SUSTAINABLE AGRICULTURE

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ADA412-Contemporary Problems in Urban Sustainability

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For decades, we've produced the bulk of our food through industrial agriculture—a system dominated by large farms growing the same crops year after year, using enormous amounts of chemical pesticides and fertilizers that damage soils, water, air, and climate.

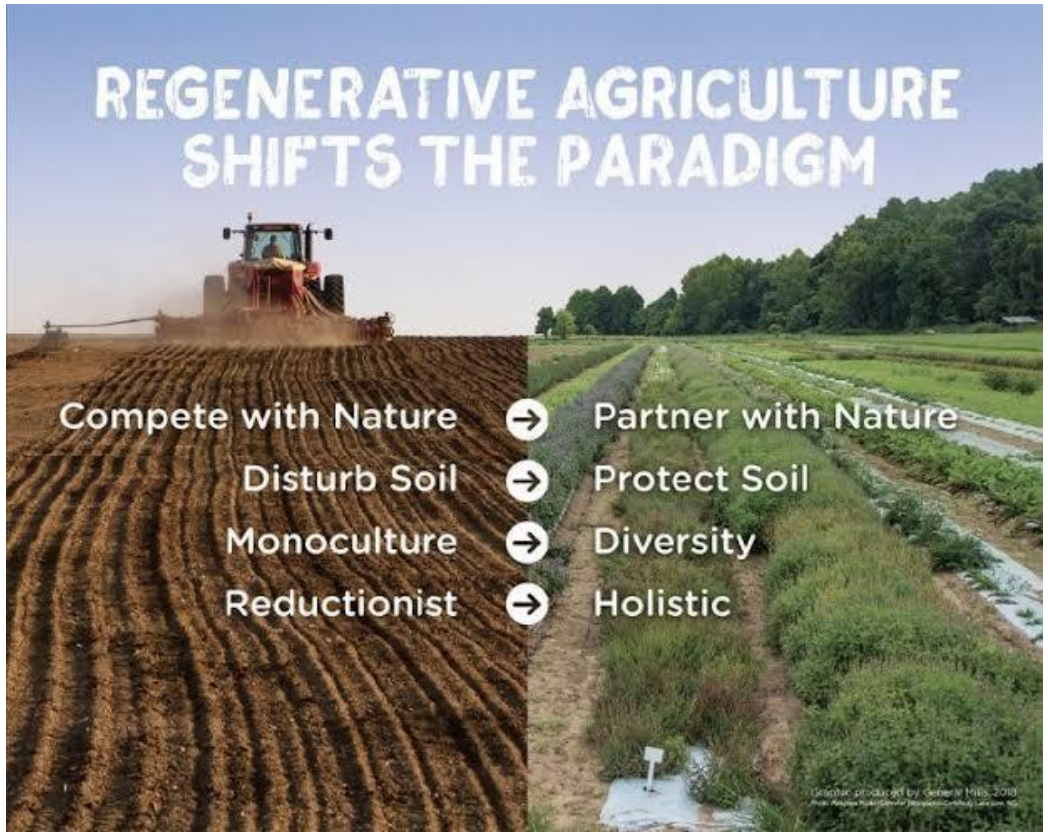
This system is not built to last, because it squanders and degrades the resources that it depends on. The ecological and social price have been steep: erosion, depleted and contaminated soil and water resources, loss of biodiversity, deforestation, labor abuses, and the decline of the family farm.

Some proponents of industrial agriculture claim that its impacts are the price we must pay to “feed the world.” In fact, a growing body of scientific evidence has debunked this claim, showing that a more sustainable model can be just as profitable—and can meet our needs for the long haul.

But a growing number of innovative farmers and scientists are taking a different path, moving toward a farming system that is more sustainable—environmentally, economically, and socially. This system has room for farms of all sizes, producing a diverse range of foods, fibers, and fuels adapted to local conditions and regional markets.

The concept of sustainable agriculture embraces a wide range of techniques, including organic, free-range, low-input, holistic, and biodynamic.

The common thread among these methods is an embrace of farming practices that mimic natural ecological processes. Farmers minimize tilling and water use, encourage healthy soil by planting fields with different crops year after year and integrating croplands with livestock grazing, and avoid pesticide use by nurturing the presence of organisms that control crop-destroying pests.



In agriculture, sustainability is a complex idea with many facets, including:

- The economic (a sustainable farm should be a profitable business that contributes to a robust economy),
- The social (it should deal fairly with its workers and have a mutually beneficial relationship with the surrounding community)
- The environmental

Environmental sustainability in agriculture means good stewardship of the natural systems and resources that farms rely on. Among other things, this involves:

-Building and maintaining healthy soil

-Managing water wisely

-Minimizing air, water, and climate pollution

-Promoting biodiversity

Sustainable agriculture practices

- Over decades of science and practice, several key sustainable farming practices have emerged—for example:
- **Rotating crops and embracing diversity**. Planting a variety of crops can have many benefits, including healthier soil and improved pest control. Crop diversity practices include intercropping (growing a mix of crops in the same area) and complex multi-year crop rotations.
- **Planting cover crops.** Cover crops, like clover or hairy vetch, are planted during off-season times when soils might otherwise be left bare. These crops protect and build soil health by preventing erosion, replenishing soil nutrients, and keeping weeds in check, reducing the need for herbicides.
- **Reducing or eliminating tillage**. Traditional plowing (tillage) prepares fields for planting and prevents weed problems but can cause a lot of soil loss. No-till or reduced till methods, which involve inserting seeds directly into undisturbed soil, can reduce erosion and improve soil health.
- **Applying integrated pest management (IPM).** A range of methods, including mechanical and biological controls, can be applied systematically to keep pest populations under control while minimizing use of chemical pesticides.
- **Integrating livestock and crops.** Industrial agriculture tends to keep plant and animal production separate, with animals living far from the areas where their feed is produced, and crops growing far away from abundant manure fertilizers. A growing body of evidence shows that a smart integration of crop and animal production can be a recipe for more efficient, profitable farms.
- **Adopting agroforestry practices.** By mixing trees or shrubs into their operations, farmers can provide shade and shelter to protect plants, animals, and water resources, while also potentially offering additional income.
- **Managing whole systems and landscapes.** Sustainable farms treat uncultivated or less intensively cultivated areas, such as riparian buffers or prairie strips, as integral to the farm—valued for their role in controlling erosion, reducing nutrient runoff, and supporting pollinators and other biodiversity.
- A key theme connecting many of these practices is diversification. “Keep it simple” is good advice in many situations, but when it comes to agriculture, the most sustainable and productive systems are more diverse and complex—like nature itself.

Pesticides

Recent decades have witnessed major growth in the use of agrochemicals worldwide, – for maximizing the food production for a rapidly growing human population.

However, the indiscriminate use of these substances especially the pesticides has led to the accumulation of toxic residues in food, soil, air, and water, as well as the development of resistance in pests.

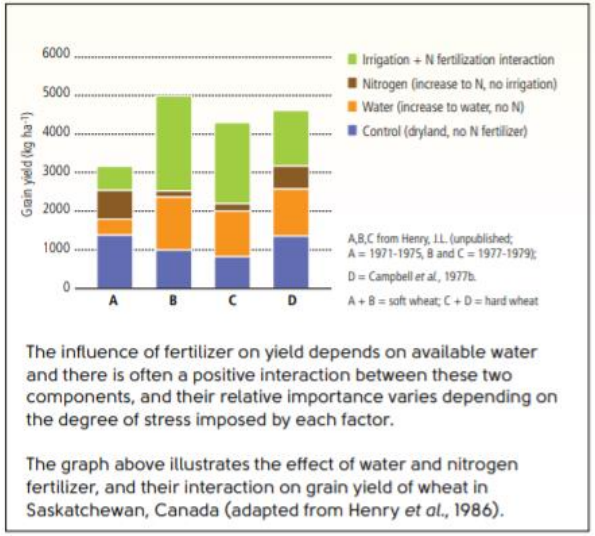
Moreover, pesticides affect soil enzymes, which are essential catalysts that govern soil quality. In order to meet the food security, it is necessary to produce more food, sustainably and safely, in a diminishing area of available arable land and with decreased water resources.

Given this situation, there is an increased interest in the use of alternative substances to synthetic agrochemicals that present less risk to the environment and human health while increasing the food safety. Promising results have been obtained using compounds derived from aromatic plants for the control of agricultural pests. Such compounds of botanical origin can be highly effective, with multiple mechanisms of action, while at the same time having low toxicity towards nontarget organisms.

However, the large-scale application of these substances for pest control is limited by their poor stability and other technological issues.

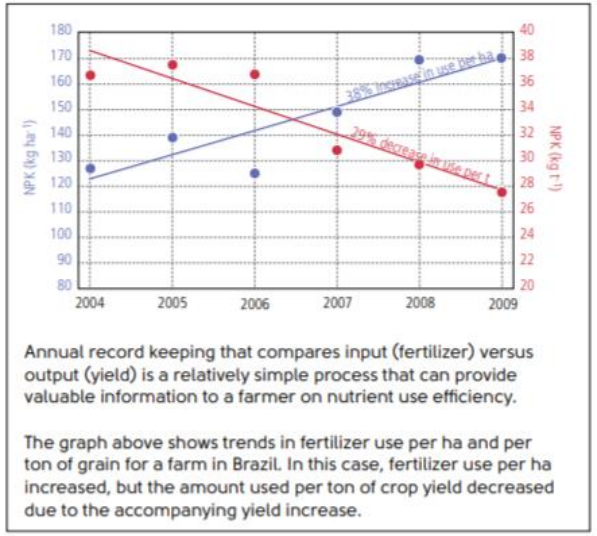
Fertilizers

In the last 50 years, the global fertilizer use has increased by 500 percent (and over 800 percent for nitrogen alone!). The world fertilizer nutrient (N+P2O5 +K2O) consumption has increased from 162 million tonnes in 2008 and is projected to reach 201
million tonnes in 2018, at annual growth rate of 1.8 percent per (FAO, 2015). Overall, mineral fertilizers has resulted in over 40 percent of the increase in food production. This is due to the fact that, nitrogen availability is the most important determinant of yield in most major crops.



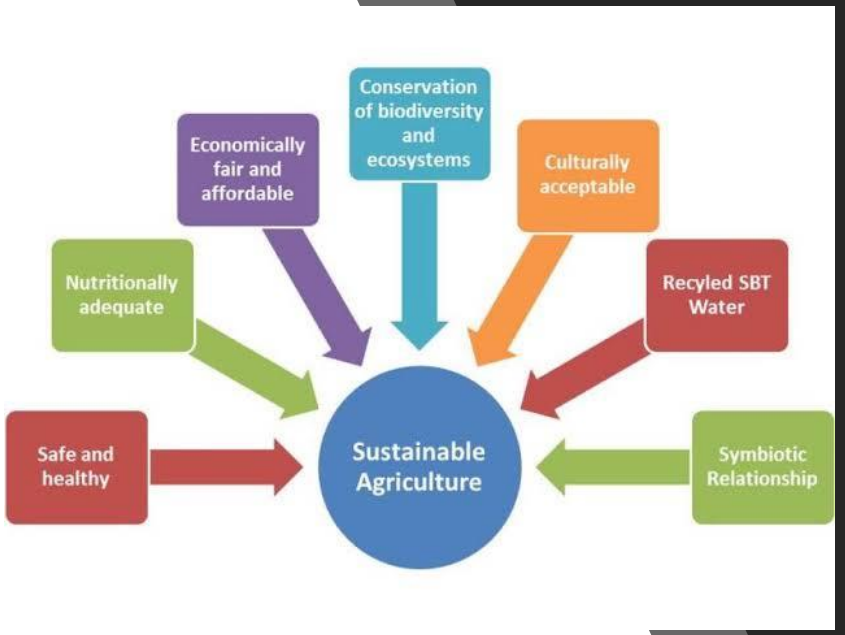
The influence of fertilizer on yield depends on available water and there is often a positive interaction between these two components, and their relative importance varies depending on the degree of stress imposed by each factor.

The graph above illustrates the effect of water and nitrogen fertilizer, and their interaction on grain yield of wheat in Saskatchewan, Canada (adapted from Henry *et al.*, 1986).



Annual record keeping that compares input (fertilizer) versus output (yield) is a relatively simple process that can provide valuable information to a farmer on nutrient use efficiency.

The graph above shows trends in fertilizer use per ha and per ton of grain for a farm in Brazil. In this case, fertilizer use per ha increased, but the amount used per ton of crop yield decreased due to the accompanying yield increase.



Excessive use of chemical fertilisers, specifically phosphorus and potassium, which have to be mined from reserves held in rocks and minerals, poses major threats to future food security. The high-energy required for production of synthetic fertilisers make agriculture and soil fertility, in particular, over-dependent on the oil price.

The widespread use of chemical fertilisers and pesticides, are also threatening crops that are dependent on pollination may affect human health negatively. Nitrate levels in water in excess of the upper limit of 50 mg/litre set by the World Health Organization (WHO) are likely to pose health hazards.

Fertilizer contamination also poses the danger of eutrophication of lakes, rivers, and coastal waters, with damaging consequences on aquatic ecosystems. Much of the chemical fertilizers applied to the soil, especially nitrogen, are leached and can easily become pollutants to the underground water. It is estimated that some countries could actually halve the use of nitrogen without negatively affecting the yield.

«Synthetic fertilizers seem to encourage farmers to move away from the more agroecological, knowledge-based and labor-intensive soil fertility management practices, and may have incentivized them to specialize on only a few crops at the expense of developing the vast biodiversity of species available for human food security and nutrition.»

Nonetheless, a judicious use of chemical fertilizers can create the necessary synergistic effect when combined with organic nutrient sources.

- The future of sustainable agriculture is through integrated nutrient management that ensures soil health and increased productivity. We need to find the right balance on intensification that reduces use of chemicals, reduce soil compaction and maintain soil health.
- The only realistic way of sustainable agriculture is to balance chemical and non-chemical control measures by applying integrated pest management (IMP) principles.

REFERENCES

- https://www.ucsusa.org/resources/what-sustainable-agriculture
- https://asi.ucdavis.edu/programs/ucsarep/about/what-is-sustainable-agriculture
- https://www.researchgate.net/publication/6186843_Agricultural_sustainability_Concepts_principles_and_evidence
- https://www.nationalgeographic.com/environment/habitats/sustainable-agriculture/
- https://www.westernsare.org/About-Us/What-is-Sustainable-Agriculture
- https://impakter.com/soil-health-fertiliser-use-agricultural-sustainability/
- http://www.iwmi.cgiar.org/Publications/Other/PDF/ifa_highlights_spl.pdf
- https://www.sciencedirect.com/science/article/abs/pii/S1470160X18302917
- https://www.debatingeurope.eu/2017/06/21/sustainable-agriculture-without-pesticides/#.Xez_kOgzZPY
- https://www.tandfonline.com/doi/abs/10.1080/03601239609372990?needAccess=true&journalCode=lesb20