

Soil Not Oil

*Environmental Justice in a Time of
Climate Crisis*

VANDANA SHIVA

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Triple Crisis, Triple Opportunity

Two hundred years into the fossil fuel era, CO₂ emissions have created a greenhouse effect that is responsible for global warming and is leading to a climate crisis. An all too likely increase in temperatures of 3 to 5 degrees Celcius will result in the melting of the polar ice caps and glaciers, and the intensification of floods, droughts, and cyclones. Some of these effects are already being felt. If we do not halt the temperature increase the climate crisis will dramatically change how we live.

And it will decide whether we live or perish.

Besides the problematic “gift” of climate chaos, the age of oil is up against another limit—peak oil. Conceptualized by M. King Hubbert in 1956, peak oil refers to the point at which the world reaches the highest possible level of oil production. After that, oil production must necessarily decrease.¹ Decreasing production will mean increasing prices. The unprecedented increase in oil prices in 2008 is a sign of an emerging oil crisis. Experts such as Jeremy Leggett and Dr. Colin Campbell of the Association for the Study of Peak Oil say we may have already reached the peak, but even if it is a few years off, it *will* occur.² As Heinberg has put it, “the party is over.”

Peak oil and the end of cheap oil make it imperative that we change the way we live. We need to move beyond oil. We need to reinvent society, technology, and economy. We need to do it fast and we need to do it creatively. We can.

Climate chaos and peak oil are converging with a third crisis—the food crisis. The food crisis results from the combined impacts

of the industrialization and globalization of agriculture. The very forces and processes that have promised cheap food are pushing food beyond people's reach. Prices of food are rising worldwide. More than 33 countries have witnessed food riots.

In early June 2008 an emergency meeting of the UN was called to address the crisis of climate change and the food crisis. As expected, the same corporate interests that have created the two crises tried to offer the disease as the cure—more fossil fuel-based chemical fertilizers, more non-renewable genetically engineered and hybrid seeds bred to respond to the intensive use of chemicals, more corporate control of food, and more globalized trade.

The food crisis reflects a deeper crisis—the creation of “redundant” or disposable people and, alongside them, the potential for violence and social and political instability.

Disposability of people is built into the denial of food to millions as well as the destruction of rural livelihoods by the substitution of human energy with machines powered by fossil fuels. The very definition of productivity in the industrial paradigm is labor productivity, i.e., the fewer human beings involved in production, the more “productive” a process is, even if it uses more energy and more resources and produces less per unit of energy and resource inputs.

While wide-ranging wars, colonial expansion, and slavery—among other things—have long resulted in human-generated misery and destruction, never before have the actions of one part of humanity threatened the existence of the entire human species. We are now facing a triple convergence of crises, each of which threatens our survival.

Climate: Global warming threatens our very survival as a species.

Energy: Peak oil spells the end of the cheap oil that has fueled the industrialization of production and the globalization of consumerism.

Food: A food crisis is emerging as a result of the convergence of climate change, peak oil, and the impact of globalization on the rights of the poor to food and livelihood.

Of the three crises, the emerging food crisis poses the most immediate threat to the survival of the poor. The food crisis emerges from two historical processes, one long-term—the industrialization of agriculture and the uprooting of peasants and family farmers from the

land—and one more recent—the effects of globalization and trade liberalization of agriculture on food security and food sovereignty. The impact of climate change on agricultural production, along with such false solutions to climate change as industrial biofuels, which divert food and land from the poor to the non-sustainable energy needs of the rich, further exacerbate the food crisis.

We can and must respond creatively to the triple crisis and simultaneously overcome dehumanization, economic inequality, and ecological catastrophe.

The energy and climate-change crisis stands as a unique social and ecological challenge. First, the very survival of the human species as a species is threatened. Second, no other challenge is so global in scope. There is no place to hide. Third, climate change is impacted by diverse human activities—how we shop, how we move, how we live, how we eat. Solutions cannot be restricted to one or two sectors. They will touch all aspects of our lives. Mitigation and adaptation must happen across all aspects of our lives. Fourth, climate change results from what is done to the land, and its impacts transform the land. Air, water, land, biodiversity, and energy are intertwined elements of climate change—its cause and solutions. Fifth, those least responsible for climate change are worst affected by it. Peasants, indigenous peoples, and artisans who live outside the industrialized globalized economy, who have caused no harm to the earth or other people, are the worst victims of climate chaos. Over 96 percent of disaster-related deaths in recent years have taken place in developing countries. In 2001, there were 170 million people affected by disasters around the world, of which 97 percent were climate-related.³ Sixth, resistance to the limitless destructiveness of the industrialized globalized economy is coming precisely from those least responsible for climate change, the women, the hawkers, and street vendors who stand in front of the juggernaut of fossil fuel-driven, energy- and resource-intensive “development,” refusing to be uprooted, refusing to be turned into disposable people, offering another paradigm and world view—of power and wealth, of nature and culture.

Climate change demands that we reduce fossil fuel use and CO₂ emissions. It also demands that we “power down” through decentralized and decreased energy use. Peak oil and the end of

cheap oil demand a paradigm shift in our conception of human progress—we need to imagine how we can live better without oil. The emerging food crisis will add another billion people to the billion who are already denied their right to food and condemned to hunger and malnutrition. The disposability and dehumanization of the poor and the marginal demand that we focus on the dignity of work and the relevance of ecological work. The dominant model of development and globalization is inherently violent because it deprives the poor of their fundamental right to food, land, and livelihoods. By bringing back dignified work based on human energy and living energies we can mitigate climate change and make a transition to a society beyond oil, while ensuring food security and good food for all.

We must, therefore:

- Power down energy and resource consumption
- Power up creative, productive human energy and collective democratic energy to make the necessary transition

Unfortunately, the forces that have given us climate change are using the crisis to further inequality by robbing the poor of their last morsel of food and last inch of land without achieving sustainability.

We have two choices: we can make a nature-centered, people-centered transition to a fossil fuel-free future, with meaningful work and decent and dignified living for all; or we can continue on our current path toward a market-centered future, which will make the crisis deeper for the poor and the marginalized and provide a *temporary* escape for the privileged. The first part of this book deals with the pseudo-solutions; the second part offers equitable and lasting solutions from a people's perspective in the Global South.

Most of the discussions and negotiations on climate change have been restricted to the commercial, consumption-oriented energy paradigm rooted in a reductive, mechanistic worldview and consumerist culture. Within this paradigm there are two dominant approaches: the approach of global business, especially the corporations that have promoted the fossil fuel economy, and the approach of those seeking renewable alternatives to support an energy-intensive consumerist society.

This paradigm, which began in the industrial countries two centuries ago and which is being spread to countries like India

through globalization, has given us disposable people, hunger, poverty, cultures of fear and insecurity, and climate chaos.

Fossil fuel-based businesses and industries first tried their best to deny any link between climate change and the economies they built for maximizing their profits. When scientific evidence and people's experience removed the blinders they attempted to put on humanity, they started to propose "solutions." However, these pseudo-solutions will make the crisis worse. Among them are the promotion of non-sustainable energy options such as nuclear energy and industrial biofuels, carbon "offsets," trading and markets in pollution, and reckless technological adventurism, such as placing reflectors in the sky and metal fillings in the ocean, which would further disrupt ecological processes in an attempt to sequester carbon dioxide.

These solutions are designed to maintain the energy-intensive systems of rich industrial societies. The energy transitions they propose work in a limited context—they work in rich countries and they work to maintain systems that are inequitable and non-sustainable in the larger context. They work by increasing the burden on the poor and the burden on the planet. Shifting to industrial biofuels is a clear example of such misplaced "solutions." Increasing biofuel production worsens the food crisis by taking land and food from the people in order to produce "feedstock" for the insatiable appetite of the fossil fuel infrastructure and the limitless consumption it requires. From the perspective of the planet and the poor, we need to make a paradigm shift from consumptive energy to productive and regenerative energy, from capital-intensive energy to low-cost energy, from labor-displacing energy to livelihood-generating energy. In other words, the energy transition that the poor need increases the possibilities for meaningful work and decreases the use of fossil fuels. A transition that brings people back into the sustenance economy helps the poor by increasing their security of livelihood and putting more resources back in their hands and helps the planet by reducing carbon dioxide emissions.

"Energy" in the mechanical paradigm, which views nature as a machine and not a living system, is defined as the capacity to do work. However, increasingly, humans are being removed from their role of providing energy, doing work. The poor are victims three times over of the fossil fuel-driven industrial system. First

they are displaced from work; then they bear a disproportionate burden of the costs of climate chaos through extreme droughts, floods, and cyclones; and then they lose once more when pseudo-solutions like industrial biofuels divert their land and their food. Whether it is industrial agriculture or industrial biofuels, car factories or superhighways, displacement and forced evictions of indigenous peoples and peasants from the land are an inevitable consequence of an economic model that creates growth by extinguishing people's rights.

Strategies that affirm the rights of the poor to their land and livelihoods are also strategies that reduce our dependence on oil. They help mitigate climate change and help us adapt to climate chaos. Addressing issues of poverty, equity, and justice on a small and finite planet simultaneously address peak oil and climate catastrophe.

The most creative and necessary work that humans do is to work with the soil as coproducers with nature. Human effort and knowledge based on care for the soil prevents and reverses desertification, the root of collapse of so many historical civilizations.⁴ Rebuilding soil fertility is the very basis of sustainable food production and food security. There is no alternative to fertile soil to sustain life, including human life, on earth. And, as I show in this book, it is our work with living soil that provides sustainable alternatives to the triple crisis of climate, energy, and food. No matter how many songs on your iPod, cars in your garage, or books on your shelf, it is plants' ability to capture solar energy that is the root of it all. Without fertile soil, what is life?

The transition from oil to soil is a multidimensional transition of economy, politics, and culture.

First, it is an economic transition from a fossil fuel-driven, globalized economy—one that favors corporations by subsidizing oil and outsourcing costs—to a network of renewable energy-driven, climate change-resilient, local economies. These living economies are grounded in the soil, literally and metaphorically. They are localized, which reduces our ecological footprint on the planet while enhancing our well-being. Economies rooted in the soil are centered on nature and people. The driving force is maintenance of life, today and in the future. Their currency is not money but life itself.

Second, the transition from oil to soil is a political transition. It is a transition from undemocratic political structures—which impose globalization and a fossil fuel infrastructure on society and force the large-scale uprooting of peasants and indigenous peoples—to a decentralized democracy in which local communities have a say in what happens to their land and their lives. In this sense, soil is a metaphor of decentralized and deep democracy. As David Bosshart writes, "Consumer democracy is the gasoline for the bulldozer of globalization."⁵ Consumer democracy is a pseudo-democracy associated with economic dictatorship; it desertifies the soil of real democracy. Authentic democracy, like plants, grows from the ground up. It is fertilized by people's participation.

Third, the transition from oil to soil is a cultural transition—from a deadly consumerism to reclamation of our rightful place as cocreators and coproducers with nature. The shopping mall and the supermarket are temples of consumerism through which global corporations seduce us into participating in the destruction of our productive capacities, our ecological rights, and our responsibilities as earth citizens. Soil teaches us how to be earth citizens. And for the half of humanity that works the soil as peasants, the soil is also protector. As globalization violently pushes peasants off the land, the soil symbolizes another culture, a culture of non-violence, a culture of permanence, a culture of dignity in work, a living culture for the protection and renewal of life.

The convergence of these three crises provides us with the convergence of three opportunities—to create living economies, living democracies, and living cultures. Earth Democracy grows in the fertile soil shaped by the earth, the human imagination, and human action.

The age of oil has symbolized a rule of capital, of centralized control and coercive government, of pollution and non-sustainability, of injustice and inequity, of violence and war. The age of soil symbolizes the age of Gaia, of the flowering of diversity and democracy, of justice, sustainability, and peace.

We will either make a democratic transition from oil to soil or we will perish. The poor, the weak, the excluded, the marginalized are threatened today. In the short term, we can continue to extend the profits and consumerism of the privileged by further dispos-

sessing the poor. But tomorrow even the rich and the powerful will not be immune from Gaia's revenge and the revenge of the billions of dispossessed. We will either have justice, sustainability, and peace together or we will descend into ecological catastrophe, social chaos, and conflict.

Soil, not oil, offers a framework for converting the ecological catastrophe and human brutalization we face into an opportunity to reclaim our humanity and our future.

Food for Cars or People

Biofuels a False Solution to Climate Change and a Threat to Food Security

ECOLOGICAL, DIVERSE, DECENTRALIZED BIOFUELS VS. INDUSTRIAL BIOFUELS

Biofuels, fuels from biomass, continue to be the most important energy source for the poor in the world. The ecological, biodiverse farm is not just a source of food, it is also a source of energy. Energy for cooking the food comes from inedible biomass like the stalks of millets and pulses, farmed trees, and village woodlots. Managed sustainably, village commons have been a source of decentralized energy for centuries. The use of decentralized energy from biomass is a vital part of the transition from fossil fuels to renewable energies. Biomass can be used directly as a cooking and heating fuel. It can be turned into biogas, a decentralized-energy alternative promoted by Gandhi, among others. Biofuels can be used to generate electricity for decentralized use and can be part of a sustainable alternative to fossil fuels and nuclear power. If embedded in a democratic, decentralized framework of management and decision-making, biofuels can rejuvenate biodiversity, recycle carbon, enhance agricultural productivity, increase the resilience of agro-ecosystems in the face of climate change, and increase the food and energy security of the poor.

However, the current euphoria over industrial biofuels is promoting monocultures and destroying biodiversity; promoting continued luxury consumption by the rich at the expense of the basic food and domestic energy needs of the poor; and promoting centralized corporate ownership and control over land and biomass by grabbing them from the poor.

In 1995, there were 34 countries that relied on wood fuels for more than 70 percent of their energy needs; in 13 of these countries wood supplied more than 90 percent.¹ The diverse crop and tree species that have supplied rural energy in biodiverse agro ecosystems do not appear in the new lexicon of “biofuels.” Biofuels are no longer an agrarian product meeting the needs of the rural poor. In fact they are not even a complementary product to food. Instead industrial biofuels are in competition with food. They are not part of diversified, decentralized, sustainable, and equitable food and energy systems.

Industrial biofuels are not the fuels of the poor; they are the foods of the poor transformed into heat, electricity, and fuel for the rich. Liquid biofuels, in particular ethanol and biodiesel, are one of the fastest-growing sectors of production, driven by the search for alternatives to fossil fuels. Industrial biofuels have been promoted through legislation and policy. Laws are being enacted to promote and subsidize liquid fuels diverting land from food production. From the richest countries in the North to the poorest countries in the South, food security is being forgotten in order to keep the energy infrastructure of the fossil fuel age “well oiled.” The entire structure built on fossil fuels is seeking to be maintained and expanded on the basis of oil from plants.

President Bush is trying to pass legislation to require the use of 35 billion gallons of biofuels by 2017—a massive increase from the estimated 4 billion gallons used in 2005. Alexander Müller of the Sustainable Development Department of the United Nations Food and Agriculture Organization (FAO) has stated: “The gradual move away from oil has begun. Over the next 15 to 20 years we may see biofuels providing a full 25 percent of the world’s energy needs.”² Global production of biofuels has doubled in the past five years and is likely to double again in the next four years. Among the countries that have enacted pro-biofuel policies in recent years are Argentina, Australia, Canada, China, Colombia, Ecuador, India, Indonesia, Malawi, Malaysia, Mexico, Mozambique, the Philippines, Senegal, South Africa, Thailand, and Zambia. Former World Bank president Paul Wolfowitz once said:

Biofuels are an opportunity to add to the world supply of energy to meet the enormous growing demand and hopefully to mitigate some of the price effect. It’s an opportunity to do so in an environmentally friendly way and in a way that is carbon neutral. It

is an opportunity to do so in a way that developing countries like Brazil can provide income and employment for their people.³

But are industrial biofuels carbon neutral? Are the poor gaining or losing with the explosive increase in the production of industrial biofuels? What are the soil and ecological implications of the new policy obsession with industrial biofuels? What are the implications for land sovereignty and food sovereignty of the poor?

INDUSTRIAL BIOFUELS: GREEN OR GREEN™

Industrial biofuels are being promoted as a source of renewable energy and as a means to reduce greenhouse gas emissions. However, there are two ecological reasons why converting crops like soy, corn, and palm into liquid fuels can actually aggravate the CO₂ burden and worsen the climate crisis while also contributing to the erosion of biodiversity and the depletion of water resources.

First, deforestation caused by expanding soy and palm oil plantations is leading to increased CO₂ emissions. The FAO estimates that 1.6 billion tons, or 25 to 30 percent of the greenhouse gases released into the atmosphere each year, comes from deforestation.⁴

According to Wetlands International, destruction of Southeast Asian forests for palm oil plantations is contributing to 8 percent of global CO₂ emissions.⁵ By 2022, biofuel plantations could destroy 98 percent of Indonesia’s rainforests.⁶ Every ton of palm oil used as biofuel releases 30 tons of CO₂ into the atmosphere, ten times as much as petroleum does.⁷ Ironically, this additional burden on the atmosphere is treated as beneficial and as a Clean Development Mechanism (CDM) by the Kyoto Protocol. Biofuels are exacerbating the same global warming that they are supposed to reduce.

BIOFUELS: A GREENHOUSE THREAT

Two important studies published in February 2008 in the journal *Science* reveal that biofuels cause more greenhouse gas emissions than conventional fuels if the full emissions costs of producing these green fuels are taken into account. The studies follow a series of reports that have linked ethanol and biodiesel production to increased carbon dioxide emissions, destruction of biodiverse forests, and air and water pollution. The destruction of natural ecosystems,

whether rainforests in the tropics or grasslands in South America, not only releases greenhouse gases into the atmosphere, but also deprives the planet of natural sponges to absorb carbon emissions. The new cropland, the study reports, also absorbs far less carbon than the rainforests or even scrubland it replaces. Together the two studies offer sweeping conclusions: taken globally, the production of almost all biofuels resulted, directly or indirectly, intentionally or not, in new lands being cleared. Whether that land was rainforest or scrubland, the greenhouse gas contribution is significant.

Joseph Fargione, an author of one of the studies and a scientist at the Nature Conservancy, says, "The clearance of grassland released 93 times the amount of greenhouse gases that would be saved by the fuel made annually on that land." In Indonesia and Malaysia, palm biodiesel, one of the most controversial biofuels currently in use, because of its connection to rainforest deforestation in these countries, has a carbon debt of 423 years. Soybean biodiesel in the Amazonian rainforest has a debt of 319 years. "Until the carbon debt is repaid, biofuels from converted land have greater GHG impacts than the fossil fuels they displace."⁸ A "carbon debt" refers to the CO₂ released during the first fifty years from the land conversion. "People don't realize there is three times as much carbon in plants and soil than there is in the air. While we cut down forests, burn them, churn the soil, we release all the carbon that was being stored," says Dr. Fargione.⁹

According to Dr. Fargione, the dedication of so much cropland in the United States to growing corn for ethanol has caused indirect land-use changes far away. Previously, Midwestern farmers had alternated growing corn and soy in their fields, one year to the next. Now many grow only corn, meaning that soy has to be grown elsewhere. The studies show that the purchase of biofuels in Europe and the United States leads indirectly to the destruction of the natural habitats far afield. This has also been proven by the Navdanya study on food versus fuel, which found that the grasslands and common lands are being destroyed in Chhattisgarh and Rajasthan to grow jatropha for biofuel.

David Pimentel and Ted Patzek, professors at Cornell and Berkeley, respectively, have shown that all crops have a negative energy balance when converted to biofuels—it takes more fossil fuel energy input to produce biofuels than the resultant biofuels can generate.

It takes 1.5 gallons of gasoline to produce one gallon of ethanol.¹⁰ For each fossil fuel unit of energy spent producing corn ethanol, the return is 0.778 units of energy, 0.688 units for switchgrass ethanol, and 0.534 for soybean diesel.¹¹ Pimentel and Patzek were criticized by the US government for including the energy used for building new refineries. However, these are new energy investments that do generate emissions, and Pimentel and Patzek are right to include them when calculating the overall energy balance.

In 2006 the US used 20 percent of its corn crop to produce 5 billion gallons of ethanol, which only substituted for 1 percent of its oil use. If 100 percent of the corn crop were used to make ethanol, it would be able to substitute for 7 percent of the total oil used.¹² Even if all US soy and corn were converted to fuel it would only substitute for 12 percent of the gasoline and six percent of the diesel. To satisfy the entire current oil demand of the US with biofuels would take 1.4 million square miles of corn for ethanol or 8.8 million square miles of soy for biodiesel, which is more than all the agricultural land in the US.¹³ All the solar energy collected by every green plant in the US in 2006—including agriculture, forests, and lawns—is only half as much as the fossil fuel energy consumed in that year.¹⁴ This is clearly not a solution to either peak oil or climate chaos.

In fact, ethanol is a source of other crises when you look at all the resources it demands. It takes 1,700 gallons of water to produce a gallon of ethanol. Corn uses more nitrogen fertilizer, more insecticides, and more herbicides than any other crop. Ethanol constitutes 99 percent of all biofuel production in the US. In 2004, there were 3.4 billion gallons of ethanol produced and blended into gasoline, amounting to about 2 percent of the nation's gas consumption.¹⁵

There has been a flood of subsidies in the West for production of biofuels. The cost of support of ethanol varies from \$0.29 to \$0.36 per liter in the US and \$1 per liter in the EU.¹⁶ Support for biodiesel varies between \$0.20 per liter in Canada and \$1 in Switzerland. In 2007 US taxpayers provided \$6 billion to ethanol producers through subsidies.¹⁷

In 2008, the government introduced a tax credit of \$0.51 per gallon on ethanol and mandated a doubling of the amount of ethanol to be used in gasoline by 2012, to 7.5 billion gallons. The total cost to the consumer of subsidizing corn ethanol is \$ 8.4 billion per year.¹⁸

Subsidization of biofuels is creating a deep impact on demand for foodstuffs from the United States. In 2007, for example, the increase in ethanol production will account for more than half of the global increase in demand for corn. Much the same is true in the US and EU for soybeans and rapeseed used in biodiesel. The rising price of food is good for producers. It is dreadful, however, for consumers, particularly for those in poor, food-importing countries. Increased production of biofuels also adds stress on existing land and water supplies.

These subsidies will distort agriculture policy and encourage farmers to divert their crops from food to fuel. They promote monocultures and industrial agriculture, which contribute to climate change. In effect, industrial biofuels will increase climate instability, rather than mitigating it.

According to Patzek, "the United States has already wasted a lot of time, money, and natural resources pursuing a mirage of an energy scheme that cannot possibly replace fossil fuels. The only real solution is to limit the rate of use of these fossil fuels. Everything else will lead to an eventual national disaster."¹⁹

For Italy to meet the EU requirement to have 5 percent of its gas and diesel be biofuel by 2010 will require 69 percent more land to be farmed than is available in the entire country and require 102 percent more water and 40 percent more chemicals.²⁰ The UK has set targets of 2.5 percent of fuel to be biofuel by 2008, rising to 5 percent by 2010. Compulsory biofuels are a recipe for disaster. It is a case of the cure being worse than the disease.

The planet and the poor are losing; the rainforests—the lungs, the heart, the liver of the planet—are being bulldozed to plant soy and palm. In Brazil, 22.2 million hectares have been converted to soy plantations, producing in 2004–2005 over 50 million tons.²¹ Brazil will clear an additional 60 million hectares of land due to the gold rush for soy. Since 1995 in Brazil, soy cultivation has been increasing at 3.2 percent (320,000 hectares) per year. Twenty-one percent of Brazil's cultivated area is now soy, and 300,000 people have been displaced in Rio Grande do Sul.²² Since January 2003 nearly 70,000 kilometers of the Amazon rainforest have been cleared for biofuels production. Corporations like Cargill, ADM, and Bunge are at the heart of the destruction of the Amazon, according to Greenpeace.²³ Since 1990, Indonesia has destroyed 28 million hectares of rainforest for palm plantations.²⁴ The poor are

losing because land and water that would have produced food for the hungry is being used to run cars.

Automobile companies and agribusiness are the ones who gain. Using liquid biofuels to run cars allows car manufacturers to keep selling cars despite peak oil and climate crisis. Biofuels gives them another way to avoid doing anything about fuel efficiency. As George Monbiot, the environmental columnist for the *Guardian*, reports:

The European Commission was faced with a straight choice between fuel efficiency and biofuels. It had intended to tell car companies that the average carbon emission from new cars in 2012 would be 120 grams per kilometer. After heavy lobbying by Angela Merkel on behalf of the car manufacturers, it caved in and raised the limit to 130 grams. It announced that it would make up the shortfall by increasing the contribution from biofuel.²⁵

Agribusiness is also benefiting from the expanded market for soy, corn, and palm. Monsanto can sell more herbicide-resistant seeds and collect more royalties from Argentina and Brazil. Cargill can make more profits selling fertilizers, agrochemicals, and agricultural commodities for biofuel, while also increasing its profit margins on the food commodities it sells as prices rise.

CORPORATE CONTROL OF BIOFUEL FEEDSTOCK²⁶

	Top Corporations	Corporate Control
Corn merchants (US)	Cargill, ADM, Con-Agra	Top three control over 80% of US corn exports
Corn seeds (US)	Monsanto, DuPont, Syngenta	Monsanto controls 41% of global market
Sugar trade (Brazil)	Cargill, Louis Dreyfus, Cosan/Tereos/Sucden	Cargill is the largest shipper of raw sugar from Brazil.
Palm oil trade (Global)	Wilmar, IOI, Synergy Drive, Cargill	In Malaysia 60% is owned by corporations; only 9% by individuals.
Soy trade (Global)	Bunge, ADM, Cargill, Louis Dreyfus	Three companies control 80% of European production.
Soy seeds (Global)	Monsanto, DuPont	Monsanto controls 25% of the global market.

The expansion of industrial biofuels has also served as a convenient backdrop for the continued use and legitimization of genetically modified crops. Various companies have joined with Monsanto to modify crops to exhibit traits beneficial for increased production of biofuels and are particularly active in promoting second-generation biofuels derived from non-food biomass—husks, switchgrass, woodchips. Work is being done to genetically engineer plants to have lower levels of lignin, a compound in plant cell walls that impedes the breaking down of cellulose.

The biotechnology industry is promoting second-generation biofuels as its response to those who say the use of food crops for fuel threatens food security. However, it is feared that the large-scale removal of organic residues from fields will undermine food security by depriving soils of the organic matter required for soil fertility and soil moisture conservation. Deprived of this organic matter future crops will require greater use of synthetic nitrogen fertilizers, increasing nitrous oxide emissions, which contribute to climate change.

Agribusiness and the auto and oil industries have set the ground for climate change. They will use the climate crisis they have created to increase their market opportunities, even if it comes at the expense of the starving poor and pushes the planet deeper into climate disaster.

BIOFUELS A THREAT TO FOOD SECURITY

The biofuel sector has been growing rapidly. The United States and Brazil have established ethanol industries and the European Union is fast catching up. Governments all over the world are encouraging biofuel production by mandating that biofuel account for a percentage of their fuel supply. The United States, because of its voracious demand for energy, is promoting industrial biofuels in a big way. Fidel Castro has strongly criticized the use of biofuels by the US. Lashing out at the 2007 ethanol deal between Brazil and the US, he described it as “the internationalization of genocide.”²⁷

The deal, coming on the heels of President Bush’s widely protested tour of Latin America, aims to encourage the development of biofuels projects in poor countries, particularly in the Caribbean and Central America, and to promote a global biofuels market.

Brazil and the US will cooperate more closely on researching and developing biofuel technology.

Washington’s interest in ethanol accelerated after Bush admitted in January 2006 that the US was “addicted to oil,” which posed a “national security problem” because oil is “often imported from unstable parts of the world.” In 2006, the US produced 18 billion liters of ethanol from 53 million tons of corn. Increasing the use of corn for ethanol production has caused corn and other food-crop prices to rise. An internal World Bank report states that biofuels have forced global food prices up by 75 percent.²⁸

The increased use of corn and soybean oil for biofuel production has raised world food prices by about 10 percent, according to an IMF report.²⁹ Biofuel production has pushed up feedstock prices. The clearest example is corn, whose price rose by 23 percent in 2000 and by 50 percent in 2005 and 2006, largely because of the US ethanol program. Spurred by subsidies and the Renewable Fuel Standard issued in 2005, the United States has been diverting more corn to ethanol. Because it is the world’s largest corn exporter, biofuel expansion in the United States has contributed to a decline in international grain stocks and has put upward pressure on world cereal prices. Largely because of biodiesel production, similar price increases have occurred for vegetable oils (palm, soybean, and rapeseed). Cereal supply is likely to remain constrained in the near term and prices will be subject to upward pressure from further supply shocks.

Worldwide agricultural commodity price increases were significant between 2004 and 2006: corn prices rose by 54 percent, wheat by 34 percent, soybean oil by 71 percent, and sugar by 75 percent. This trend accelerated in 2007, due to continued demand for biofuels and drought in major producing countries.³⁰ The World Bank reports that food prices increased by 83 percent from 2006 to 2008.³¹ Continued demand and floods in the US Midwest suggest that this trend will continue. Wheat prices have risen more than 35 percent since the 2006 harvest, while corn prices have increased nearly 28 percent. The price of soybean oil has been particularly volatile, due to growing demand in China, the US, and the EU.

The Hamburg-based oilseeds analysts of Oil World have predicted a substantial deficit of 17 to 18 million tons in the output of

major oilseeds during 2007 and 2008 and a food crisis unless the use of agricultural products for biofuels is curbed or 2008 proves to be a bumper-crop year.³²

Inevitably, this massive increase in the demand for grains is going to price poor people out of the food market. The Brazilian Landless Workers Movement declared, "the expansion of the production of biofuels aggravates hunger in the world. We cannot maintain our tanks full while stomachs go empty."³³

The diversion of food for fuel has already increased the price of corn and soy. There have been riots in Mexico because of the price rise of tortillas. More than 40 countries have had food riots, and this is just the beginning.

The agrarian crisis created by trade liberalization and globalization is being used in India to promote the conversion of food crops to ethanol. The argument is that farmers will get a better price for these crops. In India, the two target crops are sugarcane and sorghum. India grows as much sugarcane as Brazil, but because Brazil uses 55 percent of its sugarcane for ethanol, India is the largest producer of sugar. The sugar industry in India is now promoting the diversion of sugarcane from human nutrition to ethanol for cars. Sorghum, a cereal that grows in the semiarid tropics, is another food crop being promoted for ethanol. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), one of the institutes run by the World Bank, is a major promoter of growing sorghum for ethanol production using public funds to promote the conversion of food into fuel. Corporations like Tata and Seagram are jumping onto the ethanol bandwagon, with Tata setting up a 60,000-liter-capacity plant in Nanded.

In 2002, the government of India introduced a policy of supplying gas with 5 percent ethanol. With the automobile explosion in India and high fuel prices, ethanol demand is growing. Projected demand is outpacing supply. Of the 132 million gallons of ethanol required, only 37 percent is in current production.

In Argentina, the pampas, the region's biggest and most diverse ecosystem, is under threat from the expansion of herbicide-resistant soy cultivation. Soy has become Argentina's biggest export. If deforestation continues at the current rate, the forest ranges of the Yungas will disappear by 2010. More than 2.3 million hectares of dry and humid vegetation have been cleared for soy since 1995.

Forests are disappearing and people are being displaced. Three out of five people in Chaco province have been driven out of rural areas to Argentina's slums.³⁴

Biofuels have in fact become a basis for legitimizing the spread of genetically modified (GM) soy. President Lula of Brazil has declared that GM soy is to be used for biofuels and "good" soy for human consumption. While the Amazon is being destroyed for soy—for cattle feed and biofuels—the rainforests of Borneo and Sumatra are being cut down for palm oil. Ninety percent of the world's palm oil is grown in Indonesia and Malaysia. Indonesia has 6 million hectares of land under palm cultivation and has cleared three times as much—18 million hectares of forests—to expand palm oil plantations. A further 20 million hectares have been allocated in Sumatra, Kalimantan, Sulawesi, and West Papua. Plans are also being made to establish a 1.8 million hectare palm oil plantation, the world's largest, in the heart of Borneo's rainforests. Biodiesel has become the most important reason for the expansion of palm cultivation, and palm oil has become the largest cause of tropical deforestation in Southeast Asia.³⁵ In Malaysia too, the increase in palm oil production is the reason for rainforest destruction and the disappearance of countless species of plants and animals. Fifty-four projects have been set up to create B100, a biodiesel made entirely from palm oil.

BIOFUELS LEADING TO WATER SCARCITY

An International Water Management Institute (IWMI) study warns that the ambitious plans in China and India to greatly increase domestic production of biofuels derived from crops will put greater stress on these countries' water supplies, seriously undermining their ability to meet future food and feed demands. In many areas where water is already scarce, biofuel production could threaten river and groundwater systems. China aims to increase its biofuel production by fourfold, from a 2002 level of 3.6 billion liters of ethanol to around 15 billion liters by 2020, or 9 percent of the country's projected gasoline demand. India is pursuing a similarly aggressive policy. To meet their targets, China would need to produce 26 percent more corn and India 16 percent more sugarcane. Doing so would require an extra 75 liters of irrigation water

per person per day in China and an additional 70 liters per person per day in India.³⁶ When the recommended WHO minimum supply of 20 liter per person per day often goes unmet, this increase is a high demand indeed.

Biofuel crops in India will compete with food crops for a limited supply of water and are likely to jeopardize sustainable water use. The IWMI landmark study, prepared in consultation with more than 700 water-management experts, concluded that more than a third of the world's population contends with water scarcity. The 2008 report predicts that, with incomes rising and diets diversifying, to feed another 2 to 3 billion people the demand for water for food will increase 20 to 55 percent. This increase does not take into account the demands made by biofuels, which will put greater stress on water systems and make it more difficult to achieve food security for all.

HOW THE POOR IN INDIA ARE AFFECTED

The fears of a food crisis in India are coming true. According to the World Bank's *World Development Report 2008*, the country will have to increase its cereal production by 50 percent by 2030 to meet the escalating demand.³⁷ The increasing shift toward biofuels will further add to the crisis. India has once deferred wheat imports, with global prices hitting an all-time high. International wheat prices in early 2008 were 83 percent higher than they were a year before. The *WDR 2008*, focusing on agriculture and development, has warned that the long-term downward trend in food prices may have come to an end, and the world can continue to expect food prices to drift upward, adding to food insecurity. The government of India was forced to hike the gasoline and diesel prices by 10 percent in June 2008, which also impacts the price of food. Any increased dependency on imports and escalating food prices could be the source of economic and political trouble. The report also warns that the potential conflict between food and fuel is bound to increase. India's biofuel program is creating problems through its demands on the food supply, the land supply, and the water supply, yet it doesn't have the potential to solve either the fuel or the climate crisis.

In India, the availability of adequate food supplies could be threatened by bioenergy production if land and other productive resources are shifted away from food-crop cultivation. The degree of competition between energy crops and food and fodder production will depend on, among other things, progress in crop yields, livestock-feeding efficiency, and bioenergy conversion technologies. Many of the crops currently used as feedstock in liquid biofuel production require high-quality agricultural land and significant quantities of fertilizer, pesticides, and water. India lacks in all of these. Furthermore, crop yields depend on the vagaries of the weather and rainfall. Increased production of biofuels will result in increased use of water, fertilizers, and pesticides, which will be beneficial only for the fertilizer companies. If biofuel production pushes up commodities prices in India, the households will not have access to sufficient food.

Price volatility can affect food security, particularly for the poor. Because of the importance of fertilizers and machinery as inputs, agricultural commodity prices have long been sensitive to changes in the cost of energy; increased biofuel production adds another element to this relationship and will increase the volatility of food prices.

JATROPHA AND LAND GRAB

One of the biofuel crops being promoted in India is jatropha. *Jatropha curcas* is a plant indigenous to Central America that was brought to Asia and Africa by Portuguese and Dutch mariners. It has been used as a hedge because animals do not eat it. The kernel of its plum-sized fruit is 60 percent oil. The cultivation of jatropha as a biofuel is being promoted on village common lands through high subsidies to farmers. Traditionally, the commons have protected food security by providing pastureland for livestock to graze on. Though jatropha is inedible and not a food crop, its use as a biofuel has serious consequences for food security, land security, and livelihood security of the poor.

The government wants to plant jatropha on tribal land in Chhattisgarh. The people there are being robbed of land on which they have been cultivating rice for the last 40 years. The villagers in Rajasthan are losing their grazing lands to the govern-

ment in spite of opposition from the panchayat (village government). These pastures are the common resources in Rajasthan. Jatropha cultivation severely limits the ability of the commons to support rural livelihoods comprehensively. Livestock, a major source of livelihood for the poor, is heavily dependent on the common pastures for grazing. Planting jatropha decreases the available fodder.

The cultivation of biofuel crops in India has emerged as a threat to the social, economic, and political security of India. Unless the constitutional rights of the people to manage their natural resources and make decisions through decentralized democratic processes are respected, there will be more conflicts in the name of land. The increased production of biofuels will take land and food away from the poor. In short, biofuels are a recipe for violence and civic breakdown, for hunger, for climate chaos and ecological catastrophe.

INDIA'S BIODIESEL PROGRAM

The Indian government intends to replace 20 percent of India's diesel with biodiesel. Starting from 400,000 hectares of jatropha, yielding 1.5 million tons of oilseed a year by 2007 the plan calls for a continued increase in jatropha cultivation through 2012 and for the construction of more transesterification plants. To meet its biodiesel target, the planning commission called for the cultivation of jatropha on 11 million hectares of "unused" or "waste" land. The commission did not define what it actually means by "unused." In Rajasthan jatropha has become synonymous with land grabs.

"Biofuel" has become a buzzword, and innumerable companies have sprung up in a rush to cultivate jatropha and set up oil-processing factories. Many state governments, including those of Chhattisgarh, Rajasthan, and Maharashtra, have joined the bandwagon, instituting biofuel policies for their states and promoting jatropha cultivation in a big way. The governments want to mobilize a large number of stakeholders, including individuals, communities, entrepreneurs, oil companies, businesses, industries, and members of the financial sector to spur the growth of the nonedible oil industry.

JATROPHA BIOPIRACY

D1 Oils, the world's largest commercial jatropha cultivator, has engaged in jatropha biopiracy. In 2005 D1 Oils hired Sunil Puri, head of the Department of Forestry at the Indira Gandhi Agricultural University (IGAU) in Raipur, Chhattisgarh. Puri then transferred varieties of jatropha considered to have high oil content and disease- and drought-resistance qualities from the university to D1's nearby farm. A high-quality Pendra variety was also stolen. D1 claims to have cultivated it in a rented farmhouse near Raipur. Puri had previously worked on two studies that found that Chhattisgarh's Pendra and Surguja regions had a high-yielding variety of the plant.

An inquiry committee set up by the university, accompanied by the police, raided Puri's house and seized seeds of 43 accessions of jatropha germplasm. Another raid at the research farm of D1 in Panchdeori village yielded 1,540 plants of 28 accessions. All the plants seized had the accession and tag numbers of the university. A government inquiry concluded that both the scientist and D1, by accepting the plants without the necessary authority, had breached India's biodiversity laws designed to protect the country's biore-sources from foreign exploitation. The government has blocked D1's application to do research on jatropha in the country.

JATROPHA FOR LOCAL ENERGY NEEDS: THE FALSE PROMISE

Proponents of jatropha production say it will provide villages with a local energy source. However, setting up large-scale, centralized, industrial plants for biodiesel from jatropha ensures that the oil will flow to cities, not to villages; it will make cars run while animals and people starve.

The National Development Council, in its approach draft to the 11th five-year plan (2007), has had a change of heart on jatropha cultivation, raising concerns about the socioeconomic and environmental impacts of jatropha cultivation.

The survival of pastoralism is crucial to sustainable land use. Besides conserving biodiversity, it is a means of producing food in dry lands without depleting groundwater resources. However, there are many constraints on expansion in this area. Grazing

permits are denied in traditional grazing sites that have been converted to protected areas/wildlife sanctuaries/national parks/JFM [Joint Forest Management] programme areas. Original pasture lands or stipulated animal drinking water pots are encroached upon or used for other purposes. Biodiesel (*Jatropha*) planting is being promoted by state agencies without any thought to the consequences. Migration routes of animals are blocked or herd-passing pathways are encroached upon.³⁸

Based on our observations of the impacts of *jatropha* cultivation through the Navdanya studies in Chhattisgarh, Vidarbha, and Rajasthan, we are pleased that the council, which once strongly encouraged *jatropha* cultivation, has now expressed its apprehensions about the issue.

India is following a monocrop-based cultivation model for *jatropha*. Indiscriminate use of *jatropha* as a major biofuel crop in India not only harms ecology and agriculture, but also the interests of the farmers who grow it. There are a lot of risk factors for the farmers engaged in *jatropha* cultivation. Unlike other biofuel crops, the seeds of *jatropha* are inedible and can be used only to make biodiesel. If there is not enough demand, farmers will end up with a loss—they will not even be able to survive by eating their crop.

Though rural development is one of the objectives of switching to *jatropha* cultivation, there is little evidence that fuel made from *jatropha* is being used to meet rural energy demand. The main objective behind the greater use of biofuels is to decrease fuel-import bills.

On July 8, 2008, the government of India approved a national biofuel policy that prioritizes food crops over biofuel crops. It recognizes that giving biofuel crops precedence will destroy the country's food security. The national policy has said that the biofuel program will not compete with food security, and fertile farmlands will not be diverted for plantation of biofuel crops.³⁹ However, because *jatropha* is not an edible plant, and because it is supposedly cultivated on "wastelands," the promotion of *jatropha* will continue.

The conservation, propagation, and sustainable use of biodiversity for food security and energy security of local communities needs local decision-making. This is why the *gram sabha* must be strengthened, not undermined, by government policies or laws.

TOWARD SUSTAINABLE, BIODIVERSE, AND
DECENTRALIZED BIOENERGY ALTERNATIVES
FOR INDIA

Diverting land and food to produce industrial biofuel undermines the land and food sovereignty of the poor, generating social conflicts and threatening the fragile fabric of democracy. Ethanol production has already contributed to an increase in food prices. With 1 billion people already going hungry, high food prices can only increase hunger around the world. Even when nonfood crops like *jatropha* are grown on nonagricultural lands, the poor lose. They are losing their commons, which supply them fodder and fuel. This in turn undermines their livelihoods, food security, and energy security.

The climate crisis and the end of cheap oil demand a shift to sustainable energy. However, energy supplied from plants and crops is not necessarily sustainable. Energy can only be considered sustainable if it does not compete with the food supply, does not divert organic matter from the maintenance of the essential ecosystem, is decentralized and based on decisions by local communities, and is based on biodiversity, not monocultures.

Local energy needs decentralized energy systems. Decentralization needs diversity, not monocultures. Biodiversity with multifunctional uses makes for the best local energy supply. It is complementary and not competitive with the local food supply. India has a rich diversity of oilseed trees and crops. Diverse oilseed-bearing tree crops used locally can be an important source of village energy security. A Navdanya report on biodiversity-based organic farming shows that food production can increase with biodiversity intensification and ecological agriculture. And biodiverse organic farming also fixes more carbon in vegetation and the soil.

At the village level, multiple sources of biodiversity provide multiple sources of renewable energy—from animal energy to biogas to biomass for electricity. Biogas digesters were first developed in the 1950s in India, using cow dung to produce methane gas and a nitrogen-rich fertilizer. Asia has more than 15 million small digesters in rural areas to provide cooking fuel and fertilizer.

Alternatives to fossil fuel are limitless. Industrial biofuels are not an alternative because

- Their net energy efficiency is negative.
- They restrict themselves to liquid fuels, forgoing the many other forms of bioenergy needed at the village level.
- They promote non-sustainable industrial monocultures that serve to increase greenhouse gas emissions.
- They are becoming a major cause of hunger and landlessness.

Industrial biofuels threaten to impoverish the planet by reducing biodiversity and its benefits. This reductionism is leading to ecological and economic impoverishment. Biodiversity can lead to ecological and economic enrichment. A decentralized, biodiversity-based bioenergy policy can be a major component in rural development.

Democratic decision-making at the village level is the best process for determining the best mix of energy needed to meet local needs. Unfortunately, the current model of industrialized production of ethanol and biodiesel from plants based on monocultures fails the criteria of sustainability, justice, and democracy. It is centralized and driven by corporate greed, not community needs.

We need a new model, one that respects people's right to land and food, to their commons and biodiversity. A biodiversity-based, democratically evolved bioenergy program could enhance food security, energy security, and livelihood security of the poor.

CHAPTER FOUR

Soil Not Oil

Securing Our Food in Times of Climate Crisis

Industrialized agriculture and globalized food systems have been put forth as sources of cheap and abundant food. However, food is no longer cheap. The era of cheap food and cheap oil is over. The food crisis, mainly triggered by rising prices, that emerged in 2007 and 2008 has led to food riots in many countries. From 2007 to 2008 the price of wheat increased by 130 percent.¹ The price of rice doubled during the first three months of 2008.² Biofuels, speculation, destruction of local food economies, and climate change have all contributed to the rise in food prices. Climate change is aggravated by industrialized, globalized agriculture based on fossil fuels, and the resulting climate crisis in turn impacts food security in numerous ways, including intensified floods such as those Iowa experienced in 2008 and intensified and extended droughts like the one Australia witnessed in 2007. Globalization has also led to the destruction of local food economies and increased control by corporations like Monsanto and Cargill over our food systems. Global integration of agriculture in effect means global control over the world's food supply.

In India, the World Bank-imposed structural adjustment program of 1991 and the WTO rules that came into force in 1995 have jointly worked to dismantle the public framework for food sovereignty and food security and to force the integration of India's food and agriculture systems with those of rich countries. This has resulted in a deep agrarian crisis and an emerging food crisis, with farmers' incomes crashing as food prices go through the roof. The food and agriculture crises are a direct result of policies of cor-

porate globalization. Yet globalization is what the government is offering as a cure for globalization's ills.

Food prices started to rise as a result of connecting India's domestic market to global markets, especially the edible oil and wheat import markets. At first, in the early days of globalization, the agribusinesses that dominate trade lowered prices to grab markets. The dumping of soy in the 1990s is a prime example. Now that global corporations like Cargill have created import dependency, they are increasing prices. Additionally, speculation through futures trading is driving prices upwards. Climate change and the diversion of foods to biofuels are also adding an upward pressure on international prices. The increase in international prices highlights the need to focus on food sovereignty. It makes both political and economic sense to focus on self-reliance in food and agriculture.

While millions go hungry, corporate profits have increased. Cargill saw profits increase by 30 percent in 2007; Monsanto's profits increased by 44 percent.³ These profits will increase as corporate monopolies deepen. Monsanto increased the price of corn seed by \$100 per bag to \$300 per bag. For a 1,000-acre farm in the US, this means an increased cost of \$40,000.⁴

The solution to the food crisis is to reclaim food sovereignty and rebuild local food economies based on ecological farming. This path also frees agriculture from its dependence on fossil fuels while increasing mitigation and adaptation to climate change. A shift from oil to soil addresses the triple crisis of climate, energy, and food.

EATING OIL

Industrialized, globalized agriculture is a recipe for eating oil. Oil is used for the chemical fertilizers that go to pollute the soil and water. Oil is used to displace small farmers with giant tractors and combine harvesters. Oil is used to industrially process food. Oil is used for the plastic in packaging. And finally, more and more oil is used to transport food farther and farther away from where it is produced.

Fossil fuels are the heart of industrial agriculture. Fossil fuels are used to run the tractors and heavy machinery and to pump

the irrigation water necessary for industrial farming. Industrial systems of food production use ten times more energy than ecological agriculture does, and ten times more energy than the energy in the food they produce.⁵

The *Stern Review on the Economics of Climate Change* has identified the following sources of greenhouse gas emissions responsible for climate change:

GREENHOUSE GAS EMISSIONS, BY SOURCE⁶

Power	24%
Industry	14%
Transport	14%
Buildings	8%
Land Use	18%
Agriculture	14%
Waste	3%
Other	5%

What the report does not mention is the particular kinds of agriculture, transport, and buildings that are responsible for the emissions. It fails to differentiate industrial, globalized agriculture, which is responsible for a large part of the 14 percent of emissions in agriculture, from non-industrial, biodiverse, ecological agriculture, which has much lower emissions and helps in carbon sequestration. It also does not break out the share of the 18 percent of emissions attributed to land use created when tropical forests are cut down to grow agricultural commodities, or the part of the 14 percent of transport emissions resulting from unnecessarily shipping and flying food around the world.

Localized, biodiverse ecological agriculture can reduce greenhouse gas emissions by a significant amount while improving our natural capital of biodiversity, soil, and water; strengthening nature's economy; improving the security of farmers' livelihoods; improving the quality and nutrition of our food; and deepening freedom and democracy. Instead of focusing on achievable solutions, the Stern report promotes the pseudo-solution of carbon trading, which translates into business as usual for the agrochemi-

cal and agribusiness corporations profiting from globalized, industrialized agriculture.

An analysis of energy in the US food chain found that on average, it takes 10 calories of energy to produce 1 calorie of food. This is a net negative energy production system.⁷ A shift to ecological, non-industrial agriculture from industrial agriculture leads to a two- to seven-fold energy savings and a 5 to 15 percent global fossil fuel emissions offset through the sequestration of carbon in organically managed soil.⁸ Up to four tons of CO₂ per hectare can be sequestered in organic soils each year.⁹

From field to table, the industrial, globalized food system is moving toward an increased dependence on fossil fuels. There have been dramatic changes in how food is produced, processed, and distributed over the last 50 years. The most significant changes include the following:

- The mechanization of agriculture and increased reliance on external inputs such as synthetic fertilizers, pesticides, feed, plastics, and energy.
- A major shift to highly processed and packaged food.
- The globalization of the food industry, characterized by an increase in food imports and exports. Of particular note is the rise in imports of fresh fruits and vegetables, with more produce sourced from farther afield.
- Supermarkets emerging as sales leaders, accompanied by the loss of small shops, markets, and wholesalers. Parallel to this trend is the concentration of supply into the hands of fewer, larger suppliers, partly to meet supermarkets' preferences for bulk, year-round supplies of uniform produce.
- Major changes in delivery patterns, with most goods now routed through supermarkets' regional distribution centers, and a trend toward the use of large heavy goods vehicles (HGVs) and just-in-time delivery, sometimes referred to as "warehouse on wheels."
- A switch from frequent food shopping on foot at small local shops to shopping by car at large out-of-town supermarkets.¹⁰

David Pimentel and Mario Giampietro have focused on the relationship between endosomatic and exosomatic energy. "Endo-

somatic energy is generated through the metabolic transformation of food energy into muscle energy in the human body. Exosomatic energy is generated by transforming energy outside of the human body by mechanical means, such as by burning oil in a tractor."¹¹ Pimentel and Giampietro found that it takes 10 kilocalories of exosomatic energy to produce every 1 kilocalorie of food in the US. The remaining 9 kilocalories go to create waste and pollution, and increase entropy.¹² Part of this wasted energy is going into the atmosphere to contribute to climate change.

Industrial agriculture in the US uses 380 times more energy per hectare to produce rice than a traditional farm in the Philippines. And energy use per kilo of rice is 80 times more in the US than in the Philippines. Energy use for corn production in the US is 176 times more per hectare than on a traditional farm in Mexico and 33 times more per kilo.¹³ One cow maintained and marketed in the industrial system requires six barrels of oil.¹⁴ A 450-gram box of breakfast cereal provides only 1,100 kilocalories of food energy but uses 7,000 kilocalories of energy for processing.¹⁵

Chemical industrial agriculture is based on the idea that soil fertility is manufactured in fertilizer factories. This was the idea that drove the Green Revolution, introduced in India in 1965 and 1966. In 1967, at a meeting in New Delhi, Norman Borlaug, the Nobel Prize-winning "father of the Green Revolution," was emphatic about the role of fertilizers in the new revolution. "If I were a member of your parliament," he told the politicians and diplomats in the audience, "I would leap from my seat every fifteen minutes and yell at the top of my voice, 'Fertilizers! . . . Give the farmers more fertilizers.' There is no more vital message in India than this. Fertilizers will give India more food."¹⁶ Today, the Green Revolution has faded in Punjab. Yields are declining. The soil is depleted of nutrients. The water is polluted with nitrates and pesticides.

The fertilizer industry has now found Africa.

The Rockefeller and Gates foundations have set up AGRA, the Alliance for a Green Revolution in Africa. However, AGRA will not be the site of a Taj Mahal for Africa's agriculture. The new Green Revolution for Africa is in fact the old Green Revolution for Asia. And as the Punjab experience shows, the Green Revolution

was neither green in terms of ecological sustainability and conservation of natural capital of soil-water-biodiversity nor revolutionary in terms of increasing equality and promoting justice for small and marginal peasants. This not-so-green revolution is now being proposed as a solution for hunger and poverty in Africa.

AGRA has a \$150 million Program for Africa's Seeds Systems (PASS) that seeks to transform farming in Africa. The strategy is based on promoting private seed companies and commercializing the seed supply, which it assumes are necessary for improving Africa's farm productivity. It is also based on increasing the sale of chemical fertilizer. Gary Toenniessen of the Rockefeller Foundation writes in *Securing the Harvest*, "No matter what efficiencies genetic enhancement is able to build into crop plants, they will always draw their nutrition from external sources," and "No alternatives to the use of inorganic nitrogen currently exist for densely populated developing countries."¹⁷ This ignores the successes in Asia, Africa, and Latin America of doubling and tripling farm productivity through biodiverse organic farming based on the farmers' breeding, biodiversity conservation, and agro-ecology. Not only are chemical fertilizers not necessary for farming, synthetic fertilizers actually harm the living processes in the soil that are responsible for soil fertility, plant growth, and production of healthy food.

Fertilizer advocates also ignore how the rising cost of oil affects fertilizer prices. Imported fertilizer costs from Rs 55,000 to Rs 60,000 per ton and is sold at Rs 9,350 per ton. Rs 45,000 per ton is paid through taxes collected to cover the subsidies. In India the shift to chemical agriculture has created the need for 4 to 4.8 million tons of synthetic Diammonium phosphate (DAP). As only around 2 million tons are produced in India, the rest must be imported.

Fertilizer protests are taking place in Karnataka, where a farmer was killed when police opened fire on hundreds of farmers waiting for fertilizers. This was an entirely unnecessary tragedy. Similar incidents have occurred in Amrati, Vidarbha, Latur, Marathwada, and Maharashtra. First the Green Revolution made Indian farmers addicted to chemical fertilizer. Now globalization is making them dependent on imports.

While the soil and farmers die, agribusiness corporations like Cargill are making a killing. Cargill's fertilizer profits doubled from

2006 to 2007, with India paying 130 percent more for fertilizers and China 227 percent more for fertilizers during that period.¹⁸

Baron Justin von Liebig, a German chemist, carried out research in the latter part of the 19th century on the elements and chemicals required by plants for growth. He determined that the principal ingredients for soil fertility were nitrogen (N), phosphorus (P), and potassium (K). This is how the NPK mentality was born.

In 1909, Fritz Haber invented ammonium sulfate, a nitrogen fertilizer made by using coal or natural gas to heat nitrogen and hydrogen. The manufacture of synthetic fertilizers is highly energy-intensive. One kilogram of nitrogen fertilizer requires the energy equivalent of 2 liters of diesel. One kilogram of phosphate fertilizer requires half a liter of diesel. Energy consumed during fertilizer manufacture was equivalent to 191 billion liters of diesel in 2000 and is projected to rise to 277 billion in 2030.¹⁹

Plants, however, need more than NPK. And when only NPK is applied as synthetic fertilizers, soils and plants, and consequently humans, develop deficiencies of trace elements and micronutrients. A pioneer of organic agriculture, Sir Albert Howard defined fertile soil as:

a soil teeming with healthy life in the shape of abundant microflora and microfauna, will bear healthy plants, and these, when consumed by animals and man, will confer health on animals and man. But an infertile soil, that is, one lacking sufficient microbial, fungous, and other life, will pass on some form of deficiency to the plant, and such plant, in turn, will pass on some form of deficiency to animals and man.²⁰

The millions of organisms found in soil are the source of its fertility. The greatest biomass in soil consists of microorganisms, fungi in particular. Soil microorganisms maintain soil structure, contribute to the biodegradation of dead plants and animals, and fix nitrogen. They are the key to soil fertility. Their destruction by chemicals threatens our survival and our food security. A Danish study analyzed a cubic meter of soil and found 50,000 small earthworms, 50,000 insects and mites, and 12 million roundworms. A gram of the soil contained 30,000 protozoa, 50,000 algae, 400,000 fungi, and billions of individual bacteria. It is this amazing biodiversity that maintains and rejuvenates soil fertility. To feed human-

ity we need to feed the soil and its millions of workers, including the earthworm.²¹

When I carried out research on the Green Revolution in Punjab, I found that after a few years of bumper harvests, crop failures at a large number of sites were reported despite liberal applications of NPK fertilizers. The failure came from micronutrient deficiencies caused by the rapid and continuous removal of micronutrients by "high-yielding varieties." Plants quite evidently need more than NPK, and the voracious high-yielding varieties drew out micronutrients from soil at a very rapid rate, creating deficiencies of such micronutrients as zinc, iron, copper, manganese, magnesium, molybdenum, and boron. With organic manure these deficiencies do not occur, because organic matter contains these trace elements, whereas chemical NPK does not. Zinc deficiency is the most widespread of all micronutrient deficiencies in Punjab. Over half of the 8,706 soil samples from Punjab exhibited zinc deficiency, which has reduced yields of rice, wheat, and corn by up to 3.9 tons, 1.98 tons, and 3.4 tons per hectare, respectively. Consumption of zinc sulfate in Punjab rose from zero in 1969–70 to nearly 15,000 tons in 1984–85 to make up for the artificially created zinc deficiency. Manganese is another micronutrient that has become deficient in Punjab soils. Sulfur deficiency, which was earlier noticed only in oilseed and pulse crops, has now been noticed in cereals like wheat.

The Green Revolution has also resulted in soil toxicity by introducing excess quantities of trace elements into the ecosystem. Fluorine toxicity from irrigation has developed in various regions of India. Twenty-six million hectares of India's lands are affected by aluminum toxicity. In the Hoshiarpur district of Punjab, boron, iron, molybdenum, and selenium toxicity has built up through Green Revolution practices and is posing a threat to crop production as well as animal health.

As a result of soil diseases and deficiencies, the increase in NPK application has not shown a corresponding increase in output in rice and wheat. Wheat and rice yields have been fluctuating and even declining in most districts in Punjab, in spite of increasing levels of fertilizer use.

Experiments at the Punjab Agricultural University (PAU) are now beginning to show that chemical fertilizers cannot be substi-

tutes for the organic fertility of the soil, and organic fertility can be maintained only by returning to the soil part of the organic matter that it produces. In the early 1950s, before the entry of the advisers of the Ford Foundation, when K. M. Munshi, India's Agriculture Minister at the time, referred to repairing the nutrient cycle, he was anticipating what agricultural scientists are today recommending for the diseased and dying fields of Punjab. And Howard's prediction, that "In the years to come, chemical manures will be considered as one of the greatest follies of the industrial epoch," is beginning to come true.²²

Fertilizers block the soil capillaries, which supply nutrients and water to plants. Infiltration of rain is stopped, runoff increases, and soil faces droughts, requiring ever more irrigation and ever more fossil fuels for pumping groundwater. Excess nitrogen in the root zone also denies nutrients to the plant. The negatively charged ions in the nitrates, the anions, take the cations, the positively charged ions of other elements, away from the root zone, thereby robbing the trees and plants of positive cations such as magnesium and calcium ions. Plants deficient in micronutrients create micronutrient deficiency in food and the human diet. And micronutrient deficiency leads to metabolic disorders.

Chemical fertilizers do not just destroy the soil and human health. They are also a major contributor to climate change because of pollution both from their production and from their use.

Long-distance globalized food systems, like the industrial food-production system they service, are contributing in a major way to greenhouse gas emissions. A study by the Danish Ministry of the Environment showed that 1 kilogram of food moving around the world generated 10 kilograms of CO₂. "Food-miles," which measure the distance food travels from where it is produced to where it is consumed, have increased dramatically as a result of globalization. As reported by environmental journalist Dale Allen Pfeiffer,

In 1981, food journeying across the US to the Chicago market traveled an average of 1,245 miles; by 1998, this had increased 22 percent, to 1,518 miles. In 1965, 787,000 combination trucks were registered in the United States, and these vehicles consumed 6,658 billion gallons of fuel. In 1997, there were

1,790,000 combination trucks that used 20.294 billion gallons of fuel. In 1979, David and Marcia Pimentel estimated that 60 percent of all food and related products in the US traveled by truck and the other 40 percent by rail. By 1996, almost 93 percent of fresh produce was moved by truck.²³

A study in Canada has calculated that in 2003 food in Toronto traveled an average of 3,333 miles.²⁴ In the UK, the distance traveled by food increased 50 percent between 1978 and 1999.²⁵ A Swedish study found that the food-miles of a typical breakfast would cover the circumference of the Earth.²⁶

The increase in food-miles is related to fossil fuel and food subsidies, which allow food transported long distances to be cheaper than food produced locally. Thus, India imported 5.5 million tons of wheat in 2006, based on the argument that it was cheaper to import wheat from Australia and the US than to transport it from Punjab in the north to Kerala and Tamil Nadu in the south. We should be reducing food-miles by eating biodiverse, local, and fresh foods, rather than increasing carbon pollution through the spread of corporate industrial farming, nonlocal food supplies, and processed and packaged food. We need to reduce CO₂ emissions by moving toward economic localization and satisfying our needs with the lowest carbon footprint. Economic globalization, on the other hand, only serves to increase CO₂ emissions. This total disconnect between ecology and economics is threatening to bring down our oikos, our home on this planet.

Imports, which add unnecessary food-miles, are a direct result of free-trade agreements. Transport accounts for one-eighth of oil consumption, and a large part of it goes for food. Take, for example, the wheat imports that resulted from the US-India Knowledge Initiative on Agriculture. India is the second-largest producer of wheat in the world. Today, because of manipulation by the US and Indian governments, it has suddenly emerged as a big importer of wheat.

At the start of 2006 India's domestic production of wheat was projected to exceed domestic demand; it had been six years since India had needed to import wheat. However, by opening its domestic market to private corporations, foreign companies were able to buy so much wheat that the government found itself

announcing that it would need to import wheat. It initially purchasing 0.8 million tons from the Australian Wheat Board, the only company able to meet India's import standards. The company had previously been implicated in the Volcker report for giving Saddam Hussein's regime a \$300 million kickback through Iraq's Oil-for-Food program.

As the year progressed and the Indian government continued to refuse a fair price for domestic wheat they found themselves, once again, forced to import wheat. This time they increased the price they were willing to pay and relaxed their import guidelines—allowing higher levels of toxins and pesticides. This meant that the big US agribusinesses, primarily Cargill and ADM, could sell their wheat to India. India imported another 2.2 million tons, corporate agriculture gained, and food security suffered.²⁷

FROM FOOD FIRST TO EXPORT FIRST

Until recently food has primarily been produced locally. Local food systems have evolved in accordance with local climates, and biodiversity, which in turn have shaped the rich cultural diversity of food. We need both the diversity and the decentralization of local food systems to mitigate as well as adapt to climate change. However, both the World Bank and the World Trade Organization are forcing countries to dismantle their local food economies, export what they produce and import what they need. The rise of "cash crop for export" policies are a result of World Bank structural adjustment policies. And the creation of import dependency is a result of World Bank conditionalities and WTO rules.

Sustainable agriculture is based on the sustainable use of natural resources—land, water, and agricultural biodiversity, including plants and animals. The sustainable use of these resources in turn requires that they are owned and controlled by decentralized agricultural communities, to generate their livelihoods and provide food. These three dimensions—ecological security, livelihood security, and food security—are essential elements of sustainable and equitable agriculture policy.

The current process of globalization of agriculture threatens to undermine all three of these dimensions. It is undermining

ecological security by removing all limits on concentration of ownership of natural resources—land, water, and biodiversity—and encouraging non-sustainable resource exploitation for short-term profits. Trade liberalization of agriculture is not guided by the need to provide livelihood security for the two-thirds of India's people who are farmers or to provide food security for the poorer half of Indians and for India as a whole. Just the opposite: it severely threatens food security at the household, regional and national levels.

The diversion of our natural resources from ecological maintenance, protection of livelihoods, and basic-needs satisfaction to luxury exports and corporate profits has been made possible because of the past three decades of agriculture policy. In that time agriculture has been made a state monopoly and run on massive debts and subsidies, while all ecological imperatives of sustainability have been ignored.

However, the new trade liberalization and globalization policies are not reducing the centralized control of agriculture; they are increasing it. Part of the reason people are not recognizing this new concentration and are misconceiving trade liberalization as a new freedom for farmers is because of the power shift from the nation-state to transnational corporations (TNCs). People have learned to recognize the lack of freedom built into the rule of the nation-state. They have not yet learned to recognize the lack of freedom intrinsic to corporate rule. As the state withdraws from agriculture, it is not returning power to farming communities and autonomous producers. It is instead facilitating the transfer of control over natural resources, production systems, markets, and trade to global agribusiness, further disempowering and dispossessing small farmers and landless laborers.

The WTO and the World Bank are pushing countries like India to move from food-first to export-first policies. A nutritional apartheid is thus being created, with the scarce land and water of the South being used for growing fruits and vegetables for the rich North and the elites of the South, and leaving the people of the South dependent on imports of food staples such as wheat, rice, and corn. Both sides of the equation add food-miles to our daily bread. And while the destruction of local food systems and

dependence on globalized food supply is made to look "natural," it is a deliberate result of policy designed and driven by global agribusiness and supermarket chains. The step-by-step dismantling of India's local food markets exemplifies just how artificial and violent the globalization of food systems really is.

FAILURE OF "EXPORT-FIRST" POLICIES

It is a sad irony that the creation of Agricultural Export Zones (AEZs) intended to increase farm exports proved of no help to the vegetable grower. A bumper crop of potato did not bring farmers any profit; in fact, it ruined them, driving many to commit suicide. Despite the fact that the Indian government created three AEZs for potato cultivation, the potato could neither be exported nor utilized in the food-processing industry. Rather than increasing the exports of vegetables, the creation of AEZs has facilitated the import of vegetables.

- India is now the fifth-largest importer of raw vegetables, after the US, the EU, Japan, and Canada.
- The import bill for vegetables rose almost 20 percent in 2002; exports have been virtually static.
- India is spending three times more buying raw vegetables from the world markets than it is earning from exporting them. The bill came to a huge \$678 million in 2002. That was higher than the combined imports of Russia, Hong Kong, and Brazil. In contrast, India sold only \$246 million worth of vegetables in 2002.²⁸
- Exports of processed vegetables, fruits, and nuts plummeted from \$70 million in 2001 to just \$58 million in 2002.²⁹

Experts have expressed fears that the large-scale diversion of land, capital, and other resources for crops like vegetables, flowers, and gherkins will severely affect food security. The very profitability of the cultivation of these crops needs to be properly assessed, taking fully into account the investment, the incentives given, and the value of the land and other forms of scarce natural resources diverted, or to be diverted. Since fruits and vegetables are perishable, they need to be transported in refrigerated trucks and by air. Trade in perishables is adding to the global carbon footprint.

The biodiverse, water-prudent, and drought-resilient agriculture of the South is being destroyed precisely when diverse and decentralized systems need to be conserved to reduce the impact of and increase resilience to climate change. On the one hand, drought is increasing as a result of climate change. On the other hand, it is increasing due to globalization of the food supply and diversion of the land and water to produce cheap food for the rich in the North. Peasants and pastoralists are pushed off the land and denied access to water as corporate farming for exports takes over.

A 50-gram bag of salad in the UK costs about 1 pound but wastes almost 50 liters of water. A mixed salad takes 300 liters.³⁰ As Bruce Lankford of the University of East Anglia has stated, "We are exporting drought." Global retail chains like Tesco, Sainsbury's, and Wal-Mart are increasingly sourcing fruits and vegetables from Africa and India. This is leading to the large-scale uprooting and impoverishment of farmers, and is contributing to drought and desertification, while increasing food-miles and undermining food security and food sovereignty. While India is being made to grow vegetables for Europe, we are also being forced to import pesticide-laden wheat in spite of sufficient domestic production, which is further threatening farmers' livelihoods.

The poor are paying three times over—through increased vulnerability to climate change, through increased water scarcity as scarce water is used for export crops, and through the uprooting of communities from their land, villages, and homes to make way for wasteful globalized trade.

Globalized trade in food is hurting the poor and the planet. It is putting the future of our food at risk for short-term profits of global agribusinesses.

SOIL NOT OIL: MAKING A TRANSITION TO BIODIVERSE, ORGANIC, LOCAL FOOD SYSTEMS

The industrialized, globalized food system is based on oil. It is under threat because of the inevitability of "peak oil." It is also under threat because it is more vulnerable than traditional agriculture to climate change, to which it has contributed. Industrial agriculture

is based on monocultures. Monocultures are highly vulnerable to changes in climate, and to diseases and pests.

In 1970 and 1971, America's vast corn belt was attacked by a mysterious disease, later identified as "race T" of the fungus *Helminthosporium maydis*, causing the southern corn leaf blight, as the epidemic was called. It left ravaged cornfields with withered plants, broken stalks, and malformed or completely rotten cobs. The strength and speed of the blight was a result of the uniformity of the hybrid corn, most of which had been derived from a single Texas male sterile line. The genetic makeup of the new hybrid corn, which was responsible for its rapid and large-scale breeding by seed companies, was also responsible for its vulnerability to disease. At least 80 percent of the hybrid corn in America in 1970 contained the Texas male sterile cytoplasm. As a University of Iowa pathologist wrote, "Such an extensive, homogenous acreage is like a tinder-dry prairie waiting for a spark to ignite it."³¹

Industrial agriculture is dependent on chemical fertilizers. Chemically fertilized soils are low in organic matter. Organic matter helps conserve the soil and soil moisture, providing insurance against drought. Soils lacking organic matter are more vulnerable to drought and to climate change. Industrial agriculture is also more dependent on intensive irrigation. Since climate change is leading to the melting of glaciers that feed rivers, and in many regions of the world to the decline in precipitation and increased intensity of drought, the vulnerability of industrial agriculture will only increase. Finally, since the globalized food system is based on long-distance supply chains, it is vulnerable to breakdown in the context of extreme events of flooding, cyclones, and hurricanes. While aggravating climate change, fossil fuel-dependent industrialized, globalized agriculture is least able to adapt to the change.

We need an alternative. Biodiverse, organic farms and localized food systems offer us security in times of climate insecurity, while producing more food, producing better food, and creating more livelihoods.

The industrialized, globalized food system is based on oil; biodiverse, organic, and local food systems are based on living soil. The industrialized system is based on creating waste and pollu-

tion; a living agriculture is based on no waste. The industrialized system is based on monocultures; sustainable systems are based on diversity.

LIVING SOIL

Every step in building a living agriculture sustained by a living soil is a step toward both mitigating and adapting to climate change. Over the past 20 years, I have built Navdanya, India's biodiversity and organic-farming movement. We are increasingly realizing there is a convergence between the objectives of conserving biodiversity, reducing climate-change impact, and alleviating poverty. Biodiverse, local, organic systems reduce water use and risks of crop failure due to climate change. Increasing the biodiversity of farming systems can reduce vulnerability to drought. Millet, which is far more nutritious than rice and wheat, uses only 200 to 300 millimeters of water, compared with the 2,500 millimeters needed for Green Revolution rice farming. India could grow four times the amount food it does now if it were to cultivate millet more widely. However, global trade is pushing agriculture toward GM monocultures of corn, soy, canola, and cotton, worsening the climate crisis.

Biodiversity offers resilience to recover from climate disasters. After the Orissa supercyclone of 1998, and the tsunami of 2004, Navdanya distributed seeds of saline-resistant rice varieties as "Seeds of Hope" to rejuvenate agriculture in lands that were salinated as a result of flooding from the sea. We are now creating seed banks of drought-resistant, flood-resistant, and saline-resistant seed varieties to respond to such extreme climate events. Climate chaos creates uncertainty. Diversity offers a cushion against both climate extremes and climate uncertainty. We need to move from the myopic obsession with monocultures and centralization to diversity and decentralization.

Diversity and decentralization are the dual principles needed to build economies beyond oil and to deal with the climate vulnerability that is the legacy of the age of oil. In addition to reducing vulnerability and increasing resilience, biodiverse organic farming also produces more food and higher incomes. As David Pimentel has pointed out: "Organic farming approaches for maize and beans

in the US not only use an average of 30% less fossil energy but also conserve more water in the soil, induce less erosion, maintain soil quality, and conserve more biological resources than conventional farming does."³²

After Hurricane Mitch struck Central America in 1998, farmers who practiced biodiverse organic farming found they had suffered less damage than those who practiced chemical agriculture. The ecologically farmed plots had on average more topsoil, greater soil moisture, and less erosion, and the farmers experienced less severe economic losses.³³

Fossil fuel-based industrial agriculture moves carbon from the soil to the atmosphere. Ecological agriculture takes carbon from the atmosphere and puts it back in the soil. If 10,000 medium-sized US farms converted to organic farming, the emissions reduction would be equivalent to removing over 1 million cars from the road. If all US croplands became organic it would increase soil-carbon storage by 367 million tons and would cut nitrogen oxide emissions dramatically.³⁴ Organic agriculture contributes directly and indirectly to reducing CO₂ emissions and mitigating the negative consequences of climate change.

Navdanya's work over the past 20 years has shown that we can grow more food and provide higher incomes to farmers without destroying the environment and killing peasants. We *can* lower the costs of production while increasing output. We have done this successfully on thousands of farms and have created a fair, just, and sustainable economy. The epidemic of farmer suicides in India is concentrated in regions where chemical intensification has increased costs of production. Farmers in these regions have become dependent on non-renewable seeds, and monoculture cash-crops are facing a decline in prices due to globalization. This is affecting farmers' incomes, leading to debt and suicides. High costs of production are the most significant reason for rural indebtedness.³⁵

Biodiverse organic farming creates a debt-free, suicide-free, productive alternative to industrialized corporate agriculture and brings about a number of benefits. It leads to increased farm productivity and farm incomes, while lowering costs of production. Pesticide-free and chemical-free production and processing bring safe and healthy food to consumers. We must protect the

environment, farmers' livelihoods, public health, and people's right to food.

We do not need to go the Monsanto way. We can go the Navdanya way. We do not need to end up in food dictatorship and food slavery. We can create our food freedom. Biodiverse, organic, and local food systems help mitigate climate change by lowering greenhouse gas emissions and increasing absorption of CO₂ by plants and by the soil.

Organic farming is based on the recycling of organic matter; industrial agriculture is based on chemical fertilizers that emit nitrous oxides. Industrial agriculture dispossesses small farmers and converts small farms to large holdings that need mechanization, which further contributes to CO₂ emissions. Small, biodiverse, organic farms, especially in third world countries, can be totally fossil fuel-free. The energy for farming operations comes from animals. Soil fertility is built by recycling organic matter to feed soil organisms. This reduces greenhouse gas emissions. Biodiverse systems are also more resilient to droughts and floods because they have a higher water-holding capacity, making them more adaptable to the effects of climate change. Navdanya's study on climate change and organic farming has indicated that organic farming increases carbon absorption by up to 55 percent and water-holding capacity by 10 percent.

FERTILITY INCREASE DUE TO ORGANIC FARMING³⁶

Crops	percent increase over industrial farming						
	Organic matter	Microbial activity	Microbial biomass	Water-holding capacity	N	P	K
Pearl millet	28-55	4-25	2-10	2-3	0-2	0-1	8-15
Clusterbean	32-44	22-54	12-25	4-9	12-34	2-4	25-47
Moth bean	31-47	11-23	8-15	4-7	7-21	1-2	4-9
Mung bean	27-41	28-59	11-33	4-8	11-27	2-6	5-11

The environmental advantages of small-scale, biodiverse organic farms do not come at the expense of food security. Biodiverse organic farms produce more food and higher incomes than industrial

monocultures. Mitigating climate change, conserving biodiversity, and increasing food security go hand in hand.

The conventional measures of productivity focus on labor as the major input (and the direct labor on the farm at that) and externalize many energy and resource inputs. This biased productivity pushes farmers off the land and replaces them with chemicals and machines, which in turn contribute to greenhouse gases and climate change. Further, industrial agriculture focuses on producing a single crop that can be globally traded as a commodity. The focus on "yield" of individual commodities creates what I have called a "monoculture of the mind." The promotion of so-called high-yielding varieties leads to the displacement of biodiversity. It also destroys the ecological functions of biodiversity. The loss of diverse outputs is never taken into account by the one-dimensional calculus of productivity.

When the benefits of biodiversity are taken into account, biodiverse systems have higher output than monocultures. And organic farming is more beneficial for the farmers and the earth than chemical farming. When agro-forestry is included in farming systems, carbon absorption and carbon return increase dramatically. Date palm and neem increase the carbon density in the soil by 175 and 185 percent, respectively.

Studies carried out by the USDA's National Agroforestry Center suggest that soil carbon can be increased by 6.6 tons per hectare per year over a 15-year rotation and wood by 12.22 tons per hectare per year. Since both soil and biomass sequester carbon, this amounts to removing 18.87 tons of carbon per hectare per year from the atmosphere.³⁷

Soil and vegetation are our biggest carbon sinks. Industrial agriculture destroys both. By disrupting the cycle of returning organic matter to the soil, chemical agriculture depletes the soil carbon. Mechanization forces the cutting down of trees and hedgerows.

Organic manure is food for the community of living beings that depend on the soil. The alternatives to chemical fertilizers are many: green manures such as *sesbania aculeata* (dhencha), *gliricidia*, and sun hemp; legume crops such as pulses, which fix nitrogen through legume-rhizobium symbiosis; earthworms; cow dung; and composts. Farmyard manure encourages the

buildup of earthworms by increasing their food supply. Soils treated with farmyard manure have from two to two and a half times as many earthworms as untreated soils. Earthworms contribute to soil fertility by maintaining soil structure, aeration, and drainage. They break down organic matter and incorporate it into the soil. The work of earthworms in soil formation was Darwin's major concern in his later years. Of worms he wrote, "It may be doubted whether there are many other animals which have played so important a part in the history of creatures."³⁸ The little earthworm working invisibly in the soil is the tractor, the fertilizer factory, and the dam combined. Worm-worked soils are more water-stable than unworked soils, and worm-inhabited soils have considerably more organic carbon and nitrogen than the original soil. Their continuous movement forms channels that help in soil aeration. It is estimated that they increase the air volume of soil by up to 30 percent. Soils with earthworms drain four to ten times faster than those without, and their water-holding capacity is higher by 20 percent. Earthworm castings, which can amount to 4 to 36 tons per acre per year, contain five times more nitrogen, seven times more phosphorus, three times more exchangeable magnesium, 11 times more potash, and one and a half times more calcium than soil.³⁹ Their work on the soil promotes the microbial activity essential to the fertility of most soils.⁴⁰

At the Navdanya farm in Doon Valley, we have been feeding the soil organisms. They in turn feed us. We have been building soil and rejuvenating its life. The clay component on our farm is 41 percent higher than those of neighboring chemical farms, which indicates a higher water-holding capacity. There is 124 percent more organic-matter content in the soil on our farm than in soil samples from chemical farms. The nitrogen concentration is 85 percent higher, the phosphorus content 10 percent higher, and the available potassium 25 percent higher. Our farm is also much richer in soil organisms such as mycorrhiza, which are fungi that bring nutrients to plants. Mycorrhizal association makes food material from the soil available to the plant. Our crops have no diseases, our soils are resilient to drought, and our food is delicious, as any visitors to our farm can vouch. Our farm is fossil fuel-free. Oxen plow the land and fertilize it.

By banning fossil fuels on our farm we have gained real energy—the energy of the mycorrhiza and the earthworm, of the plants and animals, all nourished by the energy of the sun.

BIODIVERSITY: OUR NATURAL CAPITAL, OUR ECOLOGICAL INSURANCE

Biodiversity is our real insurance in times of climate change. Traditionally, farmers have increased their resilience by growing more than one crop.

Sir Albert Howard saw in "mixtures," or biodiversity, the secret of sustainability and stability of farming in India. As he wrote in the 1940 classic on organic farming:

Mixed crops are the rule. In this respect the cultivators of the Orient have followed Nature's method as seen in the primeval forest. Mixed cropping is perhaps most universal when the cereal crop is the main constituent. Crops like millets, wheat, barley, and maize are mixed with an appropriate subsidiary pulse, sometimes a species that ripens much later than the cereal. The pigeon pea, perhaps the most important leguminous crop of the Gangetic alluvium, is grown either with millets or with maize. The mixing of cereals and pulses appears to help both crops. When the two grow together, the character of the growth improves. Do the roots of these crops excrete materials useful to each other? Is the mycorrhizal association found in the roots of these tropical legumes and cereals the agent involved in this excretion? Science at the moment is unable to answer these questions: she is only now beginning to investigate them. Here we have another instance where the peasants of the East have anticipated and acted upon the solution of one of the problems which Western science is only just beginning to recognize. Whatever may be the reason why crops thrive best when associated in suitable combinations, the fact remains that mixtures generally give better results than monoculture.⁴¹

At Navdanya we have built on this ancient, time-tested knowledge, farming in nature's ways, based on biodiversity. Not only are we protecting biodiversity, we are increasing food production, farmers' incomes, and resilience in the face of climate change.

On our farm, we have fields of seven (*saptarshi*), nine crops (*navdanya*), and twelve crops (*baranaja*). *Navdanya* in fact means

“nine seeds” or “nine crops.” Biodiverse fields always perform better than monocultures. They survive frost and drought, early rain and late rain, too much rain and too little rain.

BIODIVERSE VS. MONOCULTURE PRODUCTION⁴²

	Crop	Avg. Production (kg/ha)	Avg. Price (per kg)	Total Income (in Rs)
BARANAJA (12)				
1	Bajra	440	8	3,520
2	Maize	1,280	8	10,240
3	Safed Chemi	600	25	15,000
4	Ogal	360	20	7,200
5	Mandua	600	10	6,000
6	Jhangora	440	15	6,600
7	Urad	600	20	12,000
8	Navrangi	680	20	13,600
9	Koni No. 1	280	10	2,800
10	Lobia	600	20	12,000
11	Til	400	30	12,000
12	Koni No. 2	340	10	3,400
	Total	6,620		104,360
MONOCULTURE				
1	Maize	5,400	8	43,200
NAVDANYA (9)				
1	Til	400	30	12,000
2	Safed Chemi	720	25	18,000
3	Mandua	1,120	10	11,200
4	Dholiyia Dal	640	20	12,800
5	Safed Bhatt	760	15	11,400
6	Lobia	800	20	16,000
7	Jhangora	520	15	7,800
8	Maize	560	8	4,480
9	Wheat	480	25	12,000
	Total	6,000		105,680
MONOCULTURE				
1	Mandua	3,600	10	36,000
SAPTARSHI (7)				
1	Urad	600	20	12,000
2	Moong	520	25	13,000
3	Mandua	560	10	5,600
4	Safed Bhatt	680	15	10,200
5	Dholiyia Dal	560	20	11,200
6	Maize	680	8	5,440
7	Lobia Dal	600	20	12,000
	Total	4,200		69,440
MONOCULTURE				
1	Urad	2,400	20	48,000

The baranaja (twelve crops) of bajra (pearl millet), maize (corn), safed chemi (beans), ogal (buckwheat), mandua (finger millet), jhangora (barnyard millet), urad (black gram), navrangi (rice bean), two varieties of koni (horsetail millet), lobia (bean),

and til (sesame) produced more food and earned more than twice that of the corn monoculture. The baranaja or navdanya system of farming is a guarantee against hunger and an insurance against crop failure due to climate variability. In diverse parts of the country, biodiverse agricultural systems outperform monocultures.

Symbiosis among plants contributes to an overall increase in productivity of the crops. In the Western Ghats, a small farm typically has 1.5 acres of paddy, 0.5 acres of areca nut, and a kitchen garden with vegetables that include eggplants, beans, cucumbers, chilies, and small gourds. Likewise, in the eastern Himalayas, especially in Sikkim, the dominant land use is the sustainable *Alnus*-cardamom agro-forestry system, in which cardamom plants and *Alnus* trees are intercropped to the benefit of cardamom production. In Rajasthan too, in the arid tract of Jodhpur and parts of western Rajasthan, neem-based agro-forestry and khejri (*Prosopis cineraria*), wherein crops like bajra, sorghum mung, moth bean, and corn are grown together, have fulfilled the nutritional requirements of the communities.⁴³

A recent study conducted by Navdanya in four districts of West Bengal shows that multiple cropping (MC) is economically more efficient than modern intensive chemical farming systems that cultivate monocultures. The net value of the annual production of an average MC farm is uniformly more than that of an average monoculture farm. The MC farms of East Medinipur district are sown with a wide range of crops, both in a sequential rotation and intercropped. Some of these farms—mostly smaller than a hectare in size—grow over 50 types of crops, excluding rice. The rain-fed farms of Bankura district are comparatively less diverse, hardly exceeding 14 crops a year, including rice. The irrigated monoculture farms, by contrast, grow two rice varieties in Bankura district and three rice varieties in East Medinipur district (all high-yielding varieties, or HYV). The cost of all inputs (water for irrigation, seeds, agrochemicals, labor, and energy) was calculated to compare the relative gain in output value of the modern monoculture farms with that of the MC farms, and the remarkable finding was that the value of farm produce increases significantly with greater diversity of crops. Farmers explain this as “farm fatigue”

from monoculture and intensive use of agrochemicals—an essential feature of modern agriculture.

These data contradict the prevailing mainstream agronomic view that intensive cultivation of a staple crop enhances productivity. A majority of farmers in Bankura and Medinipur have realized over years that the yield of monoculture farms is unsustainable. Many of these farmers have reverted back to traditional farming systems involving folk crop varieties. Some of them have experimented with a hybrid system of rotational cropping of a large number of “secondary” crops and an HYV rice. However, most of these MC farmers reported that the cost of the inputs eats away at the extra production of HYV rice and that the best means to cut down on the extraneous inputs is to “give the land a recess” by growing vegetables and fruits for a few years before replanting it with rice.⁴⁴

Small biodiverse farms have higher productivity than monocultures, which are a necessary aspect of industrial agriculture based on external inputs. Higher biological productivity translates into higher incomes for small farmers. In Rajasthan, monocultures of pearl millet yielded Rs 2,480 of net profit per acre, whereas a biodiverse farm of pearl millet, moth bean, and sesame yielded a net profit of Rs 12,045 per acre, nearly five times the profit. In Uttarankhand, a monoculture of paddy yielded Rs 6,720 per acre, whereas a biodiverse farm yielded Rs 24,600 per acre, three and a half times the profit. In Sikkim, a monoculture farm of corn yielded Rs 4,950 per acre while a mixed farm of corn, radish, lahi saag, and peas yielded Rs 11,700 per acre. Navdanya’s rice and wheat farmers have doubled production by using indigenous seeds and organic methods. Jhumba rice in Uttarankhand produces 176 quintals per hectare compared with 96 quintals per hectare of Kas-turi, a high-yielding rice variety. The paddy yields are 104 and 56 quintals per hectare, respectively. Farmers in West Uttar Pradesh have gotten yields of 62.5 quintals per hectare using a native wheat variety for organic production, compared with 50 quintals per hectare for chemically produced wheat.

Conservation of native seeds and biodiverse ecological farming have yielded incomes two to three times higher than monoculture farming, and eight to nine times higher than industrial systems using genetically engineered seeds.

SEEDS OF FREEDOM, SEEDS OF LIFE

Twenty-one years ago, in 1987, I started to save seeds to create a different future than the one envisioned by the biotechnology industry—in which all seeds are genetically engineered and patented. The vision for seed freedom evolved as Navdanya. *Navdanya* means “nine seeds,” and it also means “the new gift.” Through Navdanya, we have brought the new gift of ancient seeds to our farmers. Navdanya builds community seed banks based on rescuing, conserving, reproducing, multiplying, and distributing native varieties or farmers’ varieties—varieties evolved and bred over millennia. On the one hand, our seed saving defends seeds as a commons—resisting through our daily actions the degraded, immoral, uncivilized idea that seeds are the “intellectual property” of corporations, and that saving them is a crime. On the other hand, Navdanya’s seed banks are the basis of another food economy, one based on biodiversity and cultural diversity, on sustainability, and on the future.

The dominant food economy is based on monopolies and monocultures, on industrialization of production and globalization of distribution of a handful of crops—corn, soy, rice, and wheat. This economy has pushed 1 billion people into hunger; another 2 billion into obesity. It is killing species and farmers. One hundred fifty thousand small farmers of India have committed suicide because they were forced to buy costly, unreliable seed every year from corporations like Monsanto, which collect exorbitant royalties.

Navdanya’s seed saving spreads seeds of life instead of seeds of death. We spread seeds of hope instead of seeds of hopelessness and despair. We spread seeds of freedom instead of seeds of slavery and seeds of suicide.

After the 2004 tsunami, our salt-resistant rice varieties rebuilt the devastated agriculture of Tamil Nadu. Our seeds of *Dehradun* basmati gave us the strength to fight RiceTec of Texas, which had patented basmati rice. Our seeds of native wheat varieties inspired us to fight Monsanto when it patented low-gluten wheat.

Our seeds teach us lessons in diversity and democracy. From our seeds we learn how to defend freedom of biodiversity and freedom of farmers in an age of corporate monopolies, terminator technologies, and globalized monocultures.

A false assumption is growing that we need genetic engineering to deal with climate change.

It is false for a number of reasons. First, nature and farmers have evolved, and continue to evolve, varieties of plants that are resilient to drought, floods, and salinization due to cyclones, three major impacts of climate change.

In Navdanya community seed banks, we have crops like millet that can withstand severe drought; we have rice that grows 18 feet tall and can survive the floods of the Ganges basin. We have rice that can tolerate salt, which we distributed after the Orissa cyclone and the tsunami. The salt-tolerant varieties we have saved, multiplied, and distributed include *Kalambank*, *Kartikapatini*, *Chaakaakhi*, *Dhala patini*, *dudeshwar*, *lilabati*, and *luna* (which means "salt"). Flood-resistant rice varieties include *Jalaj*, *Abhiman*, *Bhutana*, *Sada dhepa*, *Sada pankul*, *Jal kalas* (which means "the water pot"), *Bagada*, *Betana*, *Bhundi*, *Champi*, *Fareka*, *Indrijiba*, *Madia*, and *Kala bagada*. In regions that face floods and the ingress of saltwater from the sea, these varieties offer security in the face of climate change.

But rice does not only grow in wet regions. We have also saved hundreds of drought-tolerant rices, such as *Bhat kalon*, *Chaina*, *Gyarsu*, *Jhumka*, *Ramjawain ukhri*, *Asan leija*, *Bhut moni*, *Kaya*, *Loha*, *Gora*, *Nata*, and *Raja manik*. These are rain-fed rices that need no irrigation.⁴⁵ And there are many varieties of other crops that have the potential to evolve and help us face the growing water scarcity. The drought-resistant native wheats, and the millets like ragi, jhangora, koni, bajra, and jowar are "forgotten foods" that are the foods of the future.⁴⁶

Second, genetic engineering will only allow corporations to take these seeds, appropriate their traits, patent them, and prohibit their use by farmers who don't make heavy royalty payments. Genetic engineering does not *create* the traits for drought, flood, and salt tolerance; it merely allows the *transfer* of traits across species.

In Navdanya we are creating community seed banks for climate emergencies so that the widest varieties of crops are available to communities to respond to climate-related disasters. And this diversity is available as a commons. Diversity and the commons are the two types of insurance we have in times of uncertainty and unpredictability. Diversity gives us the basis to evolve and adapt

under changing conditions. Climate change is not a linear phenomenon that creates warming everywhere, or more rain or less rain. It is nonlinear, and it is better to talk of climate chaos than climate change or global warming. Our community seed banks of climate change-resilient varieties become even more important as the gene giants like Monsanto, DuPont, Syngenta, and Dow apply for patents on climate traits in crops such as drought tolerance and flood tolerance.⁴⁷

In the context of climate chaos, diversity is the basis of adaptation. Monocultures and uniformity are recipes for breakdown. While at the ecological level, we need diversity to respond to climate chaos, at the social and political levels, we need the commons. Monopolies and concentration of ownership of resources enhance vulnerability in periods of chaos.

The mechanistic paradigms on which genetic engineering, intellectual property rights and patents on seeds, and globalized corporate control over food systems are based have given us climate chaos. They cannot help us adapt and evolve. As Einstein said, you cannot solve a problem using the mind-set that created it. Mechanistic thought creates monocultures of the mind. We must move beyond monocultures to protect the earth's rich diversity and use it to respond to climate chaos.

Humanity has eaten over 80,000 edible plants over the course of its evolution. More than 3,000 have been used consistently. However, we now rely on just eight crops to provide 75 percent of the world's food. Monocultures are destroying biodiversity, our health, and the quality and diversity of food. Monocultures have been promoted as an essential component of industrialization and the globalization of agriculture. They don't in fact produce more food. All they produce is more control and profits—for Monsanto, Cargill, and ADM. They create pseudo-surpluses and real scarcity by destroying biodiversity, local food systems, and food cultures.

In 1998, India's indigenous edible oils—made from mustard, coconut, sesame, linseed, and groundnut and processed in artisanal cold-press mills—were banned, with "food safety" used as an excuse. At the same time, restrictions on the import of soy oil were removed. The livelihoods of 10 million farmers were threatened. One million oil mills in villages were closed. More than 20 farmers were killed while protesting against the dumping of soy on the

Indian market, which was leading to a fall in the price of domestic oilseed crops. Millions of tons of artificially cheap GM soybean oil continue to be dumped on India.

Women from the slums of Delhi formed a movement to dump soy and bring back mustard oil. "Sarson bachao, soya-bean bhagao" (save the mustard, drive away the soybean) was the women's call from the streets. We did succeed in bringing back mustard through our *satyagraha* (noncooperation with the ban).

The same companies that dumped soy on India—Cargill and ADM—are destroying the Amazon to grow soy. Millions of acres of rain forest—the lungs, the liver, the heart of the global climate system—are being burnt to grow soy for exports. Armed gangs take over the forest and use slaves to cultivate soy. When people like Sister Dorothy Stang oppose the destruction of the forests and the violence against people, they are assassinated.⁴⁸

While people in Brazil and India are being threatened directly by these agribusiness monocultures, people in the US and Europe are also at risk. Eighty percent of soy production is being used as cattle feed to provide cheap meat. Cheap meat that is, in effect, destroying both the Amazon rainforest and people's health in rich countries. One billion people are without food because industrial monocultures robbed them of their livelihoods in agriculture and their food entitlements.⁴⁹ Another 1.7 billion are suffering from obesity and food-related diseases. Monocultures lead to malnutrition—for those who are underfed as well as those who are overfed.

Corporations are forcing us to eat untested GMO food. Soy is in 60 percent of all processed food. It has high levels of isoflavones and phytoestrogens, which produce hormone imbalances in humans. Traditional fermentation, as in the food cultures of China and Japan, reduces the levels of isoflavones. The promotion of soy in food is a huge experiment promoted with \$13 billion in subsidies from the US government between 1998 and 2004, and \$80 million a year from the American soy industry.⁵⁰ Nature, culture, and people's health are all being destroyed. Local food cultures have rich and diverse alternatives to soy. For protein we have thousands of varieties of beans and grain legumes—the pigeon pea, chickpea, mung bean, urd bean, rice bean, adzuki bean, moth bean, cowpea,

lentil, horse gram, and fava bean. For edible oils we have sesame, mustard, linseed, saffola, sunflower, groundnut.

With the spread of monocultures and the destruction of local farms, the food system has become dependent on fossil fuels—for synthetic fertilizers, for running giant machinery, for long-distance transport. We are increasingly eating oil, not food, threatening the planet and our health.

Moving beyond monocultures of the mind has become an imperative for repairing the food system. Biodiverse small farms have higher productivity and they generate higher incomes for farmers. And biodiverse diets provide more nutrition and better taste.

Bringing back biodiversity goes hand in hand with bringing back small farms. Corporate control thrives on monocultures. Citizens' food freedom depends on biodiversity. Human freedom and the freedom of other species are mutually reinforcing, not mutually exclusive.

REBUILDING LOCAL FOOD COMMUNITIES

The globalized food system is causing destruction at every level. Biodiversity is being destroyed in favor of monocultures of corn, soy, and canola. Food has been reduced to a commodity. And the commodity can run a car, feed animals in factory farms, or feed people. Uniqueness, distinctiveness, quality, nutrition, and taste are no longer in the equation.

Farmers are being destroyed because prices of farm products are driven down through a combination of monopolistic buying by global corporations and dumping of subsidized products. In the meantime food prices keep rising for the poor, and hunger grows. The long-distance transport of food pollutes the atmosphere with carbon dioxide emissions from fossil fuels. No one is gaining from globalized trade in food except the corporations. Localization of food systems to reduce food-miles is a climate-change imperative. It is also a food-sovereignty and human-rights imperative. Small farmers will only survive in the context of vibrant and robust local food economies.

Localization is also a food-security imperative. Short supply chains ensure better democracy in distribution, better-quality food, fresher food, and more cultural diversity. In India, the movement

for retail democracy is a vital part of keeping local markets alive. Across the world, farmers markets are reappearing. The search for local foods to reduce food-miles and create more intimate food systems has created a new dichotomy between “organic” and “local.” In my view this is a false dichotomy. To be organic means to be whole and wholesome—for the earth, for our bodies. Food that could have been grown next door but has been imported from thousands of miles away is not organic by any ecological standards. If we care about getting rid of toxins in our food, we should also care about the atmospheric pollution that is causing climate change. They are two facets of ecological destruction. A nonviolent, wholesome food system should have place for neither. Organic that leaves out food-miles is not fully organic. Organic that leaves us feeling strangers on the land is not truly organic.

As Michael Pollan observes in his book, *The Omnivore's Dilemma*,

One of the key innovations of organic food was to allow some more information to pass along the food chain between the producer and the consumer—an implicit snatch of narrative along with the number. A certified organic label tells a little story about how a particular food was produced, giving the consumer a way to send a message back to the farmers that she values tomatoes produced without harmful pesticides or prefers to feed her children milk from cows that haven't been injected with growth hormones. The word organic has proved to be one of the most powerful words in the supermarket: Without any help from government, farmers and consumers working together in this way have built an \$11 billion industry that is now the fastest growing sector of the food economy.

Yet the organic label itself—like every other such label in the supermarket—is really just an imperfect substitute for direct observation of how a food is produced, a concession to the reality that most people in an industrial society haven't the time or the inclination to follow their food back to the farm, a farm which today is apt to be, on average, fifteen hundred miles away. So to bridge that space we rely on certifiers and label writers and, to a considerable extent, our imagination of what the farms that are producing our food really look like. The organic label may conjure an image of a simpler agriculture, but its very existence is an industrial artifact. The question is, what about the farms themselves? How well do they match the stories told about them?³¹

Organic farming is based on ecological processes and principles of agroecology. It is also based on human communities working in cooperation and with dignity and freedom.

There was an old conflict between chemical-industrial agriculture and organic farming. There is a new conflict emerging between *authentic organic*, based on small, biodiverse farms, and *pseudo-organic*, based on large-scale, monoculture corporate farms that grow for export. Authentic organic farming is based on biodiversity, small family farms, local markets, and fair trade. Organic farming emerged as a systemic alternative to industrial agriculture, which destroyed biodiversity, polluted ecosystems and food with agrochemicals, uprooted and displaced small farmers, and undermined local markets through subsidized long-distance transport.

Pseudo-organic farming destroys small farms and uproots small farming communities to create large export-oriented industrial farms in which farmers are viewed as laborers and serfs, instead of sovereign producers. Pseudo-organic farming is based on destruction of biodiversity and creation of monocultures. It does not abide by the essential ecological processes of renewal of soil fertility, rejuvenation of water, and biodiversity. It merely substitutes chemical inputs with “organic” inputs. This is input substitution, not agroecology.

Agroecology is the scientific basis of authentic organic farming. Authentic organic practices are based on principles of self-organization—from the level of the organism to the farm and agroecosystem to the community. Ecologically, self-organization refers to the capacity of living organisms and agro-ecosystems to renew fertility by rejuvenating soil microorganisms and recycling organic matter; to manage pests through building resilience and maintaining a pest-predator balance; to conserve water; and to conserve and renew biodiversity. Seed giving rise to seed and earthworms rejuvenating soil fertility are examples of the self-organizing capacity of nature and living systems, which are the basis of a sustainable agriculture.

Socially, self-organization is encapsulated in Gandhi's *swaraj* (self-rule, self-governance, self-organization). It is the basis of food sovereignty—the right to produce in freedom. Social and ecological self-organization reinforce each other. Only

small farmers working in cooperation with the soil and plants can provide the care and attention required to facilitate nature's self-organization. Food sovereignty, therefore, rests on agroecology. Both are built on the principle of self-organization. Self-organized production rests on the principles of agroecology, and self-organized distribution rests on the principles of localization—local consumption through local markets. Such economic self-organization ensures that local food needs are met and local food security and livelihoods strengthened, preventing malnutrition, hunger, poverty, and unemployment. It also provides the ground for cultural diversity in food systems, supported by biodiversity in agricultural systems.

Pseudo-organic agriculture is built on the destruction of the self-organizing capacity of human communities and agroecosystems. It mimics industrial agriculture, focusing on large-scale production for export, uprooting small farmers, and undermining people's food security and sovereignty. Large-scale, industrial-style, export-oriented pseudo-organic farms are run by giant corporations for profits at the expense of the health of the earth, diverse species, and local communities. The entry of multinational corporations in organic agriculture is based on land reforms for the rich, which usurp the lands of poor and marginal farmers. This is what is happening in Punjab, where the government is taking over land by force from small farmers and handing it over to corporations planning to export "organic" vegetables and fruits. Just as chemical farming and GM seeds are driving farmers into debt and suicide, pseudo-organic farming, which is corporate and export-driven, is also killing farmers by taking away their land, their livelihoods.

An agriculture that destroys biodiversity, uproots local farmers, and leaves local communities without food is not worthy of the label "organic." To be organic is to be just and fair. An agriculture that turns rural areas into graveyards for farmers cannot be called organic. *Organic* means life-giving. Authentic organic farming gives life. Pseudo-organic farming ends life. To remain authentic, organic farming must be biodiverse, it must stay in the hands of small farmers, and it must deepen food sovereignty.

In Navdanya, we work on the following principles of organic and local:

- Food for the soil and her millions of microorganisms

Organic can be organic only if the food rights of millions of soil organisms are protected. This involves the law of return, of growing food for the soil, not just growing commodities for the market. In fact all "developments" in industrial agriculture are methods of increasing commodity production at the expense of the soil. The Green Revolution, with its chemical-intensive dwarf varieties, killed the soil organisms and used techniques that did not return organic matter to the soil. Genetically engineered herbicide-resistant crops, like Roundup Ready soy and corn, deliberately kill vegetation that would have gone back to feed the soil. Feeding markets while starving the soil is a recipe for hunger and desertification. If we feed the soil, we will also feed people, and even have quality production for the market.

- Food and nutrition for the farming family

The tragedy of industrialized, globalized agriculture is that while commodity markets grow, people starve. More than 1 billion people are now permanently hungry. Most of them are from rural areas. Many of them are food producers. They are denied food either because their soils have been desertified or because chemical agriculture and costly seeds have got them into debt or because they are growing cash crops like cotton and coffee, which bring insufficient returns because globalized trade has pushed down farm prices, or because they have been pushed off the land. It is criminal that our *annadatas*, our food providers, should themselves be hungry. That is why we ensure that every producer family that is a member of Navdanya first grows healthy and nutritious foods for the household and only trades any surplus.

- Food for local communities

Everyone must eat. If food is not grown locally, local communities will have to import their food from somewhere far away. That food will be more contaminated and adulterated and less safe. If local communities do not eat local produce, biodiversity will disappear from our farms and cultural diversity will disappear from our diets, making both the land and its people poorer.

- Unique products for long-distance trade and exports

Every part of the earth is productive. Every culture on the earth has evolved its diet according to the particular ecosystem it inhabits. As much as possible, food staples must be grown locally, both to produce what the ecosystem is best suited for, and to produce what local cultures have adapted themselves to.

Trade in food must be restricted to what cannot be grown locally; it must be restricted to foods with both a high value and a small ecological footprint in terms of land and water use.

Different vegetables and fruits grow in different climates. It is wrong to grow temperate-zone vegetables in the tropics and fly them back to rich consumers. This uproots local peasants, creates hunger and poverty, and destroys local agro-biodiversity. It also blocks the potential for localization in importing countries. Since vegetables and fruits are perishable, transporting them long distances is highly energy-intensive, contributing to climate change.

In India, the home of the mango, the Alphonso is only traded and eaten in Maharashtra and Goa, where it grows, and the Dasheri is largely eaten in the northern regions where it grows.

Global trade in perishables destroys the biodiversity of fruits and vegetables. One kind of Chiquita banana, one kind of Washington apple ends up on every table. Local production for local consumption is the best way to conserve biodiversity, taste, and quality.

Spices are a perfect candidate for long-distance trade. Tiny quantities are needed to add flavor to food. Spices grow in very specific ecosystems. They cannot be grown everywhere. They give high value with low volumes. This benefits the producer, who can also grow food. In Karnataka, spice growers use 10 percent of their land for spice gardens of pepper, cardamom, and areca nut and 10 percent for paddy for local consumption. These gardens have existed for centuries and are a model for farming that supports trade but is not destroyed by trade.

“Spice of life trade” is justified when it enriches the giver and the receiver.

Re-localization of our food systems has become an ecological and social imperative. Richard Heinberg, one of peak oils’ preeminent theorists, has pointed out that this will require the deindustrialization of agriculture.

The general outline of what I mean by de-industrialization is simple enough: this would imply a radical reduction of fossil fuel inputs to agriculture, accompanied by an increase in labour inputs, and a reduction in transport, with production being devoted primarily for local consumption. Fossil fuel depletion almost ensures that this *will* happen. But at the same time, it is fairly obvious that if we don’t *plan* for de-industrialization, the result would be catastrophe.⁵²

Rob Hopkins, the inspiration behind the new transition-culture movement, elaborates on how energy-descent plans, or “powering down” of fossil fuel use, can be a “powering up” of quality of life.

The essence of an energy descent plan is that it creates a vision of an abundant low energy future. While the transition away from fossil fuels will be a task of unprecedented proportions, at the same time it offers the potential for a society which is better in many ways, more connected to nature, healthier with more meaningful work, access to nutritious food, enhanced social capital, and more cooperation.⁵³

CLIMATE CHANGE AND THE TWO CARBON ECONOMIES: BIODIVERSITY VS. FOSSIL FUELS

Reductionism seems to have become the habit of the contemporary human mind. We are increasingly talking of climate change in the context of “the carbon economy.” We refer to “zero carbon” and “no carbon” as if carbon exists only in fossilized form under the ground. We forget that the cellulose of plants is primarily carbon. Humus in the soil is mostly carbon. Vegetation in the forests is mostly carbon. It is living carbon. It is part of the cycle of life.

The problem is not carbon *per se*, but our increasing use of fossil carbon that was formed over millions of years. Today the world burns 400 years’ worth of this accumulated biological matter every year, three to four times more than in 1956. While plants are a renewable resource, fossil carbon for our purposes is not. It will take millions of years to renew the earth’s supply of coal and oil.

Before the industrial revolution, there were 580 billion tons of carbon in the atmosphere. Today there are 750 billion tons. That accumulation, the result of burning fossil fuels, is causing the climate-change crisis. Humanity needs to solve this problem

if we are to survive. It is the other carbon economy, the renewable carbon embodied in biodiversity, that offers the solution.

Our dependence on fossil fuels has broken us out of nature's renewable carbon cycle. Our dependence on fossil fuels has fossilized our thinking.

Biodiversity is the alternative to fossil carbon. Everything that we derive from the petrochemical industry has an alternative in the realm of biodiversity. The synthetic fertilizers and pesticides, the chemical dyes, the sources of mobility and energy, all of these have sustainable alternatives in the plant and animal world. In place of nitrogen fertilizers, we have nitrogen-fixing leguminous crops and biomass recycled by earthworms (vermi-compost) or microorganisms (compost). In place of synthetic dyes, we have vegetable dyes. In place of the automobile, we have the camel, the horse, the bullock, the donkey, the elephant, and the bicycle.

Climate change is a consequence of the transition from biodiversity based on renewable carbon economies to a fossil fuel-based non-renewable carbon economy. This was the transition called the industrial revolution.

While climate change, combined with peak oil and the end of cheap oil, is creating an ecological imperative for a post-oil, post-fossil fuel, postindustrial economy, the industrial paradigm is still the guiding force for the search for a transition pathway beyond oil.

That's because industrialization has also become a cultural paradigm for measuring human progress. We want a post-oil world but do not have the courage to envisage a postindustrial world. As a result, we cling to the infrastructure of the energy-intensive fossil fuel economy and try and run it on substitutes such as nuclear power and biofuels. Dirty nuclear power is being redefined as "clean energy." Non-sustainable production of biodiesel and biofuel is being welcomed as a "green" option.

Humanity is playing these tricks with itself and the planet because we are locked into the industrial paradigm. Our ideas of the good life are based on production and consumption patterns that the use of fossil fuels gave rise to. We cling to these patterns without reflecting on the fact that they have become a human addiction only over the past 50 years and that maintaining this short-term, non-sustainable pattern of living for another 50 years comes at the risk of wiping out millions of species and destroying the very

conditions for human survival on the planet. We think of well-being only in terms of human beings, and more accurately, only in terms of human beings over the next 50 years. We are sacrificing the rights of other species and the welfare of future generations.

To move beyond oil, we must move beyond our addiction to a certain model of human progress and human well-being. To move beyond oil, we must reestablish partnerships with other species. To move beyond oil, we must reestablish the other carbon economy, a renewable economy based on biodiversity.

Renewable carbon and biodiversity redefine progress. They redefine development. They redefine "developed," "developing," and "underdeveloped." In the fossil fuel paradigm, to be developed is to be industrialized—to have industrialized food and clothing, shelter and mobility, ignoring the social costs of displacing people from work and the ecological costs of polluting the atmosphere and destabilizing the climate. In the fossil fuel paradigm, to be underdeveloped is to have nonindustrial, fossil-free systems of producing our food and clothing, of providing our shelter and mobility.

In the biodiversity paradigm, to be developed is to be able to leave ecological space for other species, for all people and future generations of humans. To be underdeveloped is to usurp the ecological space of other species and communities, to pollute the atmosphere, and to threaten the planet.

We need to change our mind before we can change our world. This cultural transition is at the heart of making an energy transition to an age beyond oil. What blocks the transition is a cultural paradigm that perceives industrialization as progress combined with false ideas of productivity and efficiency. We have been made to believe that industrialization of agriculture is necessary to produce more food. This is not at all true. Biodiverse ecological farming produces more and better food than the most energy- and chemical-intensive agriculture. We have been made to falsely believe that cities designed for automobiles provide more effective mobility to meet our daily needs than cities designed for pedestrians and cyclists.

Vested interests who gain from the sale of fertilizers and diesel, cars and trucks, have brainwashed us to believe that chemical fertilizers and cars mean progress. We have been reduced to buyers of their non-sustainable products rather than creators of sustainable,

cooperative partnerships—both within human society and with other species and the earth as a whole.

The biodiversity economy is the sustainable alternative to the fossil fuel economy. The shift from fossil fuel-driven to biodiversity-supported systems reduces greenhouse gas emissions by emitting less and absorbing more CO₂. Above all, because the impacts of atmospheric pollution will continue even if we do reduce emissions, we need to create biodiverse ecosystems and economies because only they offer the potential to adapt to an unpredictable climate. And only biodiverse systems provide alternatives that everyone can afford. We need to return to the renewable carbon cycle of biodiversity. We need to create a carbon democracy so that all beings have their just share of useful carbon, and no one is burdened with carrying an unjust share of climate impacts due to carbon pollution.