



The flawed thinking behind the “mimic nature” strategy in crop production

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Organic farming, regenerative agriculture, and agroecology all aim to ‘mimic nature’ under the assumption that natural systems offer the best solutions to challenges in crop production. Here US agronomist Andrew McGuire explains why such an approach is the result of flawed thinking. First, in failing to recognise the fundamental differences between natural ecosystems and human-managed crop production. And second, in the approach’s ‘appeal to nature’, which assumes that natural is inherently good. There is a better way, he suggests: test *all* potential solutions, and keep what is useful.

Organic farming, regenerative agriculture, and agroecology all aim to mimic nature under the assumption that natural systems offer the best solutions to challenges in crop production. A recent special issue of the journal *Outlook on Agriculture* reviewed several such efforts. Developing perennial grains, using biodiversity for pest control, and achieving regenerative agriculture’s goal of restoring soils, all produced mixed results.

We should expect this because the mimic-nature strategy is the result of flawed thinking. First, in failing to recognise the fundamental differences between natural ecosystems and human-managed crop production. And second, in the approach’s appeal to nature, which assumes natural is inherently good.

There is a better way: test *all* potential solutions, keep what is useful.

“Return to Nature” meets reality

We must continue to improve crop production but how should we do this? Organic farming, agroecology, and regenerative agriculture all look to nature for solutions because natural ecosystems have qualities we’d like to see in crop production: stability, tight nutrient cycling, etc. The papers in *Outlook on Agriculture* (see links below) explore several of these “return to nature” efforts and highlight the limitations of the strategy.

Perennial grains don't yield

One approach has been to mimic the perennial polyculture of the prairie by developing perennial grain crops. The goal is to replace annual grain crops with perennial grain crops that both keep their perennial lifespan and produce grain yields similar to annual crops. Though efforts have been ongoing for 30+ years, this has only been recently achieved in rice. For a wheat replacement, the first commercial perennial grain, Kernza, has yields 1/3 that of wheat with declining growth after the first year ([Cassman and Connor, 2022](#)).

[Loomis \(2022\)](#) and others argue that this is because there is a basic trade-off between the carbon and nitrogen needs of the perennial plant and high grain yields; achieving one negates the other. So far, this is what grain breeders have found.

“Based on reports published in refereed journals, we see little evidence that yield of Intermediate Wheatgrass or perennial wheats have improved to the point they are viable alternatives...Likewise, there is no evidence of a decrease in the severity of yield decline in the second and third years after crop establishment.” [Pulleman et al., \(2022\)](#)

Even if successful perennial grains are developed, there is another issue with this natural ecosystem mimicry. As [Lenne and Wood \(2022\)](#) point out, not all natural ecosystems are biodiverse. They present examples of natural monodominant stands of annual grasses, similar to our monoculture stands of grain crops. This undermines the assumption that because nature is biodiverse, higher diversity should always be a goal in crop production.

Pest control benefits of biodiversity are often too small, unreliable

Nature's biodiversity is also viewed as a superior way to manage crop pests. [Van der Werf and Bianchi \(2022\)](#) review the evidence for this and find that while there are many examples of reduced pest problems in intercrops, the level and reliability of this type of pest control is rarely equal to that of pesticides. The authors suggest that using biodiversity-based methods of pest control would only be feasible if society pays farmers for the higher risk of crop losses and pays more for food.

Furthermore, crop rotation ([something which nature cannot do](#)) can provide benefits similar to intercropping, but without the management complications of planting, weeding, harvesting, processing, and marketing involved with intercrops.

“The assumption that our agriculture must then mimic those processes would only be valid if natural ecosystems (including soil communities) had been selected for optimising sustainable yield, for which there is no evidence.” [Pulleman et al. \(2022\)](#)

Restoring soil organic matter to nature's levels is unrealistic

The last example is not so much about mimicking nature as it is about using nature as a standard for fields producing crops. Regenerative agriculture aims to restore soils to their pre-agricultural state, specifically the level of soil organic matter (SOM) found in unmanaged soils. [Powlson et al. \(2022\)](#) examine this goal and find little to support it. Long-term studies in the US, Canada, UK, Germany, Ethiopia, Australia, and Chile show that soil organic matter levels under annual crop production are 38-67% pre-farming levels. While using regenerative agriculture practices may result in

SOM levels at the high end of this range, basic energy flows prohibit reaching pre-agricultural levels [unless yields are reduced](#).

“...for the vast majority of situations globally, it is completely inappropriate to make this a goal for arable [annual cropping] soils as part of a climate change mitigation strategy based on soil carbon sequestration, or any other policy objective.” [Powlson et al., 2022](#)

Agriculture cannot be made into Nature

These examples show the same flawed thinking in the mimic nature strategy: natural ecosystems cannot feed current populations, but crop production does. This is a logical “comparing apples to oranges” flaw called [false equivalence](#). In comparing nature to agriculture, we are comparing different systems with different outcomes, so we should expect them to function differently. To produce food, crop production must work differently to natural ecosystems, which do not produce food. The three examples show how this plays out in different ways:

- Annual crops are not perennial because they put so much energy into their grain.
- To make food more edible for us, we have removed many anti-herbivore strategies from crops – thorns, toxins, etc. Then we fertilise them for high levels of nutritious food. Nature does not present this large, highly edible, high nutrient level source of food for pests.
- Attempting to restore natural soil conditions ignores the [lower carbon/energy flows to the soil under crop production](#), and [the nutrient exports](#), both required trade-offs in food production.

Further evidence for this flawed false-equivalence thinking is evident in the strategies of increasing biodiversity in general, cover crop mixtures, and the limited value of natural ecosystem research to agriculture.

The core problem is the idea that we can make crop production work like nature. This utopian desire is evident in the “epic narratives” ([Cabral and Sumberg, 2022](#)) of mimic-nature champions Masanobu Fukuoka, Wes Jackson, Robert Rodale, and Wendell Berry.

Many, especially those outside of agriculture, have fallen for this enticing story, but it’s impossible. They are different systems with different benefits. Nature is valuable and we should protect it, but it provides little food. Crop production provides bountiful food, which sustains not just our population, but our art, sport, music, technology, etc. We focus on what was lost in the conversion to cropland, but look at what is gained.

Trying to make cropping systems work more like nature will nearly always reduce food production, or its reliability, or increase its cost. Because of this, even when we use methods gained from nature, we cannot expect anywhere near the same results because nature does not provide anywhere near the same amount of food, year after year. There are trade-offs, not win-wins. For these reasons, nature cannot be a consistent model for agriculture.

The flawed “appeal to nature” behind mimic-nature efforts

Beyond the desire to incorporate nature’s qualities into crop production, the mimic-nature strategy assumes we should prefer natural solutions.

This is an “[appeal to nature](#),” the flawed belief that since something is natural, it is also better or good. “Nature knows best” and “the balance of nature” are popular expressions of the idea. It can also be seen in bias against synthetic inputs, as found in [organic farming’s ban on synthetic inputs](#), and in many versions of agroecology and regenerative agriculture.

There is nothing wrong with dividing natural and unnatural. The problem comes when we attach a value to the distinction: natural is good or better than unnatural. Natural is not always better, but this flawed thinking has influenced research and how we talk about solutions in agriculture.

“Even if we can agree that some things are natural and some are not, what follows from this? The answer is: nothing. There is no factual reason to suppose that what is natural is good (or at least better) and what is unnatural is bad (or at least worse).” Baggini, (2004)

Ecology is the science that looks at the relationships between organisms and their environments. However, rather than this sphere of analysis, “ecological” and “agroecological” have become sciency ways of saying “natural.” This too is flawed appeal-to-nature thinking and is not even consistent in its bias against synthetic inputs.

[Birthisel et al. \(2021\)](#) include plastic mulch, tarping, drip irrigation, tillage, fertilizer banding, and flaming under “ecological weed management”, everything except herbicides. Agroecology claims crop rotation, which is unnatural, as an ecological practice under the Diversity principle, yet herbicides are never included, even though allelopathy is natural. Driven by the appeal-to-nature fallacy, ecological and agroecological now imply values, assumptions, and prohibitions. Ecological can mean “green” or “natural” or “chemical-free” or a vague combination of these.

A better strategy: test everything, keep what is useful

As [Denison \(2022\)](#) points out, selecting the useful aspects of nature and throwing out the rest is common, and proves the point that natural is not what we want; useful is what we want. “Copy what works.” When we find solutions in nature, we should use them without assuming that it works because we found it in nature or because it is natural.

This whatever-works strategy is what we find, right now, in all modern “conventional” farming. It holds no bias for or against natural or unnatural; if it works and is cost-effective, it can be used. Conventional production is diversified by including both natural and unnatural methods and materials. Rather than conventional, I like the term [full-toolbox farming](#); we shouldn’t let flawed thinking limit what we have in our toolbox.

A toolbox that contains all useful tools, natural and unnatural, will be larger and more effective than a toolbox limited by flawed “appeal to nature” thinking.

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