Soil Not Oil: Why We Need to Kick Petroleum Out of Our Farms
By Vandana Shiva, South End Press
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The following is an excerpt from Soil Not Oil: Environmental Justice in an Age of Climate Crisis by Vandana Shiva (South End Press, 2008).

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."

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 pollution; 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."

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.

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. 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.

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.

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.

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." 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. Their work on the soil promotes the microbial activity essential to the fertility of most soils.

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.

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