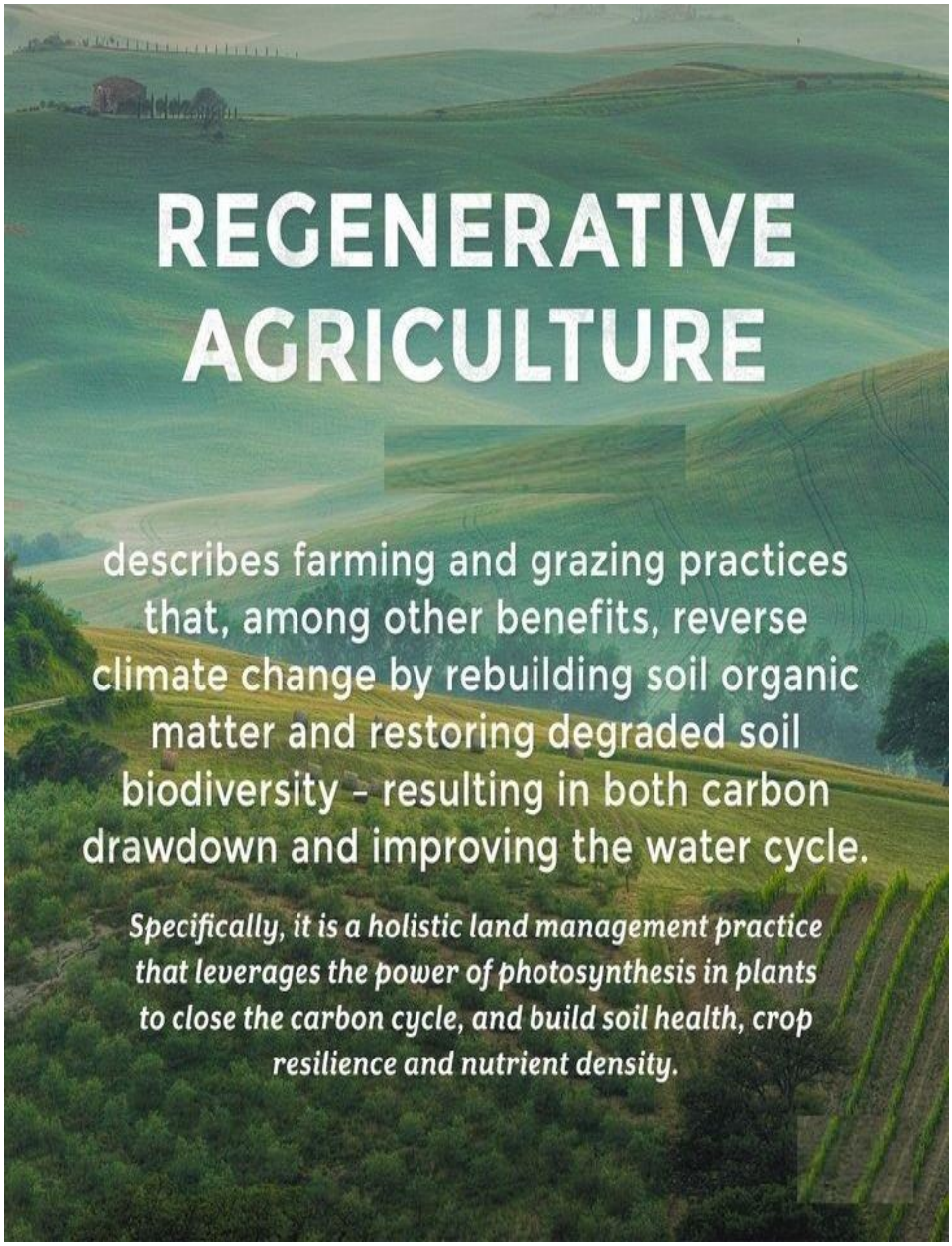
Research Study



PLANNING & RESEARCH DEPARTMENT
ZTBL

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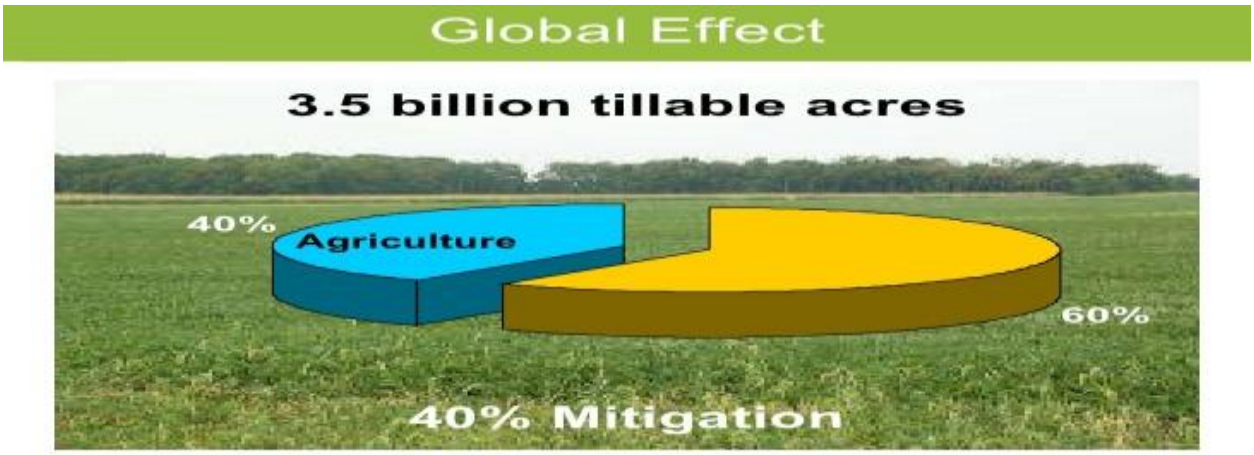
1. Introduction

The loss of the world's fertile soil and biodiversity, along with the loss of indigenous seeds and knowledge, pose a mortal threat to our future survival. According to soil scientists, at current rates of soil destruction (i.e. decarbonization, erosion, desertification, chemical pollution), within 50 years we will not only suffer serious damage to public health due to a qualitatively degraded food supply characterized by diminished nutrition and loss of important trace minerals, but we will literally no longer have enough arable topsoil to feed ourselves. Without protecting and regenerating the soil on our four billion acres of cultivated farmland, 14 billion acres of pasture and rangeland, and 10 billion acres of forest land, it will be impossible to feed the world, keep global warming below 2 degrees Celsius, or halt the loss of biodiversity. Globally, there is 3.5 billion tillable acres of land, out of which 40% is used for agriculture. If this 40% is not tilled then emissions from agriculture can be reduced to zero/minimum as agriculture contributes a major portion of green house gas emissions like livestock, soil fertilization, ruminant waste on pastures, non-agri energy and manure management.



Regenerative agriculture is a practice of organic farming designed to build soil health or to regenerate unhealthy soils. The practices associated with regenerative agriculture are those identified with other approaches to organic farming, including maintaining a high percentage of organic matter in soils, minimum tillage, biodiversity, composting, mulching, crop rotation, cover crops, and green manures.

Regenerative agriculture and farming can be traced back to the works and scientific contributions regarding the nitrogen cycle and biological regeneration of soils in southern U.S by Carver at the Tuskegee University, Alabama, USA, in the early 20th century.

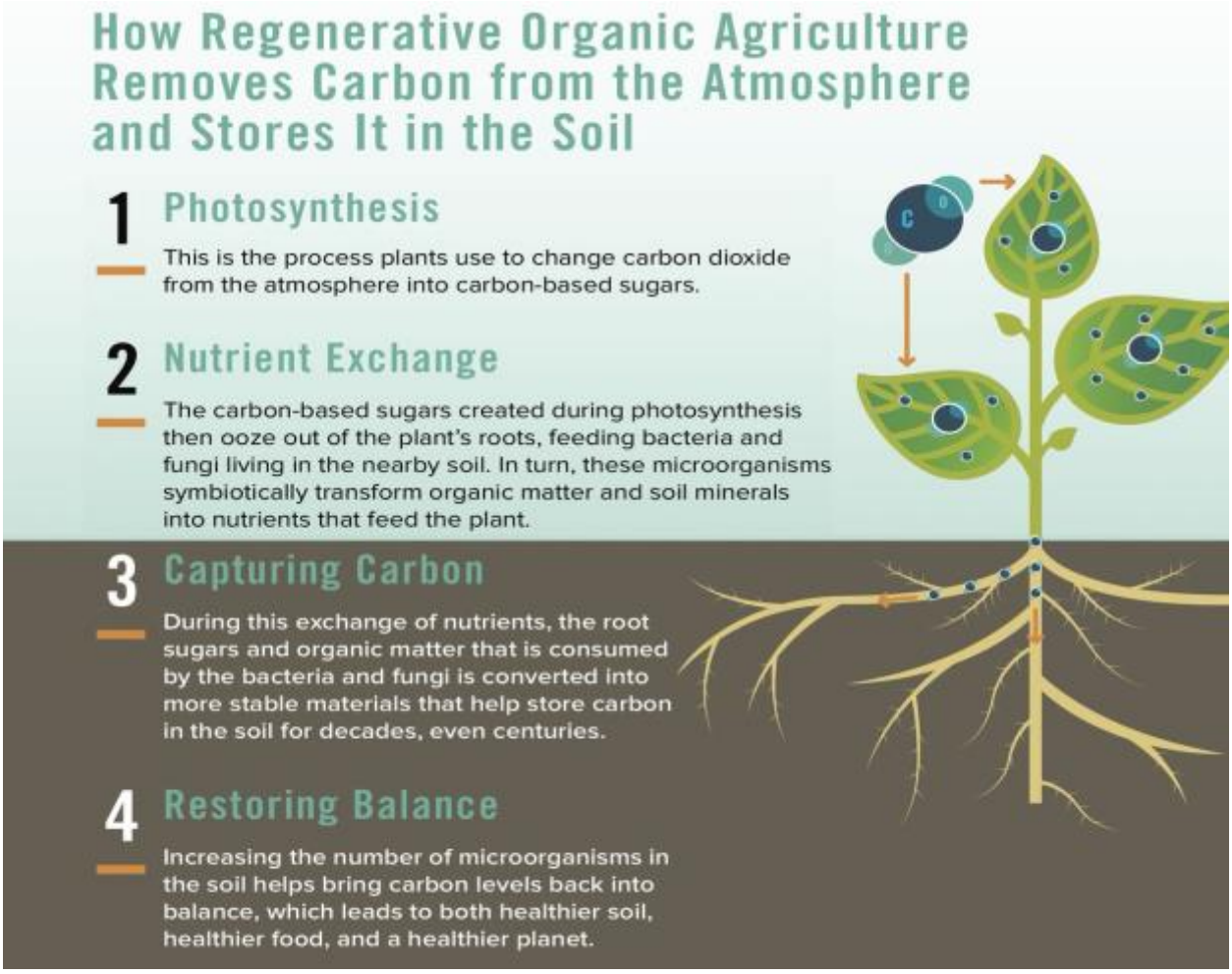
Previously, regenerative farming was seen as a long term methodology that proponents used to manufacture soil health, advance supplement maintenance, and energize nuisance and ailment resistance. A large portion of the practices connected with regenerative agriculture are administration rehearses connected with natural farming. These practices can be connected in cultivation and appropriately overseen domesticated animals with Comprehensive Arranged Eating. Where one of the principle objectives is to manufacture soil natural matter, a natural practice comprehended by professionals of natural cultivating to have expansive advantages for plant wellbeing and homestead manageability. At the point when consolidated with the soul of natural horticulture such practices are said to create sound soil, solid nourishment, clean water and clean air utilizing reasonable inputs neighborhood to the ranch. Rehearses that minimize biota unsettling influence and disintegration misfortunes while fusing carbon rich alterations and holding the biomass of roots and shoots are supported in regenerative cultivating.

2. Importance of Regenerative Agriculture

There are several reasons to encourage the design of new agronomic systems, shifting from conventional open or leaky systems to more closed, regenerative systems. Current systems cause overconsumption of environmental resources, contribute to climate change, rely on increasingly expensive fossil fuel, and result in environmental (e.g., groundwater) contamination. Moreover, the agronomic–urban interface is growing, as are markets for ecologically friendly produce, the need for low-input farming systems in low-income regions, and disenchantment with the subsidization of conventional agriculture. There is reasonable biological and economic evidence to support advocacy for a shift to regenerative systems. Such a shift presents challenges—for example, although higher labor input enhances community well-being and rural social capital, it is costly. It also offers opportunities—for example, to adapt technologies to monitor and minimize wastage. Shifting to semi closed systems would be accelerated by (a) routine life cycle analysis and costing; (b) calculation of the full costs to society of farm inputs such as pesticides; (c) food labeling and standards that draw attention to energy and other inputs; (d) government grants supporting the transition to semi closed systems; (e) changing priorities for agronomic

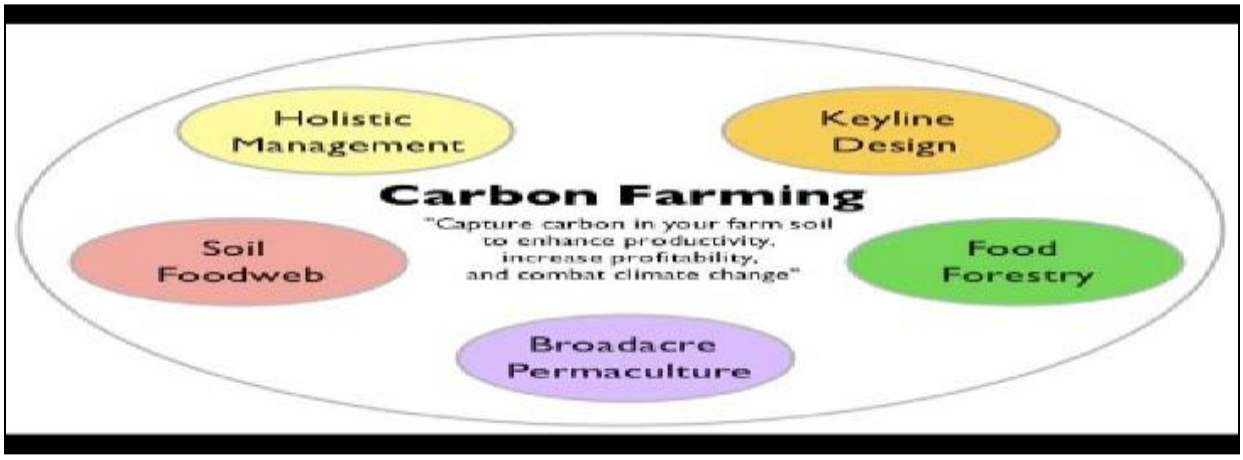
research; and (f) greater engagement of urban societies in agriculture through recreation and philanthropy.

The key to regenerative agriculture is that it not only does any harm to the land but actually improves it, using technologies that regenerate and revitalize the soil and the environment. Regenerative agriculture leads to healthy soil, capable of producing high quality, nutrient dense food while simultaneously improving, rather than degrading land, and ultimately leading to productive farms and healthy communities and economies. It is a dynamic and holistic, incorporating permaculture and organic farming practices, including conservation tillage, cover crops, crop rotation, composting, mobile animal shelters and pasture cropping, to increase food production, farmers' income and especially, topsoil.



3. Important Techniques used in Regenerative Agriculture

These are some of the most effective and important Regenerative Agriculture techniques. They can dramatically improve most farming and ranching operations. Most of them can increase profits, if applied correctly. And they are almost all guaranteed to regenerate land.



a. Holistic Decision Making

Holistic Decision Making is a method managing complex systems (like farms, families, nations, companies, etc.). This decision making framework has been tested on thousands of farms and ranches around the world for decades. It works. Holistic Decision Making takes into account the financial, environmental, and social aspects of every decision. It also offers methods for changing decisions that aren't going as planned. And it is simple enough for farmers in rural Africa with absolutely no education to use. Most farms and land managers fail because their decisions do not adequately address the social and financial and environmental aspects of their situation. Holistic Decision Making is a basic prerequisite to long-term sustainability.

South Africa
Land on the left managed under Holistic Planned Grazing (HPG) in 200 mm rainfall, showing a contrast with advancing desertification

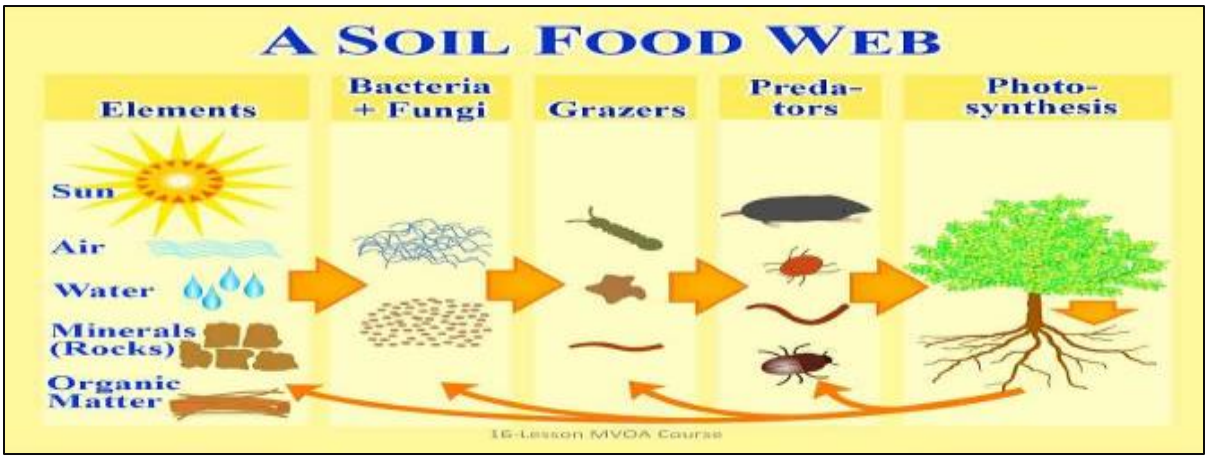
b. Permaculture Design

Permaculture is a philosophy, a design science, and a global movement. The design science of Permaculture is an invaluable tool for farmers and land managers. It is basically landscape design, but unlike most landscape design it is tailored to the needs of agriculture, and it also takes into account the principles of ecology.

A Permaculture farm will tend to be more efficient for the farmer, it will tend to have better functioning ecosystems and water cycles, and it will tend to be beautiful as an added bonus.

c. The Soil Food Web

The Soil Food Web is not a farming technique; it was not invented by anybody. It is simply the natural process which allows plants to grow when chemical fertilizers are not around (i.e. for the past hundreds of millions of years). Elaine Ingham has been the soil scientist who has done the most to reveal the critical importance of the Soil Food Web.



The Soil Food Web refers to the microorganisms in the soil (bacteria, fungi, nematodes, etc.) which extract nutrients from the soil and provide these nutrients directly to the roots of living plants. By managing the Soil Food Web on your farm carefully you can dramatically improve your plant growth in very short periods of time. This usually entails a one-time application of well-made compost or compost tea, followed by a change in management to protect the health of the soil organisms in the long term (no-till, organic, perennials, etc.).

d. No-Till Crop Production

"Tilling" refers to any major physical disturbance below the surface of the soil (plowing, cultivating, roto-tilling, etc.). Tilling is the most damaging thing that you can do to soil organisms. It is even worse than applying pesticides, fungicides, or other chemicals. With new methods for controlling weeds (like well-timed succession crops, pasture cropping, livestock, mulch, etc.) and planting seeds (no-till seed drills) farmers have begun to transition to no-till production. When a piece of land is not tilled the soil organisms are able to establish a healthy soil ecosystem. This has tremendous benefits: looser soil (decompaction), increased nutrient availability and soil fertility, fewer soil-borne diseases, faster water-infiltration rates (i.e. less soil erosion and flooding), etc. A healthy soil will actually *increase* in depth each year.

e. Perennial Crops

Perennial crops ensure that there are living roots in the soil 100% of the time. This prevents soil erosion, reduces compaction, feeds the soil food web, and pushes the soil profile lower (creates soil). Perennial plant roots can grow very deep over time, allowing the plants to access nutrient and water stores that annual plants never can.

All trees are perennials. Tree crops provide many environmental benefits including wind reduction, temperature moderation, wildlife habitat, etc.

f. Polyculture

Polyculture refers to growing many different species of plants (and animals) in one area. Traditional agriculture employs "monocultures", which means only one or two plants are grown in a given area and all other species are relentlessly exterminated. Monocultures are not found in nature, they create a very unbalanced ecosystem which leads to countless problems: plant diseases, insect imbalances, reduced soil fertility, reduced wildlife habitat, reduced crop resilience to drought, heat, etc.

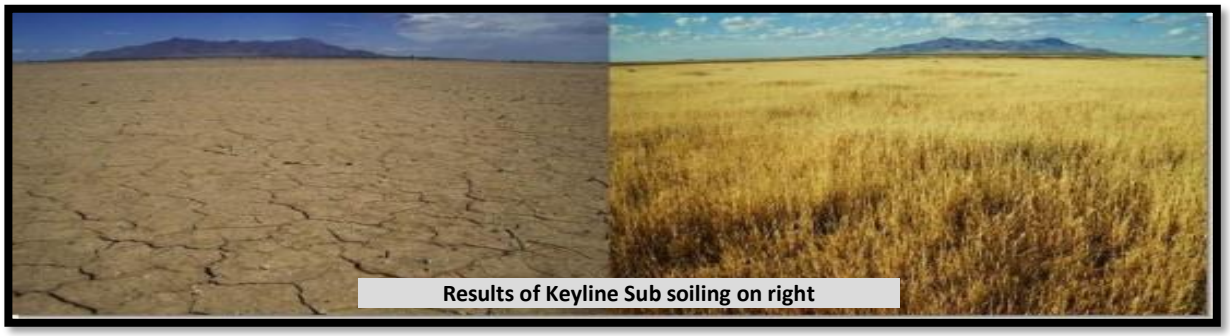
g. Thermal Compost

Most agricultural soils have lost a huge percentage of the microbial soil life which is necessary for a healthy soil food web. In the absence of these microbes' plants develop nutrient deficiencies, are susceptible to disease, and are more vulnerable to stress like drought and insect damage. Tremendous results have been achieved on large scale farms by applying carefully crafted "thermal compost" to the soil in order to replenish the missing microbe populations. A one-time application of compost or compost tea is usually all that is necessary as long as destructive farming practices (tilling, fertilizing) are stopped.

h. Keyline Sub-Soiling

It is a method for cheaply capturing water that would otherwise run off a piece of land. It is also able to increase the depth of soil very quickly. It is a non-destructive practice, unlike most plowing, and does not destroy the soil food web or existing plants growing in the area.

The plowing is usually done in a very specific pattern in order to spread water evenly across the landscape.



4. Rationale for Regenerative Agriculture

The reasons why the researchers and policy-makers should encourage the wide-scale transition from conventional farming systems to regenerative systems are given below:

1. Total global consumption is no longer sustainable. The global use of biological resources exceeds the capacity of the world's land and seas to create or renew those resources. Because agriculture is the largest user of land, a review of the regenerative efficiency of agronomic systems is in order and it will help in conserving agriculture.

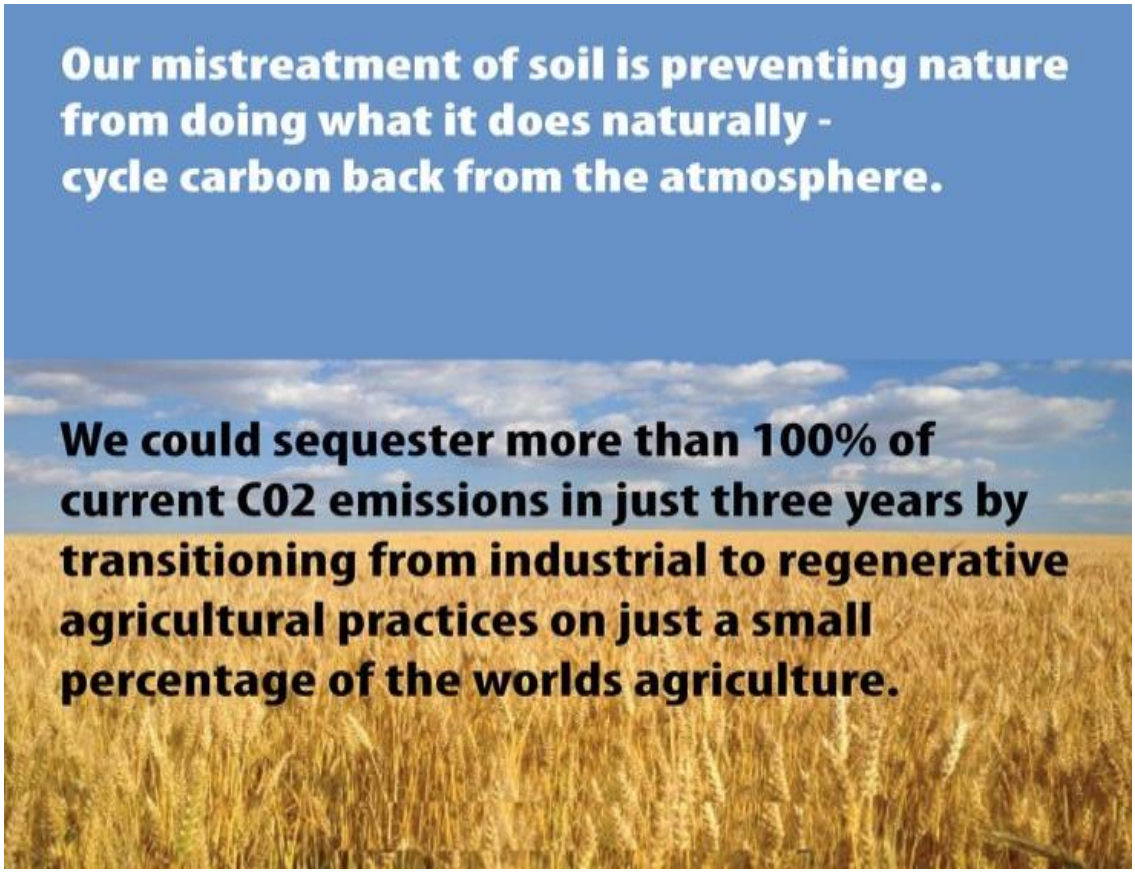
2. The problem of greenhouse gas (GHG) emissions, and the commitment of many governments to addressing rising temperatures and atmospheric concentrations of greenhouse gases, will focus attention on how agronomic practices can be modified to meet targets for greenhouse gas reductions.

3. Rising oil and gas prices (173% from 2002 to early 2006) raised questions about the viability of the trend toward complex, globally distributed agri-food chains, and about the economics of the heavy use of inorganic fertilizers. Rising oil prices make on-farm generation of energy (from wind, fermentation of bio-solids, etc.) more attractive, thereby making systems more closed.

4. Large-scale, relatively open, high-input agronomic systems are being criticized for their impacts on landscape aesthetics, biodiversity, soil (e.g., structure, organic matter, biota), groundwater, and even the fabric of rural communities. Agronomic

consumption of water is a particularly pressing problem, which will be aggravated by global warming, growing urban populations, and irrigated agriculture.

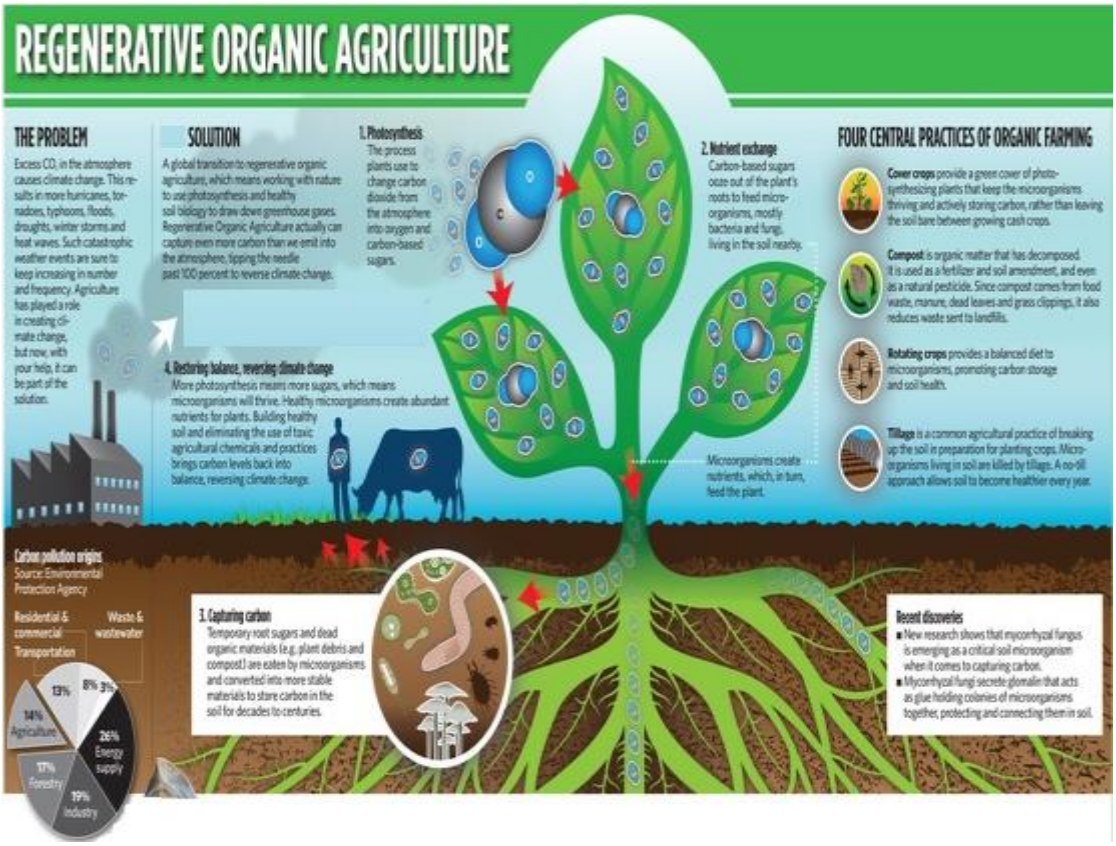
5. Urbanization has led to awareness of the need to create agronomic–urban juxtapositions or mosaics, which implies reconsideration of less open, and possibly smaller-unit farming.



6. Farming practices that are marketed in affluent countries as "good" (e.g., organic agriculture) are commanding price premiums, indicating an opportunity for further market differentiation and premiums.

7. Less affluent countries (e.g., in sub-Saharan Africa) need low-input farming systems because of the high costs or lack of availability of some off-farm inputs, such as inorganic fertilizers.

8. Disenchantment with continued subsidization of conventional agriculture is growing, especially among affluent urban taxpayers and the World Trade Organization. It is likely that agriculture will need to project and implement a new vision to capture continuing financial support from urban taxpayers in developed countries such as the United States.



9. Policy makers in the past only focused on value of food production however there is a new focus that research should be done into agronomic systems to enhance value, and to account for the impact of innovative technologies in terms of both food production and environmental services. In this way, regenerative systems can be designed to strike a balance between environmental goods and services and the output of food, whereas conventional agriculture ignores environmental benefits or treats them separately.

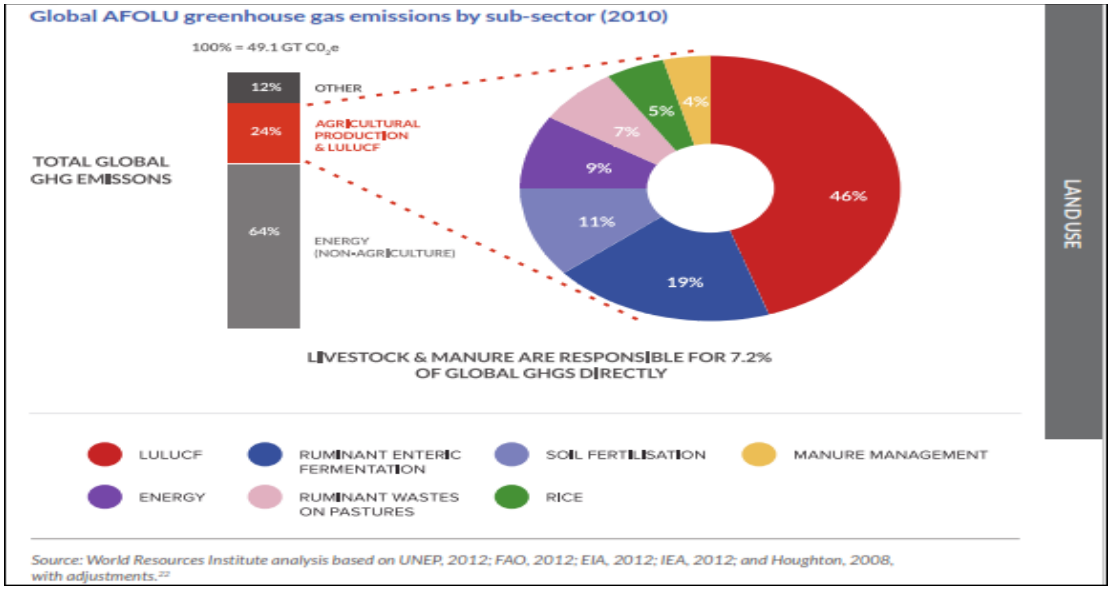
10. The negative impacts of agriculture are particular to leaky or open agronomic systems, whereas the positive externalities that are by-products of leakiness can be designed into semi closed systems.

11. Greenhouse gas (GHG) emissions and climate change are components of environmental capital. Agricultural emissions vary widely, depending on the type of agriculture (e.g., Australia's agricultural emissions are high relative to other developed countries because of the country's relatively large livestock population) and on the complexity and efficiency of the food chains (e.g., transport emissions). Nitrous oxide (N_2O; largely associated with nitrification of fertilizer nitrogen) and methane from ruminant livestock usually account for two-thirds of agronomic emissions. These two important sources of greenhouse gases-fertilizers and belching cattle and sheep-represent inefficient uses of nutrients and energy that will improve, with benefits for greenhouse emissions, when agricultural systems become more closed and less leaky.

ARABLE LAND AND CARBON EMISSIONS FROM AGRICULTURE

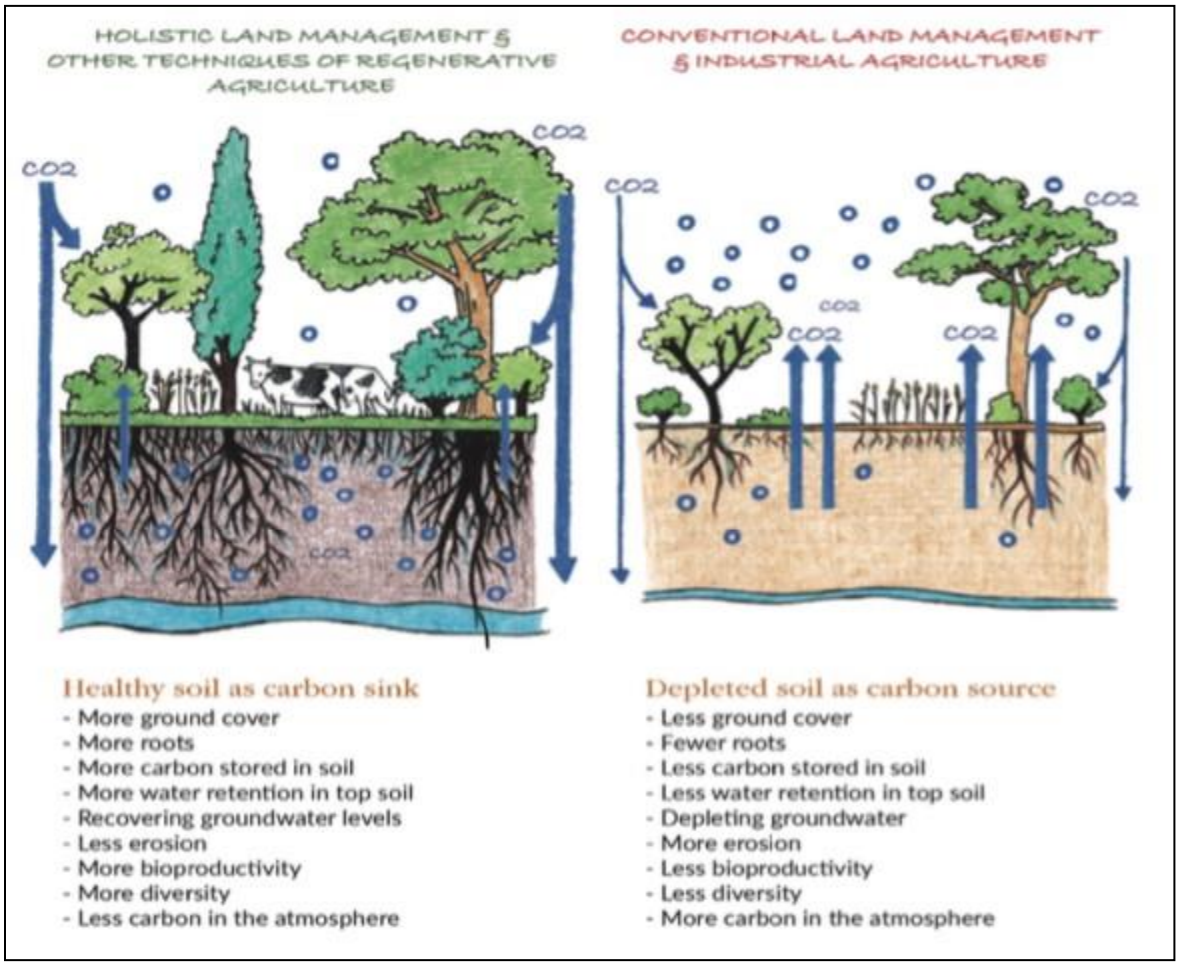
	total arable land (million acres)	greenhouse gas emissions (megatonnes)
France	45.0	89.0
Germany	29.4	70.0
Canada	113.6	56.0
U.K.	16.3	52.0
Spain	30.9	37.7
Italy	16.8	35.0
Ireland	2.7	18.0

Sources: World Bank, European Commission and Agriculture Canada



12. Conservation agriculture is more viable in perimeter of large urban centers than conventional farming.

5. Difference between Holistic and Conventional Land Management



6. Recommendations to Accelerate the Adoption of Regenerative Agronomic Systems

- **Certification of Organic Agriculture Produce**

  Closeness should be included in certification criteria through dialogue between government agencies and certification bodies. These national bodies are well positioned to draw attention to the importance of minimizing inputs and negative outputs from open agronomic systems. Similarly, labeling of locally produced food that is by region of origin and by "food miles," how far food travels to markets, will emphasize the energy economy of its distribution.

- **Research on Plant-Derived Biomaterials**

  Life cycle analysis and research in plant-derived biomaterials that will result in the use of all plant parts, not just grain may be focused in order to accelerate regenerative agriculture.

- **Discourage Traditional Farming through Taxes**

  Economic analysis of farming systems should include full costing of farming inputs (e.g., pesticides, fertilizers), which are sometimes poorly used within conventional, open systems. Here the biggest impetus for change might be through governments' introduction of taxes on pesticides to reflect the real cost to society (e.g., the cost of cleaning up waterways). Taxes are but one method of discouraging unwanted externalities and creating semi closed systems.

- **Provision of Subsidy**

  Encourage the shift to regenerative systems through government funding to support the transition period. As known by research into organic farming systems is that in the first five years or so, these systems have lower yield and more management problems than do conventional systems, and for some of this time there are no price premiums. Allocating incentive payments during this period would arguably have a great impact on reducing the long-term costs of farming and the negative environmental impacts from agriculture.

Sources:

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