

Reducing greenhouse gas emissions from farms – how and why?

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Background

Our atmosphere is changing – the concentrations of greenhouse gases (CO₂, N₂O, and CH₄) have increased sharply in recent decades, largely because of human activities. Worries about a changing climate have sparked a search for ways to curb the emissions of these greenhouse gas emissions.

Agriculture too emits greenhouse gases. My purpose is to contemplate *how* we might reduce emissions from farms, and *why* we might want to do that. Here I look mostly at cropping systems.

How can we reduce emissions?

Agriculture can help reduce greenhouse gas concentrations in two ways: by withdrawing atmospheric CO₂ by storing more C in soils ('C sequestration'); and by reducing its own emissions (especially N₂O).

Carbon sequestration

Soils contain a lot of carbon in the form of organic matter (sometimes called humus). This material is derived from crop residues added to soil over thousands of years, and is continually decaying (converted back to CO₂ by soil microbes) and being replenished (by new additions of plant residues). Since all of the organic matter came originally from CO₂ trapped by plant photosynthesis, any increase in soil carbon means a withdrawal of CO₂ from the air.

The amount of carbon stored in soil can be increased by any practice that either increases the amount of plant material added to soil, or slows the decay of organic matter already in the soil. Some examples of practices shown in to increase carbon at least in some soils include:

- Avoiding summer fallow
- Tilling less intensively
- Increasing yields by better farming practices such as adding optimal rates of nutrients (fertilizers, manures), provided that the residues are returned to the soil
- Including forage crops in rotations
- Planting marginal lands to permanent grass

Reducing N₂O emissions

Nitrous oxide (N₂O) is a gas released naturally through the activity of soil microbes. But the rates of emission are increased if soils contain an excess of plant-available nitrogen. So N₂O emissions may be reduced by practices that improve the efficiency nitrogen use by crops. Some examples of potentially effective practices include:

- Adding amounts of fertilizer and manure nitrogen to just match the amounts needed by the crop. Matching the amounts added to the amounts needed may be helped by soil testing and by applying wisdom gleaned from cropping history.
- Avoiding the addition of nitrogen at a time too far in advance of when the crop needs the nitrogen.

Unfortunately, the science of N₂O emissions from farm fields is not yet very advanced, so we cannot yet predict precisely what methods work best on a given farm, or the extent to which they reduce emissions.

Some precautions

Though many of the practices listed above have been found effective, we should not assume that they will always work; the practices that work best depend on where you are and what else you are doing on your farm. Rather than select individual options, we should think about designing systems (*combinations* of practices) best suited to the farm location and operation. This can perhaps best be achieved by merging the local wisdom of farmers with a scientific understanding of greenhouse gas emissions.

Why should we reduce emissions?

One answer to this question is obvious: to help reduce greenhouse gases in the air. But there is another reason, perhaps even more important: to keep our lands productive, healthy, and profitable. Often, if a farm is emitting excess greenhouse gases, that is a sign of inefficient flows of carbon and nitrogen on that farm. For example, if the soils are losing carbon, that is a sign that the soils are being depleted. Or if there are excess N₂O emissions, that may be a sign of wasted nitrogen. So if we correct these inefficiencies signaled by greenhouse gas emissions, we may be keeping our farms more productive and profitable for years to come.

Conclusion

Reducing greenhouse gas emissions from farms is an important goal. But it should be viewed as one part of a much larger purpose: keep our ecosystems productive, healthy, and without undue harm to water and air. From this perspective, our ability to curtail greenhouse gas emissions becomes, not a goal in itself, but a measure of how well our ecosystems are performing on a changing earth.