

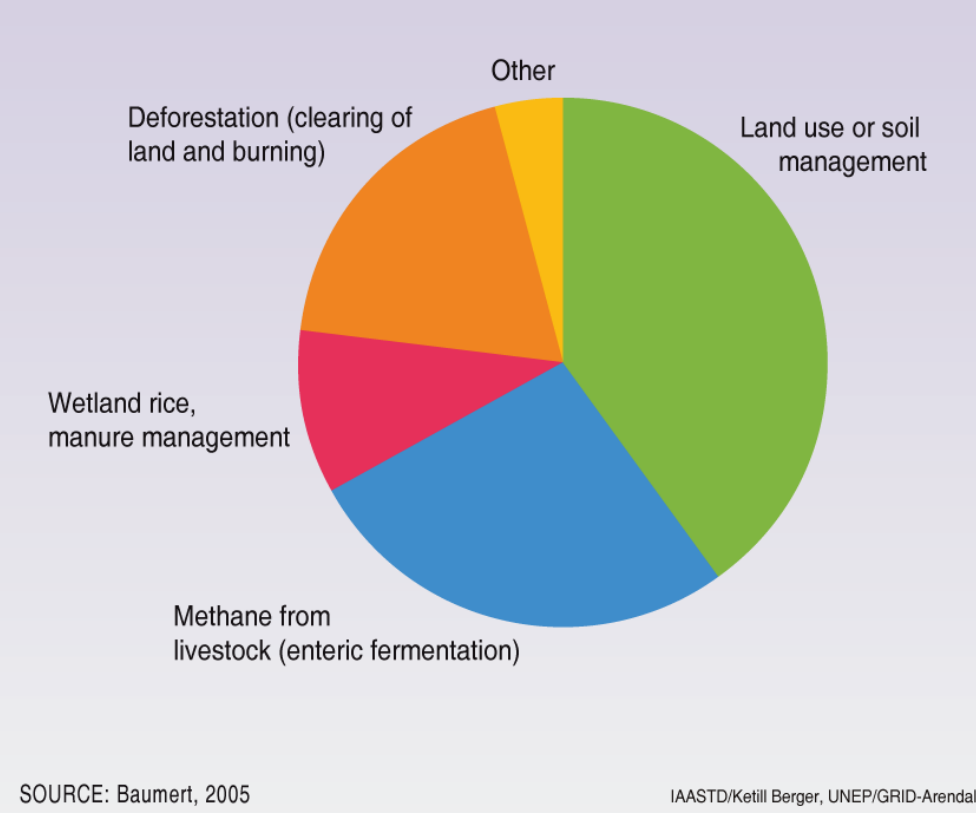
Forest Gardening: Redesigning Modern Agriculture

Jacquelyn Tupper, Christine Tang, Patrick Sheppard, Jonathan Rodgers

Advisor: Professor Svetlana Nikitina

The Issues

Greenhouse gas emissions from agriculture and land use



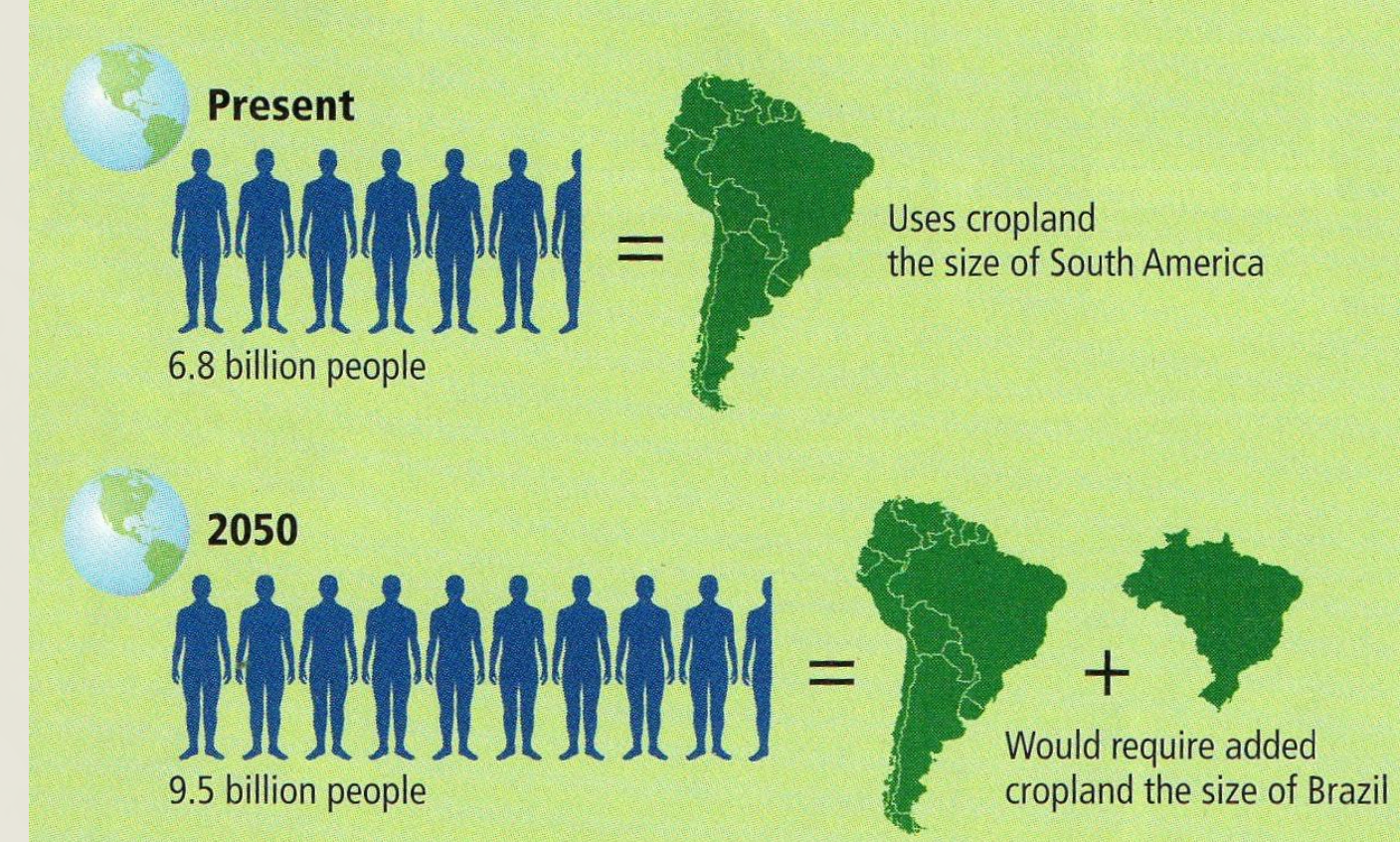
Modern agriculture is one of the primary sources of greenhouse gas emissions. Over 30% of all greenhouse gas emissions are from agriculture and land use. Gases emitted include Methane, Nitrous Oxide and Carbon Dioxide. This statistic does not include Carbon Dioxide released from the production of agricultural products and the transportation of agricultural products.

The harmful effects of modern agriculture include:

- Excessive water and land usage.
- A primary source of greenhouse gas emissions.
- Uses more energy than it produces.
- Heavy dependence on oil. Twenty percent of the gasoline and diesel fuel used in the United States goes into farming.
- Polluting the world's oceans by creating "dead zones" due to chemical runoff.
- Destroying biodiversity with use of monocultures. Natural ecosystems depend on a variety of different species that all provide individual, necessary functions that contribute to the stability of the ecosystem. Monocultures eradicate this multitude of functions and leave farms fully dependent on synthetic inputs to survive.
- Lead to soil infertility, salinization, soil erosion, water and food chain pollution, and land degradation.
- Fills the food chain with carcinogenic pesticides, herbicides, growth hormones, and antibiotics.
- Manual labor jobs replaced by machines.
- Cannot feed the world's current population. There are about one billion undernourished people in the world today.

Feeding the Future: Not Enough Land

Growing food and raising livestock for 6.8 billion people require land equal in size to South America. By 2050 another Brazil's worth of area will be needed, using traditional farming; that much arable land does not exist.



Abstract

Adequate food supply is one of the greatest problems that humanity will face in the 21st century. Earth's population is expected to hit 9.5 billion by 2050. To support this population with our current practices of industrial agriculture, another billion hectares of land would have to be deforested and transformed into farmland. We do not have this land at our disposal anymore. Modern industrial agriculture is not sustainable. Its methods degrade ecosystems, contribute to greenhouse gas emissions, consume 70 percent of the world's fresh water, and diminish biodiversity. An alternative to modern agriculture, however, does exist: forest farms. They revitalize ecosystems, are independent of artificial inputs, are more productive and biologically diverse, and also reverse greenhouse gas emissions through carbon sequestration. The fundamental principle behind a forest garden is simple: apply the concepts and ecology of a forest to the landscape of a farm. Forests are self-renewing, input-free, biologically diverse, highly productive, and environmentally sustainable. The focus of our project was to explore these benefits and determine whether forest gardens are feasible in terms of economics, productivity, and sustainability. We would like to examine the feasibility of forest gardens in developing countries and their potential contribution to the reduction of poverty and hunger. To understand the true potential of forest gardens, we approached them both as a research topic and as a current agricultural practice that is taking place as close to us as Leverett, MA. We made a field visit to a local forest farm which helped us grasp the complexity and benefits of a forest garden. From our research and field visits, we have determined that forest gardens can significantly mitigate climate change, as well as contribute to the reduction of poverty and hunger across the globe.



Goals and Objectives

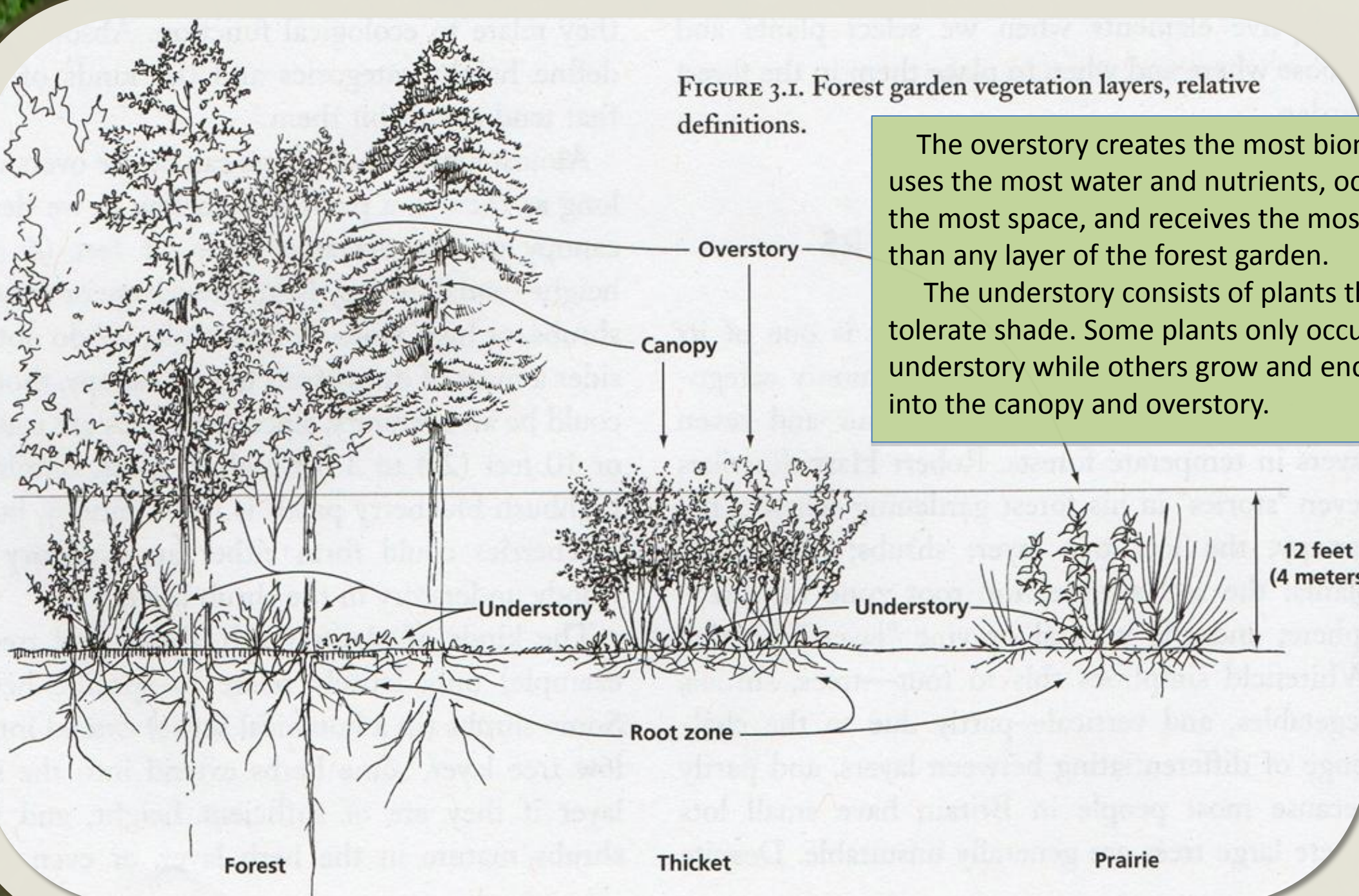
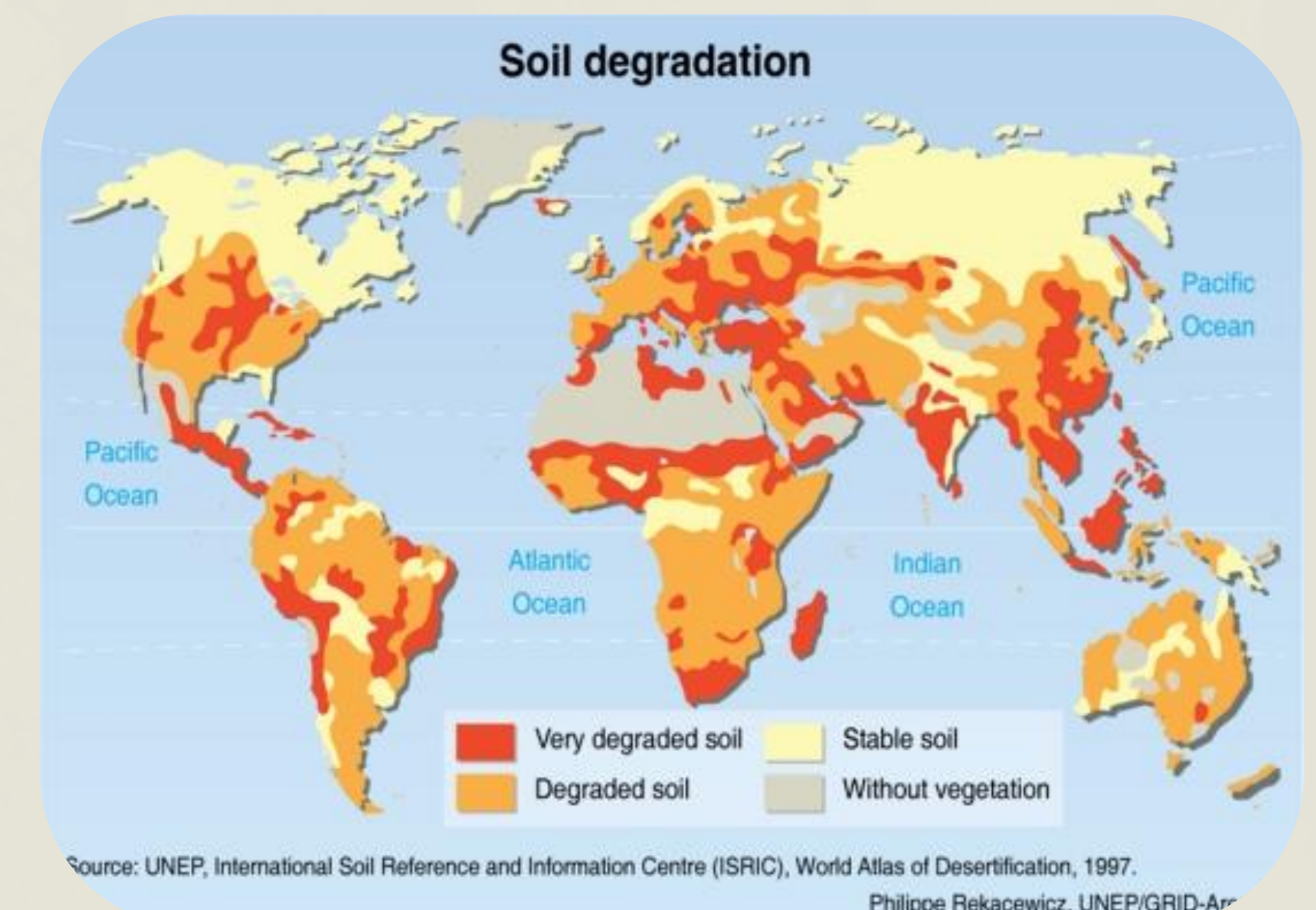
The overall goal of this project is to see if forest gardens are a plausible and realistic alternative to current agricultural practices. The project will expose the harmful effects of modern agriculture as well as its unsustainable practices. Then, it will include research on the topic of forest gardening to find out whether or not the concept solves modern agriculture's flaws.

- To determine whether or not forest gardens can replace modern farming practices and are economically viable to make.
- To determine whether or not forest gardens can be implemented in developing countries such as the nations of Africa, or in developed countries such as the United States.
- To determine whether or not forest gardens will be a solution to feeding the world's growing population using the same amount of space as modern agriculture, limit CO₂ emissions, and make the world less dependent on oil.
- To raise awareness on the problems of modern agriculture as well as introduce a possible solution in forest gardening.

A Solution

The benefits of forest gardens include:

- They are more productive per acre than current farming methods and do not require artificial inputs that are harmful to the environment.
- They restore damaged land and build soil.
- Forest gardens employ the concept of local sustainability.
- They incorporate beneficial symbiotic relationships between plants, animals and microbes that outweigh negative relationships such as plant competition.
- Forest gardens avoid dependence on single crops due to their diversity of species.
- They produce food year round, and use nature to provide functions such as nitrogen fixation, fertilization, and pest control.
- Forest gardens force farmers to think both horizontally and vertically because in a forest garden there can be production on over twelve different levels of growth.
- They require little self-maintenance. Therefore, expensive farming equipment, chemicals, and supplies required for present farming are no longer needed.
- By creating forest gardens in local communities, they provide local jobs and naturally grown food to the local community. In addition, transportation of this grown food decreases, which leads to the conservation of time, money, and oil.



Implementation

The production and sharing of knowledge

Research needs to be done in two key areas.

1. We need to develop more agricultural systems that include a diverse amount of species that contribute to biodiversity and mimic natural ecosystems
2. We need to make other farming-related practices such as transportation more sustainable

There needs to be more results documentation in three key areas:

1. Production results
2. Affect on local livelihoods
3. Impact on biodiversity

Scaling it up

We must work to empower local communities – it needs to be their decision to make the switch to more sustainable practices. All we can do is provide them with the information

Efforts need to be made to educate and involve local farmers, making them key decision makers and managers of their own land

They need to be aware of the economic, production, and social benefits

Scaling up forest gardens to a globally relevant practice will involve multiple stakeholders

Multi-stakeholder management would require an institution that aids the switch to forest gardens in terms of planning, implementation, and monitoring

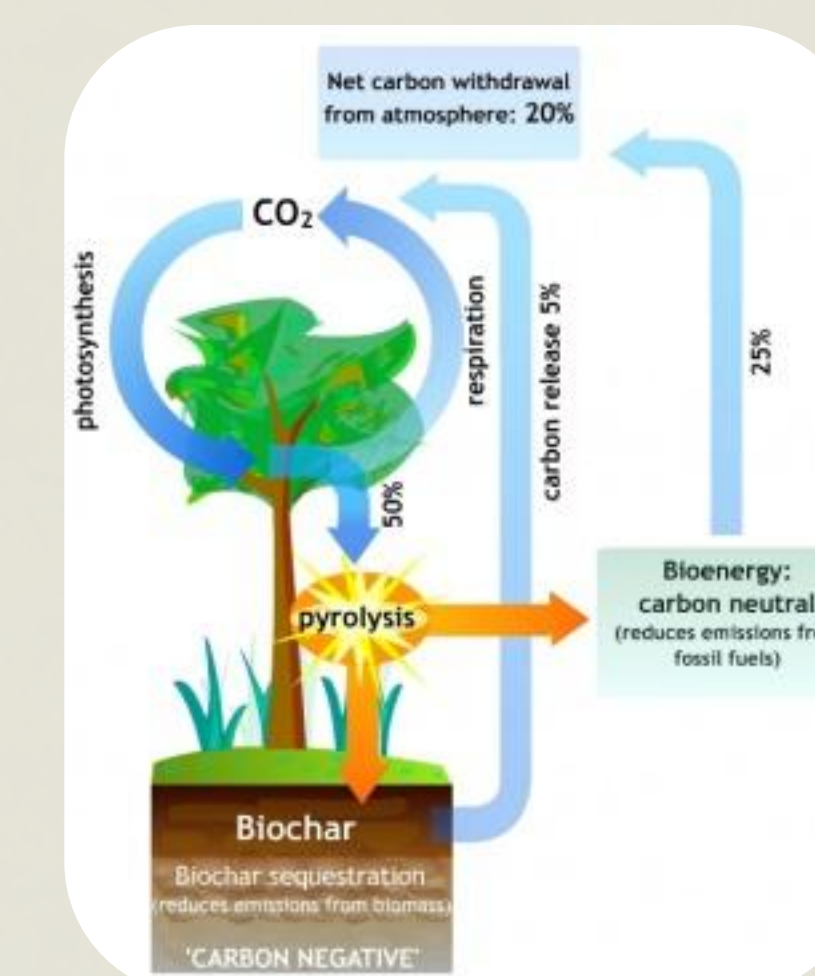
Political coalitions need to be formed in order to promote integrated cross-sectoral policies.

We need to bring in people who work in conservation policy, urban consumer groups, international financial organizations, parts of the food industry, public health advocates, and local governments, and more.

The Next Step

During our team's field trip to Jono's forest garden, he introduced us to biochar: a new and cutting edge technology that does a great job of complementing agroforestry.

Biochar is charcoal made from organic waste and used for agricultural purposes. It is produced through a process called pyrolysis where biomass is heated in a low oxygen environment. Once produced, farmers spread biochar on the top layer of the soil and incorporate it into the agricultural fields. The benefits of biochar include increasing crop yield, preventing chemical leaching and runoff, helping soil retain water and nutrients, and sequestering carbon and locking it into the ground. According to NASA scientist James Hansen, the use of biochar worldwide could potentially cut carbon dioxide levels in the atmosphere by eight parts per million in the next 50 years.

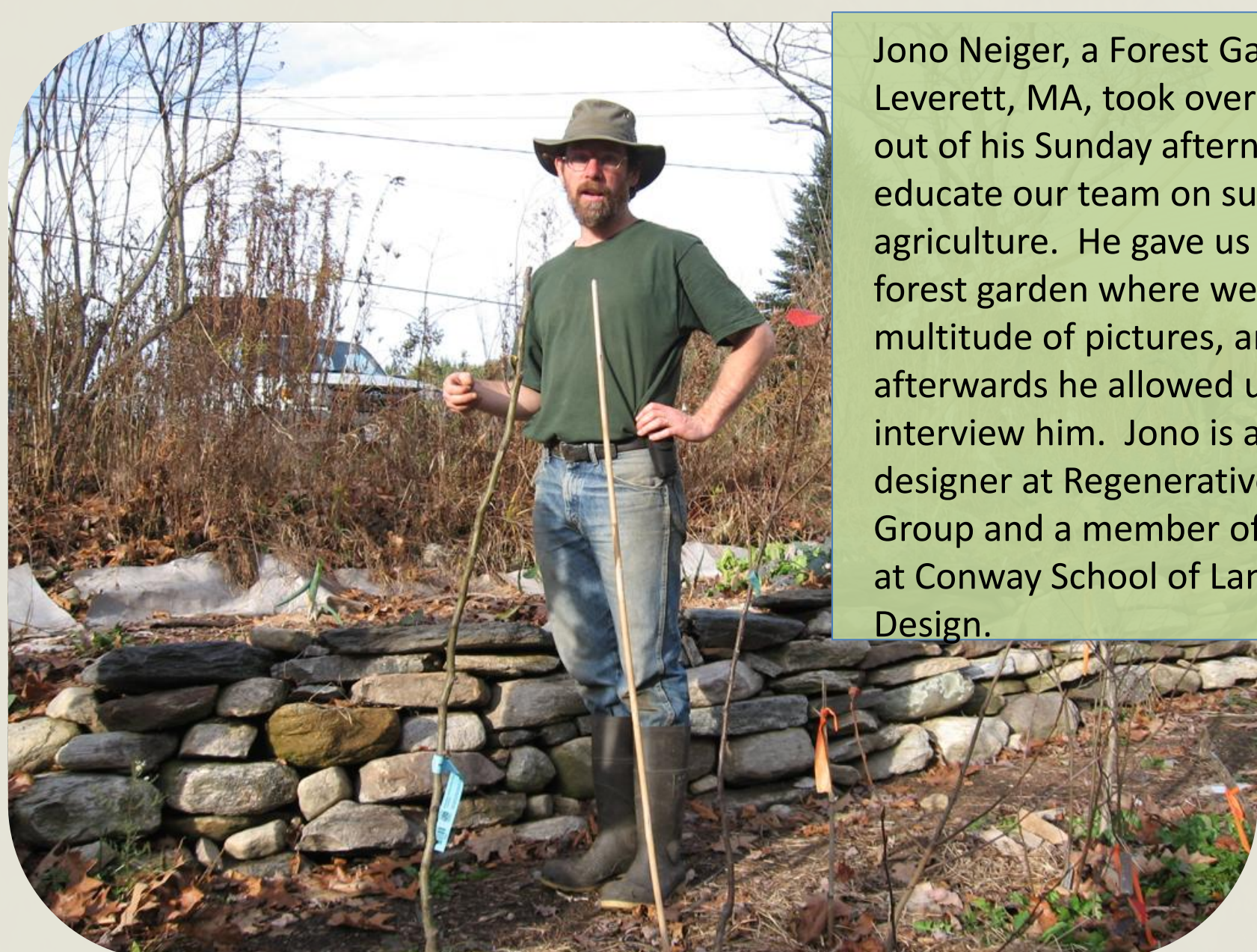


Selected References

- Ansari, Azadeh. "CNN.com." 4 Dec. 2009. Cable News Network. 4 Dec. 2009 <<http://www.cnn.com/2009/TECH/science/03/30/biochar.warming.energy/index.html>>.
- "BIOCHARinfo." Carbon Zero Project. 4 Dec. 2009 <<http://www.biochar.info/index.cfm?view=52.2&lan=en>>.
- Despommier, Dickson. "The Rise of Vertical Farms." Scientific American Nov. 2009: 80-86.
- Dr. Seuss. "The Lorax." New York: Random House 1971.
- Jacke, Dave, and Eric Toensmeier. Edible Forest Gardens. 2 vols. White River Junction, Vermont: Chelsea Green Publishing Company, 2005. Print.
- Whitefield, Patrick. How to Make a Forest Garden. East Meon, Hampshire GU32 1HR, UK: Permanent Publications, 2002. Print.
- Harris, Ed. "Local Foods Research." 25 June 2008. 1 Dec 2009 <<http://localfoods.wordpress.com/2008/06/25/greenhouse-gas-emissions-from-agriculture/>>.
- "International Assessment of Agricultural Knowledge, Science and Technology for Development." April 2008. 1 December 2009 <http://www.agassessment.org/index.cfm?Page=About_IAASTD&ItemID=2>.
- Neiger, Jono. Personal interview. 8 Nov. 2009.
- Trezza, Justin. Personal interview. 23 Nov. 2009.

Justin Trezza is a lead designer at Sustainable Harvest International. Justin served three years as a Peace Corps volunteer in the jungles of Honduras where he worked to educate the local residents in farming. Our team along with the help of our advisor scheduled an hour phone interview with Justin who graciously made time in his busy schedule to teach our team about agroforestry.

When asked whether or not forest gardens were a better solution to solving our current agricultural problems rather than intensifying the system that we already have, Justin responded immediately with the phrase "Of course!". All one needs to do is look at the results of intensifying over the years. This process degrades the soils whereas forest gardening builds it. Forest gardens are less dependent on chemicals. Justin believes that forest gardens are an international movement that creates habitats for species and food systems with very little input. One of the only difficulties associated with agroforestry is that it takes time and when implemented, many farmers want the immediate results and their money tomorrow.



Jono Neiger, a Forest Gardener in Leverett, MA, took over three hours out of his Sunday afternoon to educate our team on sustainable agriculture. He gave us a tour of his forest garden where we took a multitude of pictures, and afterwards he allowed us to interview him. Jono is a lead designer at Regenerative Design Group and a member of the faculty at Conway School of Landscape Design.

