certification—is that resource-conserving agriculture emphasizes the process of changing techniques more than the final outcome; it works to minimize environmental harm and to more fully utilize natural forces, but allows for the careful application of chemical inputs if necessary. In contrast, organic farming rejects all chemical inputs, but allows for industrially produced inputs, such as biological pest controls or mineral fertilizer. Agro-ecology, as the most rigorous concept of the three, tries to diminish industrial inputs and aims at substituting any kind of off-farm input by solely using on-farm nutrient cycles and ecosystem functions.

Resource-conserving agriculture

Resource-conserving technologies broadly fall into four groups (Pretty 1995; FAO 2005). *Integrated pest management* is a set of techniques that aims at avoiding or reducing yield losses from pests while minimizing the negative effects of pest control. It involves precise monitoring and targeting of pest populations and predators, natural-occurring biological control such as the use of alternate plants that resist pests, or land management and irrigation practices that reduce pests. *Integrated plant nutrition techniques* intend to maximize plant nutrient-use efficiency by recycling all nutrient sources within the farm and by using nitrogen fixation by legumes or livestock manure to the extent possible. External sources of plant nutrients, including manufactured fertilizers, may be used in balance with local sources in order to improve soil fertility. *Minimum tillage techniques* maintain and improve crop yields as well as resilience against droughts, while at the same time protecting and stimulating the biological functioning of the soil. Minimal soil disturbance, the maintenance of a permanent cover of vegetal material on the soil surface, direct sowing, crop rotation, etc., are essential features of the minimum tilling approach. Lastly, there are *irrigation techniques* for reducing the demand for water, for providing irrigation water more efficiently, and for capturing and using rainwater in a more prudent fashion. For example, underground irrigation or modern drip systems, which depend on a pressurized system to force water through perforated pipes running above ground, tend to be more efficient than open surface or sprinkler irrigation systems and can cut water use by 30 to 60 percent (FAO 2002).

Organic agriculture

Following the definition of the Food and Agriculture Organization's *Codex Alimentarius*: "organic agriculture is a holistic production management system which promotes and enhances ecosystem health, including biological cycles and soil biological activity. Organic Agriculture is based on minimizing the use of external inputs, avoiding the use of synthetic fertilizers and pesticides." In this definition, emphasis is put on the substitution of external inputs by internal ones, which implies the substitution of a linear production model with a cyclical one. The International Federation of Organic Agriculture Movements (IFOAM) carries the definition of "organic" a step further, stating that "organic agriculture is a whole systems approach based upon a set of processes resulting in a sustainable ecosystem, safe food, good nutrition, animal welfare and social justice. Organic production therefore is more than a system of production that includes or excludes certain inputs." The slight contrast in both definitions already alludes to the fact that the meaning of "organic" is not set in stone, but changeable and frequently debated.

Nevertheless, nationally and internationally a set of rules and limits have been established that are usually enforced by inspection and certification bodies. The "IFOAM Norms," for example, include a detailed set of general principles and standards with requirements for crop production and animal husbandry, including rules on the choice of crop varieties, the diversity in crop production, soil fertilization, pest, disease, weed and growth management, as well as for animal origin, animal nutrition, veterinary medicine, transport, and slaughter. The

IFOAM norms also set out criteria for the evaluation and use of additives, such as off-farm products for use in fertilization and soil conditioning, products for pest, disease, and weed management. Furthermore, they endorse standards for processing, handling, and labeling (IFOAM 2002). Although IFOAM is considered as the global platform of the certified organic movement, the IFOAM norms are but one set of standards among a myriad of others that have been developed by national or private organizations over the past decades. In many countries, several standards coexist, as for example in Germany there are nine different independent labels for certified organic production, plus the national one (Dabbert, Häring, and Zanoli 2002: 25).

“Traditional organic” agriculture

Presently in trade, “organic” is produce that is certified as organic. However, it is misleading to equate organic farming with certified production. In reality the practice of organic farming is much more widespread in the world, in particular in developing countries. In view of the core criteria of the absence of external inputs, many non-certified agricultural systems, where produce is consumed locally, sold directly on the farm, or marketed without labels, can qualify as organic farming. In most cases, traditional farms apply cultivation practices which have evolved through centuries and are adapted to the environmental and cultural conditions of a particular place. This is clearly the case with a range of traditional farming systems in both the South and North, which have never made the switch to external inputs, be it due to traditions or for lack of money. Whatever the motivation, non-certified organic agriculture includes traditional systems which do not use chemicals but which apply ecological approaches to enhance agricultural production. However, the last part of this definition is important. Indeed, farming which foregoes external inputs, but is not able to prevent soil erosion and biological decline, cannot be considered organic. Therefore, “agro-ecology” is an approach not only useful for industrial farming, but also for making small-scale, “traditional organic” farming more environmentally sound.

Agro-ecology

Although many small and medium-size certified organic farmers in the North practice a variety of diversified cropping systems, certification standards do not necessarily help in avoiding monoculture farming or pure cultivations. And with the “green revolution,” monoculture cropping, specialization, and the use of agrichemicals has much affected “traditional organic” farming practices in many countries of the South. As an answer, agro-ecology was developed as a knowledge-intensive concept that strictly relies on resources found on or near the farm and solely uses on-farm nutrient cycles (Altieri 1987). Agro-ecology rigorously promotes biodiversity farming in order to exploit the complementarity and synergy that result from the various combinations of crops, trees, and animals in agricultural systems. It suggests a set of strategies to restore agricultural diversity in time and space, such as crop rotations, intercropping, polycultures, cover crops, and combined agroforestry as well as crop-livestock mixtures, in order to improve soil and water conservation, provide a regular supply of organic matter, enhance nutrient recycling, and promote pest and disease regulation through biological control within the natural ecosystem.

Is Organic Enough?

As has become clear, the strategies to de-industrialize agriculture mainly address farming practices. Thus one of the two paradigm shifts described above has well evolved over the last decades. Resource-conserving agriculture, certified organic farming, and strategies for agro-ecology alike intend to generate higher quality products in terms of environmental soundness and human health. Yet aspects of economic framework conditions, such as how to re-regionalize markets and shorten production chains, to ensure small farms and diverse farm systems, or to foster consumer-producer relations, have largely remained out of sight. On the contrary, as organic agriculture becomes more and more established as *the* way for alternative farming globally, the development of "industrial organic corporations" even seems to counteract the search for a paradigm shift in economic market conditions. Thus, it is necessary to ask: Is organic enough?

Potentials and pitfalls of organic agriculture

In many countries organic agriculture is on the rise. No doubt that this is a significant achievement. Certified organic farming is now practiced in approximately 100 countries of the world, with more than 31 million hectares under organic management today, after a gain of around 5 million hectares in 2005 alone. The major share of organically managed land is located in Australia (about 12.1 million ha), followed by China (3.5 million ha, with a major increase of 3 million ha in 2005), Argentina (2.8 million ha) and Italy (about 1.2 million ha) (IFOAM 2006). Organically managed land averages around 4.5 percent of total agricultural land in western Europe, 2.2 percent in Australia, 1.3 percent in Canada, and 0.23 percent in the United States; except for China, percentages in developing countries are negligible. However, probably less than half of the global organic land area is dedicated to arable land, since in Australia and Argentina most of the organic land area is extensive grazing land for livestock production.

Although the area under organic management is growing across the globe, most sales of certified organic food and drink are restricted to the industrialized world: The two regions of North America and Western Europe account for roughly 97 percent of global revenues, other markets being Japan and Australia (ibid.). Organic produce in the developing world is generally destined for export to industrial countries. Higher purchasing power, the ability to accommodate the price premium for organic products, and more awareness about food safety, health, and environment are the main factors responsible for consumer demand being concentrated in the most affluent countries of the world.

In contrast, most of the harvest from "traditional organic" farming is consumed locally. The extent of non-certified organic crop land is difficult to quantify, but some attempts have been made. The Ghanaian Organic Agriculture Network, for example, estimates that there are around 250,000 families in South and East Africa farming around 60 million hectares on an organic basis (FAO 2005: 310). Anobah (2000) assumes that over one-third of West African agricultural crops are produced organically.

Table 2: Detailed assessment of organic farming's impact on the environment and resource use compared to conventional farming (Source: Stolze et al. 2000: 86)

	++	+	**0**	**-**	**- -**
ECOSYSTEM					
Floral diversity					
Faunal diversity					
Habitat diversity					
Landscape					
SOIL					
Soil organic matter					
Biological activity					
Structure					
Erosion					
GROUND AND SURFACE WATER					
Nitrate leaching					
Pesticides					
CLIMATE AND AIR					
CO_2					
N_2O					
CH_4					
NH_3					
Pesticides					
FARM INPUT AND OUTPUT					
Nutrient use					
Water use					
Energy use					
ANIMAL WELFARE AND HEALTH					
Husbandry					
Health					
QUALITY OF PRODUCED FOOD					

Pesticides residues					
Nitrate					
Mycotoxins					
Heavy metals					
Desirable substances					
BSE risk					
Antibiotics					

Organic farming performs + + much better + better 0 the same - worse - - much worse than conventional farming

Subjective confidence interval of final assessment

That certified organic farming leads to less water and soil pollution and fewer health risks is irrefutable, and a number of comparative studies on biodiversity in conventional and organic farming show that species richness on average is 30 percent higher with organic farming (Dabbert, Häring, and Zanoli 2002). Table 2 summarizes the literature and tries to generalize the environmental benefits of certified organic farming in Europe. In addition, organic agriculture advances rural development. It is more labor-intensive than conventional farming, since alternative soil management, weed, and pest treatment practices in part substitute chemicals through labor. For example, Offermann and Nieberg (2000) found that employment on organic farms throughout Europe on average is 20 percent higher than on conventional farms, while Maynard and Green (2006) for the United Kingdom found that organic farming is even 32 percent more labor-intensive. Because retailing and marketing organic produce often remains in the region, other local businesses take advantage and bring about new jobs and income opportunities. In addition to that, organic farming can positively affect the image of a region, as more young farmers may stick to their family farm business, and tourists may be attracted by the promotion of a healthy environment (Dabbert, Häring, and Zanoli 2002).

Despite these achievements, a number of problems remain. As certified organic agriculture mainly aims at substituting noxious agrochemicals through alternative biological inputs, it neither challenges the monoculture structure nor the dependence on off-farm inputs. This limited approach greatly diminishes the potential of more sustainable farming practices, especially since biodiversity is only addressed in an indirect way. There is no doubt that biological pest controls are much less threatening to farmland species and ecosystem functioning, and that biodiversity is somewhat increased through certified organic farming. Yet standards usually do not explicitly address the reduction of functional biodiversity of agro-ecosystems. Moreover, the same few hybridized high-yielding varieties as in conventional farming may be planted (Rosset and Altieri 1997). As biodiversity not only depends on production practices, but also on landscape structure, positive effects were highest where conventional large-scale monocultures were transformed into organic fields. Effects were less significant where agricultural landscape was already diverse, with hedgerows, habitat islands, natural wetlands and pastures or forests serving as important refuge and source areas for many organisms. In fact, studies even suggest that landscape heterogeneity can have a greater impact on biodiversity than switching from conventional to organic practices (Bengtsson, Ahnström, and Weibull 2005). Yet production standards that take care of landscape diversity, such as proportions of land to be reserved for non-cropped areas or others, so far have yet to be included into certified organic systems.

It's the Economy, Stupid!

Furthermore, as certified organic agriculture is an approach limited to farming and processing practices, it falls short of addressing additional environmental effects throughout the production chain, such as high energy use in producing farm inputs, processing and packaging the food, and delivering it on the market. Agribusiness corporations that once opposed the idea of organic agriculture now convince organic farmers to use industrially produced biological inputs, which consume large amounts of fossil fuels to be produced, transported to, and applied on the farms. Meanwhile, some organic farms have turned into huge large-scale businesses. For example, in California, over half of the value of organic production is represented by only 2 percent of the growers. Natural food stores are now filled with almost as much processed food as ordinary supermarkets, except that the ingredients are organic, and maybe less fiber has been discarded during their processing. And added preservatives or ultra-pasteurization make organic products fit for traveling large distances between farm and market: for example, 70 percent of all organic milk in the United States is now provided by only one "industrial organic corporation" in Colorado (Altieri and Nicholls 2004; Pollen 2001). As in conventional markets, prices tend to fall when production chains gain length and market size increases. As a result, farmers are subjected to the same price-cost spiral that once led them to unsustainable farming practices. Yet, standards for organic farming fail to address the size of the farm and do not seem appropriate to address trade patterns in the market.

Experiences in Germany provide a useful case study, for in the past, significant progress has been achieved in switching to organic farming. This transformation even accelerated after a Green minister for consumer protection and agriculture came into power in 2001, and the German government became the first in the world that officially headed for an "Agricultural Turnaround." This concept not only aims at boosting organic farming methods, it also intends to change consumption patterns in order to increase demand for organic produce. Therefore, the concept of Agricultural Turnaround also includes policies and measures that address the improvement of food safety and consumer information, the marketing of organic produce, the promotion of locally and regionally farmed produce, as well as the advertisement of the value of a clean and healthy (agricultural) environment. As a result, many farmers switched to certified organic farming, even large "conventional" supermarket chains (*Aldi, Plus*, *Lidl*, *DM-Markt*, *Tengelmann*, among others) have established organic product lines, and the share of organic produce in the market almost doubled between 2000 and 2005—and it is still on the rise.

However this came at a price. As the Agricultural Turnaround only addressed both ends of the food market—the many farmers and the many consumers—it failed to address the middle of the market. Consequently, unrestrained market power from processors, retailers, and supermarkets has overwhelmed the organic market, causing the same problems as in the conventional food system: Retailing becomes centralized for the national market no matter how much energy is used for transport; competition among organic farmers from different regions drives those farmers on marginal lands out of business, whereas before, organic farming in Germany was especially successful in marginal areas (Oppermann 2001); and prices for organic produce plummeted, as for example, prices for organic bread wheat decreased by around 20 percent, and for bread rye even by about 38 percent over the last ten years (Kotschi 2005).

The crisis in agriculture cannot be viewed as a mere ecological disaster in the field; rather, economic and environmental aspects need to be considered respectively. Significant achievements have been made in making farming practices more environmentally sound, but these achievements need to be accompanied by countervailing economic framework conditions. Focusing exclusively on ameliorating environmental impacts of farming practices without addressing the trade patterns in the market that perpetuate the crisis will lead to failure. For the key question arises: What kind of market structure and trade patterns are suitable for nourishing organic farming—or even more sustainable forms of agriculture?

5 Sustainable Agriculture in the WTO

It would be wrong to say the WTO is entirely unaware of agriculture's impact on the biosphere. But it would be equally wrong to say that the WTO paves the way for a reconversion of industrial agriculture in the world. Generally speaking, the WTO's attitude is one of indifference; the institution neither ignore that environmental policies are at times tied into agricultural policies nor does it put the environment ahead of the trade liberalization agenda. The rationale for this attitude is the WTO's self-definition as an organization charged with the task of facilitating trade among nations, independent of other policy concerns. Environmental or social issues are supposed to be taken care of either by other multilateral legal agreements or by policies on the national level. "The WTO is not," as the secretariat is quick to point out (WTO 2004: 6), "an environmental protection agency." However, in the present institutional landscape, the power of the trade organization is neither matched by the power of other multilateral institutions nor by the power of national governments. As a consequence of this asymmetry, deregulation policies tend to overrule a range of other public-policy concerns, among them the protection of local and global ecosystems. Against this background, it comes as no surprise that the expansion of agricultural trade largely leads to an expansion of the conventional models of crop and animal production—industrial agriculture.

Environment in the WTO Framework

The intentions that led member states to establish the WTO are laid out in the Preamble of the founding agreement. It states that members' "relations in the field of trade and economic endeavor should be conducted with a view to raising standards of living, ensuring full employment and a large and steadily growing volume of real income and effective demand, and expanding the production of and trade in goods and services, while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so in a manner consistent with their respective needs and concerns at different levels of economic development."

The rather convoluted text notwithstanding, the Preamble clearly sets out the objectives of trade: rise in living standards, full employment, increasing incomes. Putting trade into a larger political context, the Preamble suggests that trade is not an end in itself, but a means to greater economic welfare. After having indicated the overarching goal, however, the Preamble proceeds to add a qualifying condition—sustainable development. Two elements are offered to specify this condition, binding them to a further condition: economic relations among members are expected to allow for the optimal use of the world's resources and to seek to protect and preserve the environment, while taking into account different levels of economic development.

In pursuance of the Preamble, in April 1994 the Marrakech Ministerial Decision on Trade and Environment launched the establishment of the WTO Committee on Trade and Environment (CTE). While the ministers declared "the aim of making international trade and environmental policies mutually supportive" the task of the committee, the 10 items they put on the committee's agenda initiated a rather lopsided implementation of this aim. The mutual supportiveness between trade and environment was essentially explored in only one direction, tracing the effects of environmental policies on trade, but largely failing to highlight the effects of trade policies on the environment—with one self-serving exception: Item 6 invites looking into the environmental benefits of removing trade restrictions. These items identified in 1994 have dominated the WTO discussion on trade and environment ever since. Discussions have remained inconclusive and most items reappeared in the Doha Declaration of 2001 (§31 and §32). The items put on the negotiation table for the CTE include the relationship between trade-relevant provisions in multilateral environmental agreements and the trading system, the relationship between environmental taxation as well as standard-setting and the multilateral trading system, and the effect of environmental measures on market access. In shorthand they may be called the "MEA question," the "harmonization question" and the "market-access question."

All three questions reflect the core assumption that unregulated trade is to be seen as the default position of the trading system. As a consequence, any other policy concern impacting trade—using, for instance, MEAs, taxes and standards, or market entry requirements—is to be accommodated as an exception and made compatible with free-trade rules. Thus, for more than 10 years, the CTE has by and large viewed environmental measures as a potential threat to the trading system and has attempted to neutralize any distorting impact on trade flows. On the other hand, no remotely similar effort has been undertaken to explore the consequences of deregulated trade for the preservation of resources and the integrity of the environment. Moreover, the clause in the Preamble referred to above has never been the starting point for a systematic review of trade policy, although it gained in weight with the affirmation of the WTO Appellate Body in the shrimp-turtle case that "it must add color, texture and shading to our interpretation of the agreements." In retrospect, it is hardly an exaggeration to say that the WTO has all along been preoccupied with the effect of environmental policies on free trade, but that it has largely disregarded the effect of free trade on the environment.

Environment in the Agreement on Agriculture

The exception proves the rule. The saying serves nicely to characterize the approach the WTO has taken toward the environment. As the WTO implicitly defines good trade rules as rules that no longer reflect the concerns of particular national communities, trade-related environmental norms can either become a global rule binding every player equally or be placed in a box of possible exceptions to which a national government may resort. So far, the first course has rarely been taken, leaving the politics of exception as the only alternative.

The Agreement on Agriculture (AoA) is a case in point. It focuses on eliminating distortions in agricultural trade arising from national policy choices, including export subsidies, market-access rules, and domestic support measures. But the drafters of the agreement could not avoid recognizing that agriculture is more than a production facility for tradable commodities; they had to provide a space for national policies addressing non-trade concerns. Therefore, the Preamble to the AoA notes "that commitments under the reform programme should be made in an equitable way among all Members, having regard to non-trade concerns, including food security and the need to protect the environment." Since it is obvious that the production of food and fibers is intimately linked to both the livelihood of citizens and the natural systems of a country, national governments needed to retain some authority over such sensitive issues. For the last 10 years, negotiations in the Committee on Trade and Agriculture have often revolved around defining the space of permitted exceptions in a deregulated trading arena.

The first of the so-called three pillars of the agricultural trade reform—next to export subsidies and domestic support—is market access. In negotiations, almost exclusive emphasis is put on reducing tariffs and defining tariff quotas for agricultural products. Compared with the overall concern of opening markets for higher volumes of goods, considerations about quality requirements for market access pale into insignificance. Nevertheless, issues of food safety (e.g., with regard to dioxin or BSE), consumer information and labeling (e.g., with regard to genetically modified food), and of food quality as indicated through geographical origin (e.g., "Scotch Whiskey") have been raised in negotiations. They remained inconclusive, be it only for the reason that they touch on other legal frameworks, such as the Agreements on Sanitary and Phytosanitary Measures (SPS), on Technical Barriers to Trade (TBT), and on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

In any case, defining market-access requirements in terms of quality is bound to remain a contested terrain. Over and above trade in agriculture, under Article XX GATT—and confirmed by recent rulings of the WTO dispute settlement body—members have the right to protect human, animal, or plant life and health, and to take measures to conserve exhaustible resources. However, how to balance this right against the assumed right to unencumbered market access has been hotly debated, resulting in a number of restrictive conditions, such as the proof of necessity, scientific evidence, and minimal restrictions on trade. Moreover, market-access regulation has to be product-based as opposed to process-based, that is, no regulation is allowed unless it is justified by some characteristic inherent to the final product (e.g., pesticide residues in cotton products). It is of high relevance to the issue of industrial agriculture that regulations based on production methods (e.g., cotton grown using pesticides, without leaving a trace in the final product) are not permitted under WTO.

Regarding the second pillar of the agricultural trade reform—the removal of export subsidies—environmental considerations do not apply or have been absent. As export subsidies are granted by governments for giving its producers an advantage in the international market place, they most obviously have trade-distorting effects. Prices on the world market are artificially lowered for a particular commodity, undercutting the chances of foreign farmers to market their products. Therefore, export subsidies are prime targets for trade reform under the WTO. Eliminating them has only indirect environmental effects; a higher level of international prices is likely to affect volume and location of production. As volumes contract, environmental pressure is relieved, and as some production shifts from developed to developing countries, the global environmental balance sheet appears to be inconclusive. This ties in well with the background assumption in WTO negotiations, that subsidy removal would be generally beneficial for the environment .

This assumption is even more present when it comes to the reduction of trade-distorting domestic support—the third pillar of the AoA. Indeed, removing domestic subsidies is regarded a classical win-win situation (WTO 2004: 23; Lingard 2002). Since the bulk of conventional subsidies aims at reducing the cost for environmentally pernicious inputs, such as chemical fertilizers, pesticides, irrigation water, and fuel, their elimination would benefit both trade and the environment—not to mention the relief for tax payers. Moreover, support aimed at maintaining producer prices above market prices leads to higher volumes of output; its reduction, therefore, is likely to ease environmental pressure by diminishing overall production. Finally, as the removal of both export and domestic subsidies in developed countries promises to improve the returns from agriculture in developing countries, sustainable farming practices might become more viable for their producers (WTO 2004: 23). Summing up the complexities of the issue, Lingard (2002) concludes his dictionary entry on "agricultural subsidies" by stating: "a simple message remains: if you want to start saving the environment, stop financing its destruction by agricultural subsidization."

However, the triumph of trade liberalization notwithstanding, developed countries have continued to resist the reduction of domestic subsidies, among other more important reasons, on grounds of environmental policy. As the AoA already recognized, the payment of subsidies is an important instrument in a government's toolbox for improving environmental protection. For the countries concerned, abandoning this instrument would severely restrain their political space to change agricultural practices, thereby blocking the road to sustainable agriculture in industrialized countries. Since national governments require adequate room to move for taking care of "non-trade concerns," the AoA had provided for assigning support measures to the so-called Green Box. Measures in this Box are designed to be environmentally benign and helpful, without being particularly trade-distorting. They are supposed to be decoupled from output quantities and prices, stimulating instead the reduction of negative externalities (such as chemical pollution or intensive energy consumption) or the provision of public goods (such as landscapes, flora and fauna habitats, biodiversity). As a consequence, domestic support measures have to a considerable extent been shifted to the Green Box. However, though a number of further conditions have to be fulfilled to make a measure qualify for the Green Box, the placement of measures in the Green Box has very much remained contested terrain in the negotiations. Nevertheless, Green Box policy has been a major entry point for environmental concerns into agricultural negotiations—though only so far as developed countries are concerned, given the relative absence of subsidies in less affluent countries.

Agriculture and Multilateral Environmental Agreements

How the body of international economic law, as codified by GATT/ WTO, relates to the body of international environmental law, as promulgated by a host of MEAs, has been a widely debated issue since the early 1990s. Each of the legal frameworks responds to different interests and values: economic law—urging for the unencumbered circulation of goods and investments—is suspicious of protection and governments; while environmental law—aiming at the protection of natural assets—calls on governments to regulate the flow of goods and investments. The two frameworks embody competing visions of how to bring order to the emerging world society; they are frequently in tension and at times contradict each other. How to resolve these tensions and contradictions remains an unsettled issue to this date. For behind what seems to be a technical issue lie deep-running conflicts about the future shape of world politics.

By and large, however, it is the economic regimes that have emerged to a position of predominance during the past 20 years, leaving the environmental regimes trailing far behind in political importance. Culturally, this asymmetry is due to the superior attraction of the "development as economic growth" model over the "development as sustainable prosperity" model; politically, it arises from the overriding determination of the powers-to-be to create a borderless world economy; and legally, it derives from the unique sanctioning power given to the WTO. In addition, the environmental accords have been frequently set up under the shadow of the free-trade philosophy; they rarely provide a platform for questioning WTO policies, while the WTO, on the other hand, takes the liberty of defining the proper place of environmental agreements.

The Doha Ministerial Declaration, in § 31(i), thus mandates negotiations "on the relationship between existing WTO rules and specific trade obligations set out in MEAs." As the mandate shows, talks are supposed to focus on the compatibility of trade measures that MEAs have identified to further their objectives, with WTO rules. However, the mandate fails to consider the more fundamental question of what trade measures might be called for to realize the various goals of worldwide environmental protection as formulated in the MEAs. To put it in a nutshell, from the point of view of the WTO, the biosphere does not exist unless trade measures are enacted elsewhere to protect it. But even the more limited mandate has so far not yielded any results, although just 38 out of 238 MEAs contain trade-related provisions (Hoffmann 2003: 2), among them the Montreal Protocol, the Basle Convention, CITES, and the Biosafety Protocol. For the rest, the prominent agreements, along with their wide-ranging agendas—such as the conventions on climate, on biodiversity (with the exception of biosafe trade in genetically modified organisms), or on desertification—are inexistent as far as the WTO is concerned; the world economy and the biosphere seem to be located on two different planets.

But the indifference cuts both ways: MEAs largely disregard the impact of WTO rules on the environment. This is the case with respect to the Agreement on Agriculture as well. The climate impacts of the global diffusion of industrial agriculture have not been of concern to the Climate Convention, nor its impact on soil quality to the Convention on Desertification, nor its effect on marshlands to the Ramsar Convention on Wetlands. Only the parties to the Convention on Biological Diversity (CBD) have requested the Secretariat to prepare documents on the impact of trade liberalization on agricultural biodiversity, and indeed, the two documents submitted to the Conference of the Parties in 2002 (CBD 2002) and 2004 (CBD 2003) highlight in what ways the objectives of the CBD might be affected by agricultural trade liberalization.

Trade Liberalization and Environmental Impacts

Few studies have been carried out to assess the possible impact of trade liberalization on the environment. With regard to effects on agro-biodiversity, CBD 2002 and CBD 2003 probably offer the best overviews available. However, it is advisable to keep in mind that most studies are model-based assumptions about the future and not empirical real-life studies. Moreover, the studies usually operate on the highly aggregate level of countries or the entire globe; as there are always positive as well as negative effects on this level, the tradeoffs made between benefits and costs tend to hide more than they reveal. More specifically, in weighing benefits against costs, economic studies are at times biased in favor of monetized assets over non-monetized assets, economically productive over less productive groups, and future gains over present losses. In other words, they underplay the extent to which common resources, marginal people, and today’s livelihoods are sacrificed for tomorrow’s greater economic welfare on the aggregate level.

Studies often rely on modeling because most environmental effects are caused in an indirect way; they are the result of changes in agricultural production and consumption that are induced by changing relative prices on local and global markets which, in turn, are prompted by liberalization policies. The direct effects of liberalization, in contrast, are much more straightforward. They include the transport effect and the bio-invasion effect. As both agricultural exports and imports grow in the wake of liberalization, the overall volume of transport is bound to increase. Long-distance freight and shipments within exporting countries are likely to rise while the volume of domestic shipments in importing countries might marginally decline (OECD 2000: 16). Average distances will in all likelihood grow, even if trade between neighboring countries might in some cases replace shipments from more distant locations. However, some reduction in transport is possible if tariff escalation is largely abolished. In this case, processing would be encouraged to take place in countries that have mainly been exporters of raw materials. As processed food products are generally lighter and less voluminous than agricultural raw materials, increased processing close to the farming location would tend to reduce transport needs.

Apart from the well-known energy and environmental impacts of transport, increased circulation of crops, cut flowers, seeds, or potted plants could provide new pathways for alien-invasive species through expanded cross-border transportation corridors. As a consequence, non-native species of microbes, plants, and animals are being introduced to other ecosystems, potentially creating a threat to native species with, at times, considerable losses in terms of biodiversity (CBD 2002: 19).

In contrast to the direct effects, however, the indirect effects depend on the evolution of producer costs and producer prices which, in turn, are expected to impact scale, structure, techniques, and location of agricultural production. In developed countries, turning to them first, trade reform is likely to result in lower producer prices. As a consequence, all factors of production will be used less intensively—in particular, costly external inputs. Analysis suggests that a reduction in subsidies coupled to production lowers incentives for the overapplication of pesticides, fertilizers, machinery, and water withdrawal (CBD 2002: 11). However, farmers may respond to lower prices also by shifting to more valuable and more input-intensive crops, thereby setting off a cycle of increasing specialization and concentration which would lead to less farms at constant levels of output. In New Zealand, for instance, which eliminated Amber Box support after 1984, the use of pesticides and fertilizers substantially decreased at first, only to rebound after a decade of restructuring the farming industry (OECD 2000: 20). Similar tendencies might come to the fore in Europe when, as it is assumed (Gay et al. 2004), liberalization, leading to a drop in income, will prompt the disappearance of farms and spur additional concentration. Furthermore, as production incentives disappear, the land area used for cultivation is, in the long run, likely to contract as well. Biodiversity will benefit as pressure to expand cultivation into ecologically vulnerable areas lessens. If, however, the affected areas are located in extensive farming regions where traditional farming has helped to sustain a broad variety of crops, hedges and trees, and site-specific soil properties, biodiversity may suffer (CBD 2003: 13). In both regards—external inputs and land use—the environmental balance of subsidy removal in developed countries is therefore ambiguous; much will depend on the availability of support for farmers that awards environmentally friendly entrepreneurial choices.

With an increase in world prices coupled with easier access to high purchasing-power markets, developing countries—at least a number of them—can expect greater economic opportunities. In fact, several studies have concluded that a partial shift in the location of agricultural production between continents is likely to occur. Trade liberalization will contribute to a contraction in total agricultural output in developed countries, while an expansion can be expected in the developing world (CBD 2002: 9). At the same time, farm outputs may shift from grains to processed food and meat, following demand at higher income levels. Both trends combined will result in pressure to enlarge the area under cultivation, leading to the clearing of primary forests for arable land, the conversion of natural prairies for crop-growing or livestock grazing, as well as the draining of wetlands for irrigation or for cultivation. Plants and animals may be driven from their habitats, ecosystems may degrade, and the impact on biodiversity is expected to be high (CBD 2003: 13). Furthermore, realizing comparative advantages on international markets calls for intensifying agricultural production. Only larger and more specialized farms, using higher volumes of pesticides, fertilizers, water, and fuel, and relying on a narrow range of plant genetic resources, may be capable of succeeding against trans-border competition. Even if the impact of fertilizers might be less severe in nutrient-poor than in nutrient-rich countries (Lankowski 1997: 24), or if production techniques become more efficient, the course is set for high-input farming (Kirkpatrick and George 2005; Morrissey et al. 2005). This is the reason why empirical studies from Chile and Mexico, for example, report a more intense use of land, native forests, surface water and aquifers, and of agrochemicals, as well as a worsening of destructive processes, such as erosion of land and genetic stock (Figueroa 1999: 28). In short, the industrial model of agriculture is likely to spread—with detrimental effects for both the health of people and the biosphere.

6 Trade Rules for Regenerating Agriculture

In an economy that is forgetful of nature, the biosphere is not a participant in the marketplace. Not surprisingly, nature never sends an invoice to producers. Losses incurred by nature through the use of her assets are not charged to the resource-extracting company in question. Economic actors are free to reap the services of nature without paying for the costs involved. To be sure, there is oil or uranium, fish or timber sold in markets, but their price rarely reflects the losses incurred by the ecosystems. What is being paid for is at best the rent for the property owner or the amount of labor invested for making natural goods available to costumers. In other words, the price reflects the cost of drilling, extracting, catching, transporting, processing, etc., but not the loss created for the webs of life. Indeed, losses suffered by the commons, be they natural or social, are generally not shown in any balance sheet. As a result, the creation of (economic) value rarely happens without a concomitant creation of (natural and social) disvalue. This is the case not just in industry, but also in the commercial activity that deals with the fruits of nature themselves—agriculture. Industrial farming attempts to outflank nature by means of mechanical, chemical, medical, and genetic technology; its accumulated side-effects are not accounted for, but have by now become a threat to the biosphere—and to people as well.

In industry as well as in agriculture, the dominating economic system is anything but a least-cost system (Hawken et al. 1999). In a truly least-cost system, the losses inflicted upon common resources while producing commercial goods would be weighed against the gains made in the market. In other words, only the coproduction of commercial and common goods is likely to bring about real wealth. From this viewpoint, the objective of agriculture is not just to yield earnings but to produce common health, including both nutrition for people and the regeneration of ecosystems. It is not adequate any longer to discuss issues of agriculture in a productivist framework where just quantities produced and productivity rates matter. In view of the environmental challenge, it is instead high time to evaluate agricultural and food systems in terms of a common health framework that accounts for both the quality of food and the long-term health of ecosystems. It is this fundamental shift in evaluative criteria that makes regenerative systems, in general, superior to industrial systems; food systems ought to be evaluated in terms of health over the course of multiple generations rather than in terms of income over capital invested (Dahlberg 2002).

However, the market is not made for producing common goods by itself; it needs to be embedded in a larger institutional context that is designed to secure the public interest. This is where politics comes in; in the last instance, it is the original task of the government to assume responsibility for the long-term welfare of the community. Since the free play of market forces greatly favors private gain over common goods, it is up to politics to rectify this imbalance. This is particularly the case with respect to the long-term integrity of ecosystems. Public policy is called for to design framework conditions that align the pursuit of private gain with the protection of the biosphere. Trade policy is by no means exempt from this duty; on the contrary, it is a misconception to assign trade policy only with the task of improving the conditions for private value-creation rather than the conditions for public value-creation as well.

More specifically, as elaborated below, environmental trade policies in agriculture may be designed in three arenas: First, in the arena of national politics, as governments need adequate policy space in order to implement a range of instruments to stimulate and protect the ecological regeneration of domestic agricultural systems—in particular, governments need sufficient policy space to establish sustainability processes and production standards, and to eventually link imports to corresponding quality standards at the border; second, in the arena of multilateral trade policy, as global standards for internationally traded goods are required in order to create a truly least-cost playing field—however, these standards should come in the form of meta-standards, because harmonization of actual quality norms at the global level has not proven to be sustainable; and third, in the arena of multilateral tax policy, as fees charged for the use of common resources, such as air space and the seas, establish a disincentive for environmentally harmful long-distance trade, helping to re-regionalize the entire food system in order to make it more environmentally sound.

Widening National Policy Space

Economists are not getting tired of repeating the mantra: freeing world trade eventually leads to greater efficiency. The free movement of goods around the globe will increase competition and thus stimulate productivity and technological progress, which will reduce costs and prices and free capital that can then be used for other purposes. However, with regard to maintaining global commons as well as social integrity and economic viability of rural areas, it seems there is a limit. At some point, any further reduction in marginal costs of production results in the marginalization of those producing. As long as global competition in agriculture creates incentives for technological progress, efficiency gains may be justified. But if competition either forces farmers to use exploitative practices and externalize costs at any price in order to stay in business, or if it even leads to the abolishment of farming all together, the argument for efficiency loses legitimacy. All the more because agriculture is not only about producing food for the lowest cost, but also maintaining the basis of food production, and with it the health of local habitats, communities, and the biosphere.

National governments need sufficient policy space to protect their domestic agricultural producers by ensuring reasonable commodity prices that prevent farmers from being driven out of business. This may entail quantitative restrictions (e.g., quotas) or price ceilings (e.g., flexible or price-triggered tariffs, or other safeguard measures) for products that come into the domestic market. In addition it requires measures that restrict the power of (transnational) food companies (for greater detail, see Murphy 2006). Yet such strategies are much restricted, if not prohibited by current WTO rules. While the AoA still allows many countries of the North to apply high tariffs on numerous agricultural products in order to protect their farmers from excessively strong world market competition, this strategy is challenged by powerful (Southern) countries who want access to Northern markets, as well as by the current free-trade paradigm and the actual trend of WTO negotiations, which aim at eliminating border protection as such. However, if protection of local farmers and regional markets were available to every country in a fair and similar manner, criteria and standards could be defined as to whether and when this protection is justified or not.

In addition countries should retain policy space to defend their right to impose measures for the sake of food safety, food quality, and environmental security, as these are important measures for preventing food-borne illnesses. This requires increasing the capacity of countries to craft not only stronger and more effective regulatory measures—such as process and production standards for sustainable farming, processing, and retailing—but also the installation of monitoring and risk assessment systems. In order to achieve this, policy space not only requests more flexibility concerning the use of tariffs, quota, and other border-control measures, but also vis-à-vis multilateral agreements that constrain domestic regulatory competence. For national regulation has been increasingly impeded over the past two decades, in particular through a number of side agreements to the GATT, and later the WTO, such as the Agreement to Technical Barriers to Trade (TBT), the Agreement on Sanitary and Phytosanitary Measures (SPS), the General Agreement on Trade in Services (GATS), or the Agreement on Trade-Related Investment Measures (TRIMS), to name but the most important ones. As these and other agreements restrict technical regulations or the implementation of health and social standards, public policy loses its capacity to shape society to a considerable extent. Trade rules need to be reformed in order to rectify this imbalance.

Finally, governments need policy space to set framework conditions that support their domestic producers in the constant transition toward more sustainable farming practices. Jules Pretty compiled a broad range of policies that have proven workable in the past to nourish such strategies as Resource-Conserving Agriculture, Organic Agriculture, or Agro-ecology (Pretty 1995: 267ff.). For instance, if polluting practices are penalized with taxes and levies, this makes polluters pay for the resulting environmental costs, and hence, will reduce pollution. Taxes could also be raised on industrial farm inputs, such as fertilizers or pesticides, so as to accelerate the transition toward closing on-farm nutrient cycles. At the same time, governments could offer low-interest loans for investing in resource-conserving technologies, and carry out environmental restoration programs to restore the capacity of local ecosystems. If farmers' training and farmer field-schools for sustainable farming practices are supported, and if the capacities of respective local NGOs are scaled up, this will catalyze further activities in the farming communities and generate local ownership in the process.

Last but not least, communication strategies that provide better information for the public will promote a shift in consumption patterns toward more sustainable and locally produced food items. Most importantly, as explained in the next section, governments should foster the development of local and civil-society-based schemes for sustainability processes and production standards, and develop strategies to ensure that standards are mainstreamed in all aspects of agricultural production.

Setting Quality Standards for Production and Imports

In this vein, as a first step, national politics should foster the development of standard monitoring and verification schemes. The establishment of production-process standards is crucial for minimizing clear-cutting, over-exploitation of water reserves, chemical pollution, or greenhouse gas emissions. The feasibility of monitoring and evaluating production processes has been clearly demonstrated by Fair Trade and organic agriculture initiatives, which are usually enforced by inspection and certification bodies. The "IFOAM Norms" for organic agriculture, as one example, include a detailed set of general principles and standards with requirements for crop production and animal husbandry, including criteria for the evaluation and use of selected off-farm inputs, and standards for processing, handling, and labeling (IFOAM 2002). Although IFOAM is considered the global platform of the certified organic movement, the IFOAM Norms are but one set of standards among many others that have been developed by national or private organizations. Today in more than one hundred countries, farmers organizations and consumer groups have developed their own sets of organic standards and certification rules—many of them consistent with IFOAM provisions, but specified and adapted to their respective environmental circumstances (see for example, Barret et al. 2001). Governments should support the independent development of such standard schemes. In a second step, governments should plan to develop domestic agricultural transformation strategies with standards that become mandatory for all agricultural production.

In addition, strengthening the links between organic certification and other types of labeling is long overdue, especially those that address social and economic concerns. For example, good experience has been made with linking "Fair Trade" to "organic" in order to guarantee a fair share of the price for small organic farmers that enter the world market. More systematically, combining these two labels would create an important link between worldwide food security and the future development of organic agriculture. Another approach might be to combine a label for regional production with an organic label. If products that are produced regionally are visible to consumers, they are then able to chose the food they eat from the region they live in, while reducing energy-intensive transportation, storage, and centralized retailing. At the same time, such combined labels would provide an advantage to local farmers that otherwise would be exposed to unleashed competition in the global market—thus favoring the local economy over the global. If in addition, subsidies for organic production were restricted to production under such regional organic labels, it would prevent them from perpetuating discrimination of farmers in other countries, especially in marginal regions.

With increased implementation of standard monitoring and verification schemes, costs for producers for complying with this legislation would rise. Therefore, governments should foster the development of local, independent organic certification schemes. Local schemes have the potential of establishing monitoring and certification mechanisms that are best suited to the structure of the farming system and the economic capabilities of the farmers; they can best minimize costs and regulatory burdens placed on small producers. Moreover, locally and nationally independent schemes could be supported by a mechanism that shifts the costs of certification from farmers engaging in sustainable production to those who continue conventional practices, as well as from farmers to consumers. The experience with the energy feed-in law—which catalyzed an impressive penetration of costly renewable energy systems in the energy market in several countries—is an interesting model that could be considered in the agriculture context. For example, a fee could be added to all conventional products, which in turn could cross-finance the costs for certification of sustainable agriculture, and assists small farmers in complying with standards and certification requirements.

Finally, setting up specific border-control measures can greatly support such inclusive quality standards. If national policymakers have the competence to link market access to quality standards, then domestic sustainable farmers are no longer put at a disadvantage vis-à-vis farmers in foreign countries that produce at lower standards. Qualified market access will favor trade in more environmentally and socially sound products over trade in commodities which have externalized the real costs of production (Lorenzen 2007). Indeed, the qualification of market access in terms of social and environmental requirements is urgent since agro-industries and food retailers increasingly invest in countries where environmental and social requirements are weakest. Such a strategy transforms them into protagonists of unconditional market access in countries with high food prices, thus increasing profits from sales, but undermining the competitive position of the responsible domestic producers. Quality standards at the border would work like trade filters to reduce social and environmental dumping. Governments could provide a "carrot" for sustainable producers and grant preferential market access to products that adhere to certain sustainability standards (see also Clay 2004). In other words, commercial goods that have been demonstrably coproduced along with common environmental and social goods would be given a trading advantage, thus encouraging a shift in production and marketing toward EcoFair commodities worldwide.

The current stalemate in the WTO negotiations in the Doha Development Round offers an important opportunity to raise national and international interest in the concept of qualified market access. Governments are actively looking into criteria for fair and sustainable procurement practices. Reflecting the strong interest in the consequences of climate change, including global food security and sustainable farming practices, EU Trade Commissioner Peter Mandelson has recently suggested at the WTO to stepwise reduce tariffs for environmentally friendly technologies. Together with the efforts of the European Parliament to launch a process of consultation on criteria and instruments for qualified market access, this could be the beginning of a wider dialogue between civil society and decision-makers on criteria for EcoFair trade rules (Lorenzen 2007).

Establishing Meta-standards at the Multilateral Level

The Achilles heel of setting national processing and production standards in an age of open borders is well known: Companies may choose the exit option. Relocation of investments or trade flows is a permanent threat to governments that are perceived to be too demanding in terms of environmental protection. If, for example, India decides to push for regenerating domestic cotton cultivation in order to safeguard water and soils, trade flows might shift to less environmentally minded Pakistan. For this reason, national trade measures are too weak and too fragmentary for inducing change at a scale required by both rising energy prices and the accelerating decline of the biosphere. National standards need to be complemented by international standards.

However, the development of global standards is an enormous challenge, especially in a world that is characterized by highly diverse agro-ecosystems, farming practices, and food cultures. It would indeed be a loss for both ecology and culture if harmonized global standards led to the harmonization of production practices around the world. This has been the case where certified organic standards developed in one country have been transferred to production systems in another. For example, EU organic labeling standards neglect synthetic fertilizers, but in some tropical areas some amount of fertilizer seems indispensable. In several places, such as in northern Sumatra, farmers' groups have therefore developed their own organic standardization system, which aims at reducing synthetic fertilizers, but does not exclude them because intensified livestock production in that region is simply not an appropriate option (Kotschi 2005). Moreover, many organic-standards schemes focus on specific farming practices, but disregard equally important social and economic aspects that must be considered in the development of sustainable agricultural practices, such as the need for a balance between subsistence and export agriculture or the preservation and integration of traditional knowledge. Finally, standard schemes developed in the North require relatively costly monitoring and verification systems. By contrast, in Southern local markets, where farmers sell directly to consumers, simpler and less-costly standard and labeling systems would be more appropriate. Therefore, production standards should be developed locally to ensure that environmental, economic, and social considerations and the particular capabilities of the farming community are properly addressed.

The development of meta-standards may offer a solution. Meta-standards would not harmonize specific production standards. Instead they would define common norms for the process of standard setting. Is the process which leads to local or national quality standards sufficiently democratic? Are all the relevant stakeholders included? After all, standard setting should reflect a common effort that includes the participation of farmers, urban consumers, nongovernmental organizations, local retailers, and small-scale sellers. Where common criteria for the standard-setting processes have been developed, these can provide a basis for mutual acceptance of the various local and national standard schemes in the trade between nations. Universal process standards rather than production standards should be at the heart of negotiations over the mutual acceptance of national production standards in order to ensure a balanced set of common rules for a highly diverse world.

Meta-standards in the context of agriculture have been developed by IFOAM, who commissioned the IFOAM-associated International Organic Accreditation Service (IOAS) to draft guidelines for the acceptance of the various locally and nationally developed IFOAM organic standard schemes. It would be a first step in the right direction if governments around the world were to accept IOAS-accredited organic standard schemes at the domestic level. More general guidelines for process standards have been developed by the International Standardization Organization (ISO), which provides a general code of good practice for standardization (ISO/IEC Guide 59), or by the ISEAL Alliance, which provides a specific code of good practices for setting social and environmental standards (www.isealalliance.org). Negotiations for such meta-standards in sustainable agriculture standard-setting processes would ensure the independence of the myriad of sustainable production practices, while at the same time providing a common ground for cross-border trade. An independent multilateral complaint body could be established to deal with conflicts between countries regarding differences in their standards. For example, a “Center for Dispute Mediation in Conflicts Over Standards” could be established to provide impartial, complaint mediation and dispute settlement.

Although meta-standards do not define quality norms for farming and livestock practices, they will require the development of such norms, which in turn, will establish an important quality standard in international trade. The setting of such standards for trade is essential to redress the negative effects of globalization. Thus far, participation in the transnational economy has had the effect of driving down standards, since open borders invite companies to source or to locate where norms are weakest. By contrast, sustainable global markets are unachievable unless they drive up standards for companies participating in them. Transnational markets should induce a race to the top rather than a race to the bottom. As a general rule, the floor for global business should be higher than for local business, and not the other way around. Entry into global markets must be conditional on a minimum degree of sustainability performance. Otherwise, the playing field remains biased against responsible farmers and companies. Through multilaterally agreed meta-standards, countries would be required to establish and enforce domestic quality standards for sustainable agricultural production, and to develop these standards in a process that is open, inclusive, and democratic.

Making Distance More Expensive

Though about 90 percent of all food—including fruit and horticulture—is consumed in the country of production, a number of cash crops are primarily shipped onto export markets. These include products such as coffee, cocoa, tea, soy beans, rubber, tobacco. Along with food crops for export, they imply high-volume shipments over large distances. In terms of weight, by far most of the transport is carried out by ship, but some low-volume/high-value produce, such as fresh strawberries or grapes, are transported by air. Agricultural trade is a very transport-intensive affair, considering volumes over kilometers. Without declining freight costs, however, the expansion of global markets would not have been profitable. In particular, competition of foreign products in domestic market sectors—for example, Brazilian chicken legs against local chicken legs, tomatoes from Israel against domestic tomatoes—requires low transport costs; otherwise, the lower marginal production costs abroad would soon be eaten up by greater outlays for transport. There have been essentially two reasons for lower transport prices: higher efficiency through containerization and just-in-time communication technologies, as well as a long period of cheap oil. The latter factor is not likely to stay; therefore, long-distance trade will increasingly be exposed to adverse conditions.

Over and above rising oil prices, however, crop miles imply stress on the biosphere, in particular through the pollution of air and water, and the emission of greenhouse gases. Up to now, damage to the biosphere has not been redressed, because an owner who could claim compensation for any resulting wear and tear does not exist. Indeed, no single country or company can claim a property right to the air and the seas; these are global commons that belong to everybody, and no one in particular. They are common resources, and as such part of the heritage of mankind. Also in this case, the global economy in part lives from metabolizing inputs taken from global common resources, without accounting for the loss. To reverse this situation, a new generation of instruments is needed, such as user fees for the use of common resources. Such fees have been discussed in multilateral fora since the 2000 Monterey Finance Summit and the 2002 World Summit for Sustainable Development, basically for two reasons. On the one hand, user fees may protect common resources by raising the price of their use. On the other, however, they may provide an independent and truly transnational tax base that could underpin the work of the United Nations.

Global air space is used as a means for transport. Moreover, aviation is a rapidly growing source of greenhouse gases, which is not covered by reduction commitments under the Kyoto Protocol to the UN Framework Convention of Climate Change. To compensate for the use and pollution of a common resource, a user-charge based on aircraft emissions is entirely reasonable. The German Advisory Council on Global Environmental Change, which has proposed such a charge (WBGU 2002), estimates the avoidance costs for aviation-related greenhouse gases at about 3–30 billion dollars annually, meaning revenues from emission charges could already generate 3 billion dollars right from the beginning. This would amount to roughly 30 times the annual budget of the UN Environment Program. Such a charge aims at dampening the demand for air travel by incorporating some of the damage costs into the price of air passage and air freight. Moreover, it is also an incentive for mobilizing the efficiency potential in engines, aircrafts, and routing.

Furthermore, the use of the high seas for transportation is a classic example of a common resource with open access. Although environmentally speaking, ocean shipping is less harmful in comparison to air transport, marine and air pollution is still considerable. For this reason, an annual fee, possibly with rebates for sound technology, may be collected from all ships, regardless of flag state or seat of the company. Just as with subsidies and standards, user charges are also tools that governments, conscious of the maintenance of common resources, need to maintain the policy space for in order to secure long-term environmental health in agricultural trade.

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