Localizing food security with sustainable agriculture

Dan Miner, Beyond Oil NYC
www.beyondoilnyc.org

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Eng Aja Eze Foundation, http://engajaezefoundation.webs.com/

Conflict is a likely consequence of scarcity and disaster, whether in a rural African village or an American city. Many factors will combine to increase scarcity and disaster in the coming years. Communities with sustainable food production systems will be more self-reliant, and more resilient to scarcity and disaster. In such communities, conflicts will be slower to emerge, and its citizens will be safer. We'll review the trends making the future more dangerous, and innovations in agriculture that can make the future more peaceful.

Bad economic conditions, rising population, and high unemployment are common conditions around the world. In 2008, high prices of basic food staples – wheat, corn, soy, rice - triggered food riots in scores of countries.

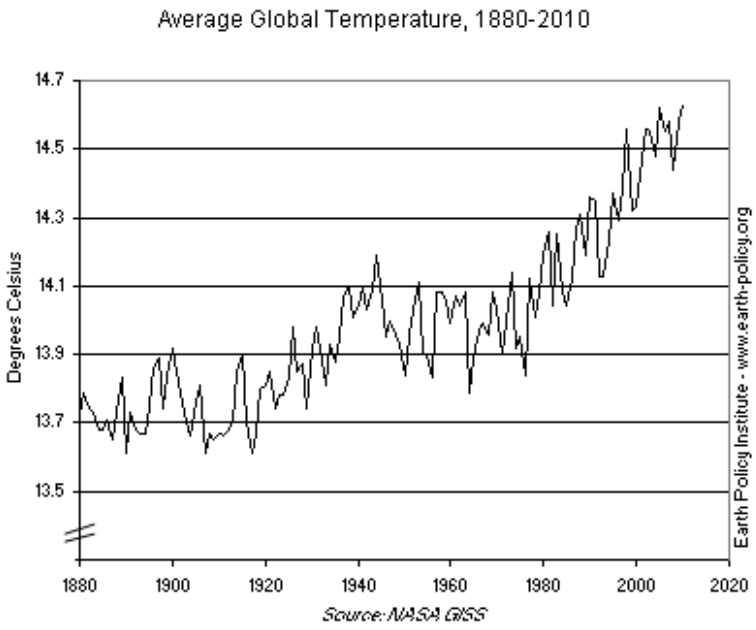
Several trends will be driving food prices higher. There's both the direct impact of weather disasters, which are increased by climate change, and the indirect impacts of changing weather patterns. There's water scarcity. And there will be higher and more volatile fuel prices, caused by depleting oil supplies.

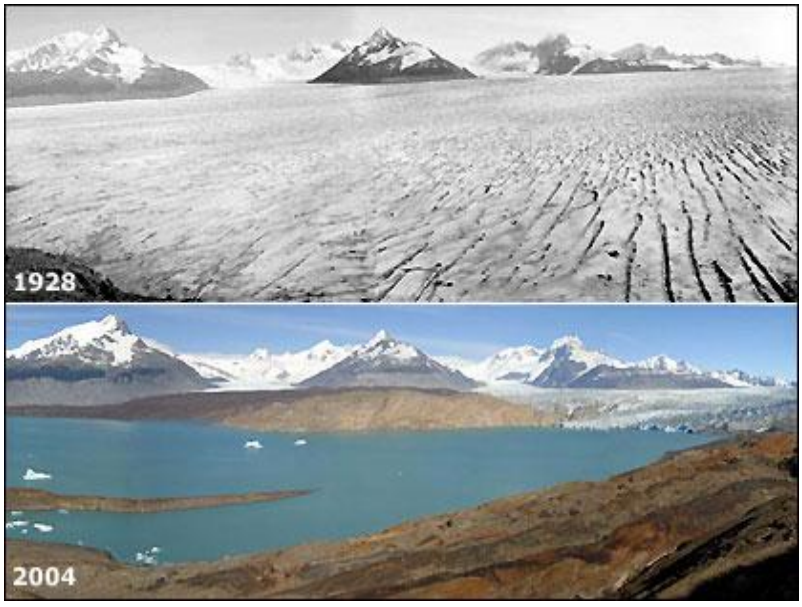
Climate change

2010 tied 2005 for the warmest year on record and nine of the 10 warmest years have come in the last decade. [1], [2] The scientific evidence is clear, but many

[1] "2010 ties 2005 as warmest year on record, researchers say," Washington Post, Jan. 12, 2011; http://www.washingtonpost.com/wp-dyn/content/article/2011/01/12/AR2011011204692.html

people, misled by fossil fuel industry campaigns, are not convinced it is caused by human activity. In late 2010, a survey found only a third of Americans believe the world is warming because of human activity – and over 40 climate change deniers were elected to the U.S. Congress. [3]





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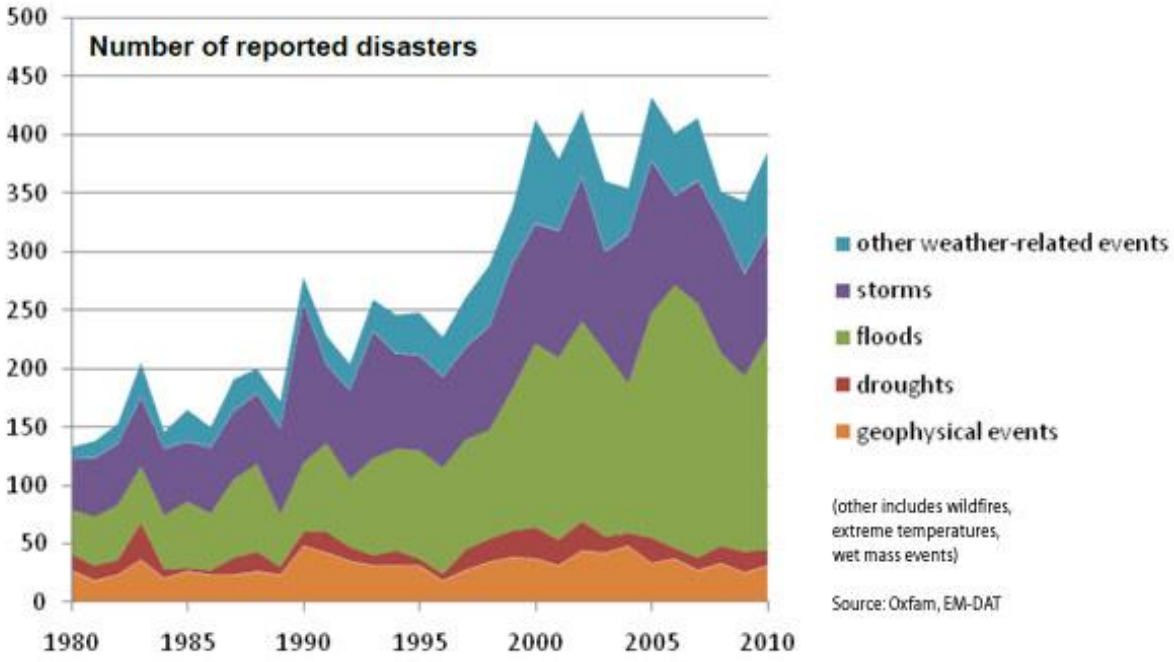
[2] "2010 hits top of temperature chart," Earth Policy Institute, Jan. 18, 2011; http://www.earth-policy.org/indicators/C51/temperature_2011

[3] "Disaster Needed for U.S. to Act on Climate Change, Harvard's Stavins Says," Bloomberg, April 29, 2011. http://www.bloomberg.com/news/2011-04-29/disaster-needed-for-u-s-to-act-on-climate-change-stavins-says.html

Climate change theorists have long warned that warming will increase the frequency and severity of storms. In 2010, we experienced extreme weather events including a heat wave in Russia, fires in Israel, flooding in Pakistan and Australia, landslides in China, record snowfall across the mid-Atlantic region of the United States, and 12 Atlantic Ocean hurricanes. In 2011, there has been unusually high tornado activity in the southern US. An Oxfam report tracking weather related disasters showed big increases in floods and storms. [4]



Agriculture is both a contributor to water scarcity, and is a victim of it. Agriculture accounts for 70% of global fresh water use. As climate change accelerates, shrinking glaciers will reduce flows in crucial rivers - such as the Ganges, Yellow, Indus and Mekong – while floods will contaminate clean water. [5]

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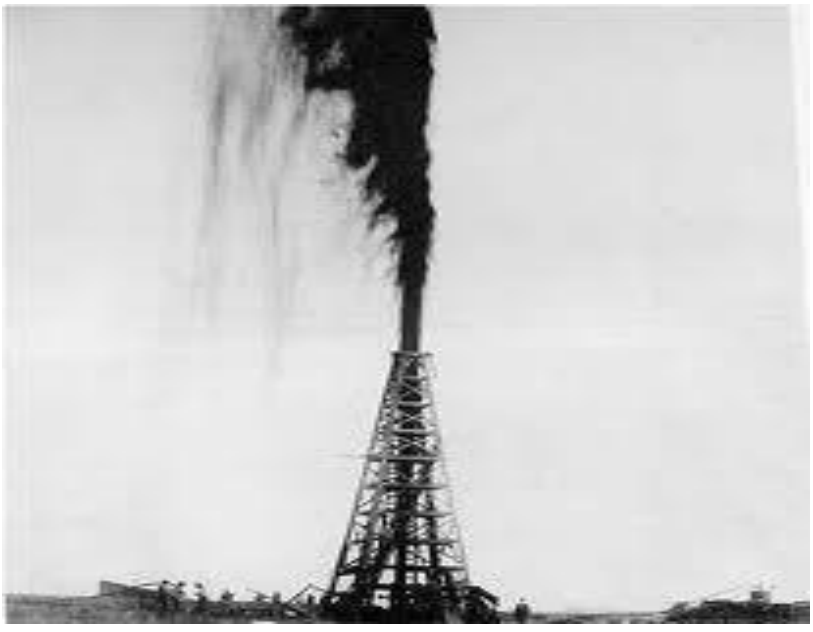
[4] "Time's Bitter Flood," Oxfam, May 2011, http://www.oxfam.org.uk/resources/policy/conflict_disasters/downloads/rr-times-bitter-floods-270511-en.pdf

[5] *"A warming planet struggles to feed itself," NY Times, June 4, 2011;* http://www.nytimes.com/2011/06/05/science/earth/05harvest.html

According to a new Oxfam report, hotter temperatures from climate change, as well as droughts and floods, will reduce agriculture production, driving up international prices of key staples will rise 120% to 180% by 2030. [6]

Fuel depletion, not as widely discussed, needs a closer look

At the beginning of the oil age, we found the easy stuff first – big oil fields, close to the surface, under pressure.



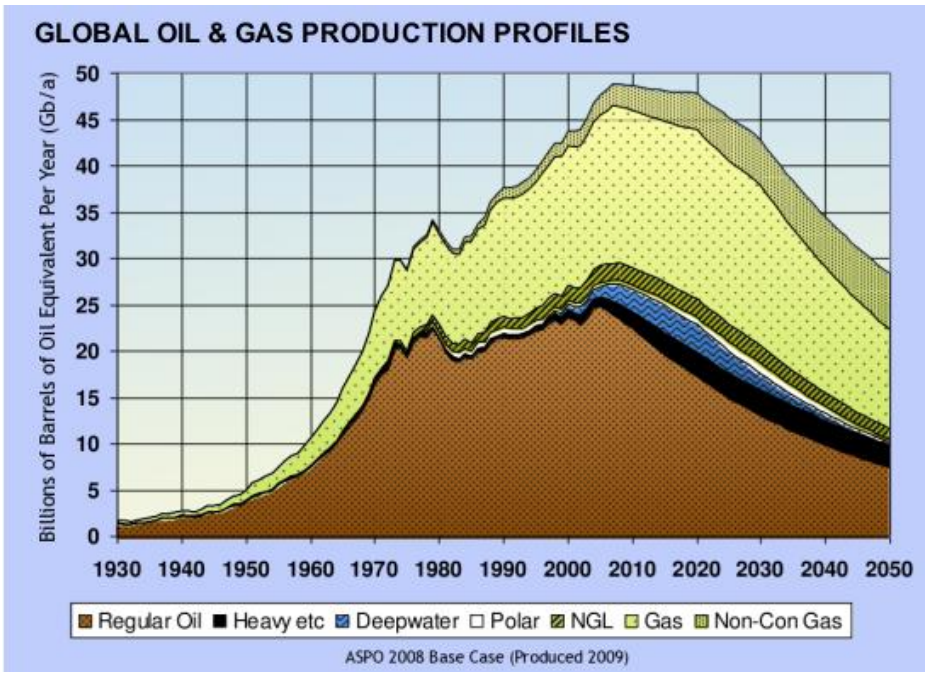
[6] *"Growing a Better Future: Food Justice in a Resource-Constrained World," Oxfam, June 2011, http://www.oxfamamerica.org/files/growing-a-better-future.pdf*

Now, only the very difficult oil is left. Why else would BP be drilling the Macondo well down through 5,000 feet – 1,500 meters - of ocean and another two miles of rock to get to the oil?

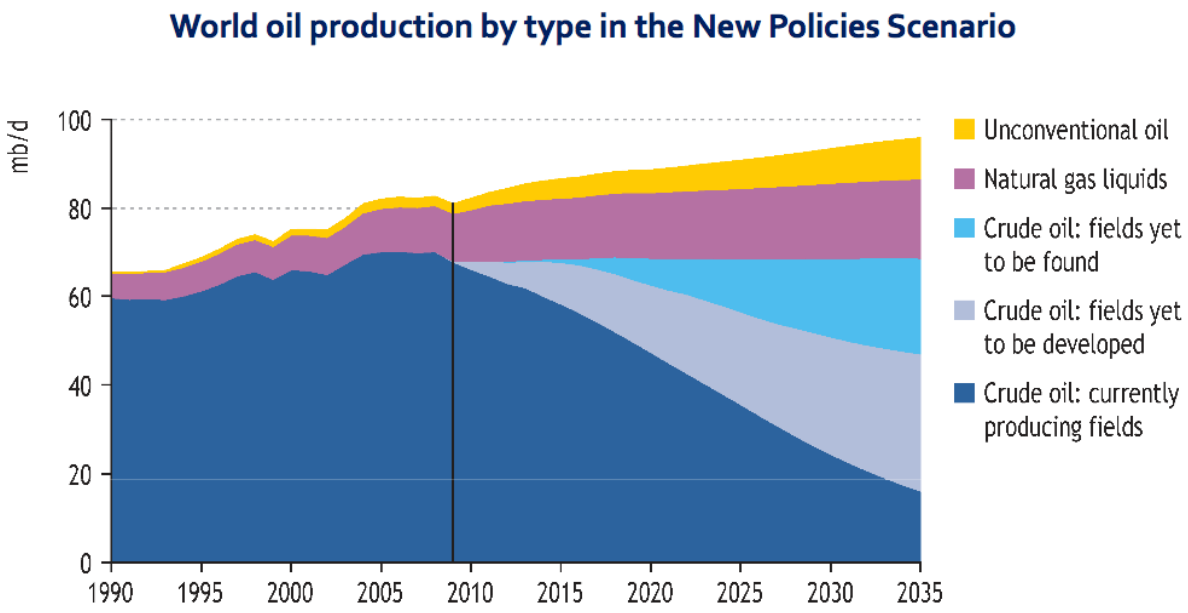
The same principles that govern the life cycle of individual oil wells apply to entire oil fields, to the combined oil production from entire countries, and finally, to the total oil production of the entire world. When production starts at a newly drilled oil well, the oil pressure is high at first, but drops off over time. Oil production from the well rises until about 50% of the oil in the well is gone, and then, oil production rates begin declining. The remaining oil becomes ever more difficult to extract and refine. Extraction costs increase, and production declines. [7]

Many energy analysts, such as the Association for the Study of Peak Oil, believe that the world is at peak oil -- the moment when global petroleum output achieves a maximum sustainable daily rate and begins a long-term, irreversible decline. Most conventional sources, including the US Energy Information Agency and the International Energy Agency, have long maintained that oil production will keep rising until the 2030s.

[7] "The year of living dangerously," Salon, January 24, 2011, http://www.salon.com/news/feature/2011/01/24/year_of_living_dangerously/index.html; Professor Michael Klare, author of "Resource Wars," "Blood and Oil," and "Rising Powers, Shrinking Planet: The New Geopolitics of Energy," http://www.hampshire.edu/faculty/mklare.htm



However, the International Energy Agency, in its *2010 World Energy Outlook,* has quietly accepted elements of the ASPO position.



In any case, the oil industry is finding it increasingly difficult and costly to boost output above current levels. In the short term, oil prices will be volatile, but over the long term, prices will rise, supplies will decline - or both. The price increase in 2008 was due partly to financial speculation. In future cycles, geological

factors may have a clearer role. Or, prices may go so high that demand will drop, and prices will follow. We can't really be sure.

What are possible effects of oil depletion?

While we'll never "run out" of oil, we are running out of cheap, plentiful oil. When oil production eventually begins to decline, production will drop at an unknown rate. Every part of the world economy will be fundamentally altered. Ask yourself how rising fuel costs or shortages might affect:

- Manufacturing?
- Transportation and shipping?
- Agriculture and food production?
- Economic activity and growth?

Agriculture

For now, let's look only at agriculture. Even without the fuel depletion issue, Oxfam and many other analysts say that the world's food systems are broken. Modern agro-industrial farming is running faster and faster just to stand still. Increasing irrigation and fertilizer use can only raise production to a point, after which returns diminish. Large scale commercial agriculture is very reliant on fossil fuel-based chemicals, and energy-intensive irrigation and equipment.

The international food system was built to deliver profits for a tiny minority of players, says Oxfam, so governments are unlikely to lead in repairing it. For example, the US is the world's biggest food aid donor, providing roughly half the world's food aid. The US does not donate cash to humanitarian agencies. American taxpayers first pays large US farming companies to produce food, then buy it from them for food aid at a high price, and then pay another premium for it to be transported across the world.

Higher fuel prices will also make long-distance shipping more costly, driving up the cost of food commodities and other goods. Again, this is not a cyclical trend, but a permanent fundamental change. So, both in the US and internationally new food systems must be developed that are sustainable.

Adopting sustainable agricultural practices everywhere will reduce dependence on imports, and reduce risk of both scarcity and conflict. Oxfam cites a compilation of 286 sustainable agriculture projects in 57 countries, which found an average yield increase of 79%.

Pressures on land and water can be reduced through new practices and techniques that boost yields, use soils and water more sensitively, and reduce their reliance on inputs—techniques such as drip-feed irrigation, water harvesting, low- or zero-till agriculture, agroforestry, intercropping, and the use of organic manures. These would also significantly reduce the carbon footprint of agriculture.

- "Growing a Better Future," Oxfam, P. 29

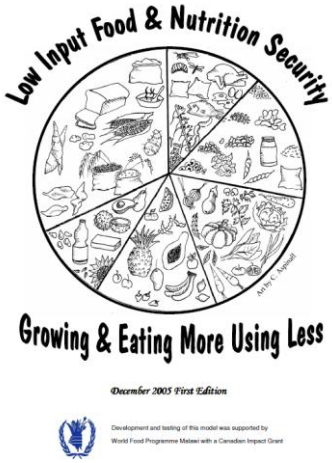
Sustainability advocates in the United States are recommending the same policy direction that Oxfam urges for developing countries: increasing regional production of food, reducing reliance on imports, and focusing on increasing yields in small scale agriculture.

The New York City Council and the Office of the Manhattan Borough President have published reports recommending that more of the food used in the City be bought from farmers within 150 miles, and consolidating distribution from small growers to City retail and wholesale.

Many promising new sustainable agriculture innovations are coming from the permaculture community, which studies natural ecosystems to design permanently sustainable agriculture systems.

Most commonly applied to agriculture, permaculture extends to design of housing and human communities. First developed by Bill Mollison and David Holmgren in the 1970s, it aims to copy the design principles observed in stable, diverse and resilient natural ecosystems. It combines indigenous agricultural practices with current scientific research.

We'll look at some projects that illustrate these principles: low input farming training in Malawi, a permaculture project creating an oasis in 10 acres of Jordan desert, and the use of charcoal to improve soil and reverse climate change.



Low input farming in Malawi

The World Food Programme (WFP) published *The Low Input Food and Nutrition Manual* in 2005 to assist Malawi relief and donor agencies to go beyond temporary food aid and start focusing on sustainable food programs. The Malawi Ministry of Education has been starting school gardens based on Permaculture methods at over 5,000 primary schools. [8]

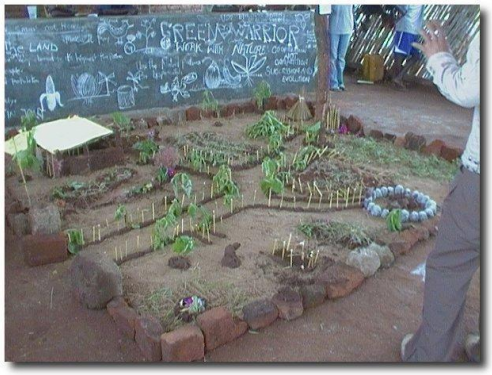
In Malawi, mono-cropping with maize, the dominant staple, is very common, with more nutritious vegetables, fruits, legumes and animals raised for cash instead of direct consumption. Programs tied to the Manual try to steer farmers to diversification and more direct consumption of other crops - other grains beside maize, plus root crops, legumes, vegetables, oil seeds and especially, permanent food trees and plants.

Model sites have been able to reduce their work by over half; reduce their watering by half; and double, even triple their yields. Projects have succeeded by using local resources and knowledge, providing specialized training at existing gardens and farms - while using very little labor, water and outside inputs.

[8] Nordin, Stacia. Low Input Food and Nutrition Security: growing and eating more using less. Malawi: World Food Programme, 2005; http://www.neverendingfood.org/h-low-input-manual/

To get a high yield from a field of only maize requires a lot of human energy for tilling every year, money for seed, fertilizer, pesticides, and adequate amounts of rain. Bad weather or insects can drastically reduce yield. Planting maize over and over again on this same acre and burning the leftover organic matter will reduce the fertility of the soil and increase the chance for maize diseases in the soil. Maize is harvested only once a year. On the other hand, the diversified crop system is resilient to setbacks.

In Malawi, dirt areas are often swept clean, and crop wastes burned. Instead, farmers are taught to use leftover organic matter as mulch, to keep the soil covered and insulated, and to compost it with animal manures. Through mulching, composting, and plant species that capture nitrogen and place it in the soil, costly chemical fertilizers are no longer needed. Strong-smelling plants that repel insects are used instead of chemical pesticides.

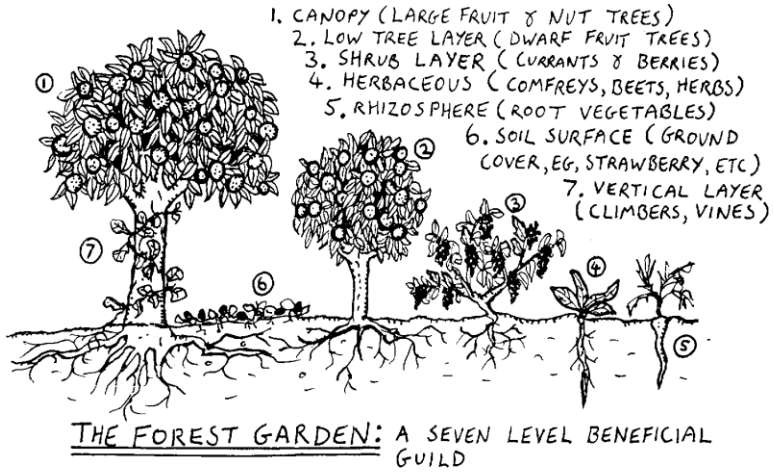


Planted areas can be carefully designed to minimize the amount of area used for footpaths. Each type of plant is situated to optimally benefit other plants, and maximize yield. Designers consider wind, light, water, trees, animals, ponds,

mulching, rocks, buildings, drains, pathways, and roads.

Permaculture design imitates natural systems. In a forest, there are multiple layers of diverse vegetation growing together. Starting with a preference for perennial plants, and those that self-seed, a garden is designed as a food forest, combining several plants that work well together. In addition to food producing plants, there can be:

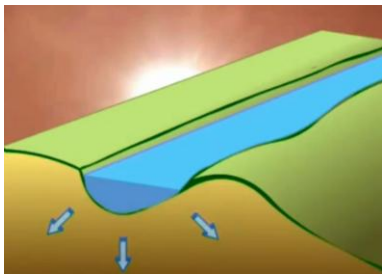
- nitrogen fixing beans, peas or trees
- plants with roots that dig deep to break up the soil
- groundcovers
- climbing vines
- supports on which the vines can climb (whether a tree, bush, stalks such as a maize or sunflower, or a house, wall, or fence)
- protectors, such as strong-smelling flowers and herbs, or plants that attract insect eating predators like frogs, birds and lizards.



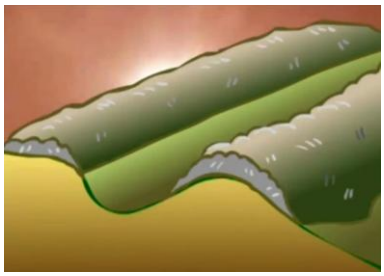
Greening the desert

In 2000, permaculture designer Geoffrey Lawton began a project on ten acres of desert land in Jordan, near the Dead Sea.[9] It had very little rainfall, and August temperatures of 50 Centigrade (120 Fahrenheit). The nearby farmers were all using irrigated plastic greenhouses, chemical pesticides and synthetic fertilizers. To harvest all the rain, Lawton dug 1.5 kilometers of swales - water harvesting ditches – two meters wide, almost half a meter deep. When it rained, the ditches caught over a million liters of water, and they would fill a few times over each winter.

[9] "Greening the Desert" final version (2009); http://www.youtube.com/watch?v=8gPvsl9ni-4



Instead of burning crop waste from fields, it was collected and spread as a thick layer of mulch over the swales, almost half a meter deep.



On the uphill side of the trench, they put in hardy nitrogen fixing desert trees – for shade, and to reduce wind evaporation.

On the lower side of the trench, they put in fruit trees...date palms, figs, pomegranates, guavas, mulberries and citrus.

Within four months, the fig trees were producing figs. Mushrooms began sprouting in the mulch, which the Jordanians had never seen before.

Biochar

When biomass is heated in the absence of oxygen – pyrolysis – you get charcoal, which is mostly carbon. Historically charcoal has been used as a high temperature fuel for smelting metal.

When plant matter decomposes, carbon dioxide is released, which is why deforestation is a major factor in climate change. When plant matter is turned into charcoal, which is ground up and added to the soil, the carbon is stable for centuries, perhaps millennia.

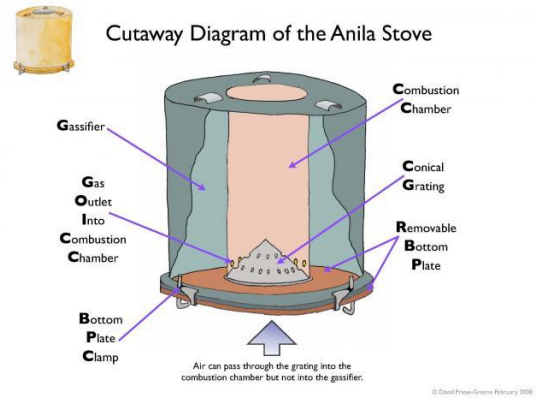
Charcoal made for this purpose is called biochar. Natives of Brazil's Amazon region, before the European arrival, are believed to have used biochar made from agricultural waste to improve soil productivity. They covered burning biomass with soil and let it smolder.

Using the slash and burn method of clearing farmland in Brazil, only 3% of the carbon from the organic material is left in the soil. Using slash and char instead, up to 50% of the carbon can be sequestered in the soil, in a highly stable form. This can decrease both deforestation and carbon dioxide emission, as well as increase the crop yield. [10]

[10] http://en.wikipedia.org/wiki/Biochar

Over two billion people still cook and heat their homes with primitive stoves or open fires, burning wood, straw, manure, or coal. These methods burn fuel inefficiently, increasing the amount of fuel that people must work hard to gather. High demand for wood accelerates deforestation.

Researchers have been working to improve biomass stove technologies, so they can produce both heat for cooking, and biochar for carbon sequestration and soil building. Testing so far indicates that these stoves are much more efficient and emit less pollution. [11]



Conclusion

Between climate change, weather disasters, and declining oil supplies, we must anticipate shortages of food, water, fuel and other resources. To become more resilient, minimize scarcity, and reduce conflicts, communities should aim to produce as much of their food locally as possible. Sustainable agriculture and permanent culture practices use less fuel, minimize carbon emissions, and conserve water. Try them in your community!

[11] International Biochar Initiative, http://www.biochar-international.org/technology/stoves