Shadows on the Soil - The Hidden Costs of Utility-Scale Solar Developments on Farmland

As farmers, I'm sure you have seen the trends, headlines, and public statements of renewable energy developers touting solar energy as a sustainable solution to our future energy needs. And while the sun may be a friend to our crops, the giant steel panels that harness its rays may be anything but. Utility-scale solar developments on farmland (let alone USDA rated Prime farmland) promise clean energy, but they also come with a less-advertised price: a hefty toll on soil health. Let's pull back the curtain and shine a little light on the reality of what these developments mean for our fields—and our future crops.



Topsoil: Nature's Nutrient Gold Mine

Think of topsoil as the delicate cream filling of a soil-layer cake. It's a nutrient-rich, finely balanced layer that has taken centuries to build, thanks to the ongoing work of microbes, fungi, earthworms, and decaying organic matter. According to soil scientist Rattan Lal, it can take hundreds to thousands of years to naturally form just one inch

of topsoil, which gives you a sense of how precious—and finite—this resource truly is.

Yet when a solar development goes up, this topsoil is often unceremoniously disturbed. The heavy equipment involved in clearing, grading, and installing solar infrastructure can compact and displace it, leading to long-term loss of soil structure, nutrients, and organic matter. Montgomery (2007), in his study published in the Proceedings of the National Academy of Sciences, highlights that topsoil disturbance impacts water retention, root growth, and ultimately crop yields. When that soil is disturbed, it's a little like taking a sledgehammer to a carefully-built sandcastle—the structure falls apart, and what's left is vulnerable to erosion, drought, and nutrient loss.

Compaction: Crushing More than Just Dirt Clods

To support the massive panels and thousands of pounds of steel that make up a solar array, fields are often lined with galvanized steel posts, embedded deep into the soil. Installing these posts is no gentle process; it requires significant force, which can result in widespread compaction. Compacted soil is like a mattress that has seen better days—flattened and dense. While it might not keep you up at night, it's a nightmare for your plants' roots, which struggle to penetrate the ground and access essential nutrients and water.

Studies on soil compaction, like the findings by Herrick et al. (2006) in Journal of Nature Conservation, reveal that compacted soil reduces water infiltration, which in turn limits crop growth. Moreover, compacted soil essentially suffocates the countless beneficial microorganisms that call it home, disrupting the microbial ecosystem that took generations to establish. And unlike your mattress, you can't just flip compacted soil over to get it back to normal.

The Slow Burn of Electromagnetic Fields

As solar energy production ramps up, it brings with it not only steel and glass but also powerful electrical cables, buried just under the surface. These high-voltage lines emit electromagnetic fields (EMFs), which may have unintended effects on the very soil they sit within. Although the jury is still out on the full extent of EMF effects, early studies suggest they may disrupt microbial activity. For instance, Pimentel et al. (1995), published in Science, notes how disruptions in soil microbial communities can limit nutrient cycling and ultimately impact crop productivity.

Think of it this way: soil microbes are like a symphony orchestra, each species playing a part in nutrient cycling and organic matter breakdown. When EMFs

interfere, it's as if the conductor lost their place, leaving the orchestra out of tune. While some may argue that the effects are negligible, farmers reliant on that land know that even small changes in soil biology can have large impacts on crop yield.

Soil Chemistry: When Zinc Goes from Friend to Foe

The steel posts themselves may also be contributing to an unforeseen problem. Galvanized steel, while durable, contains zinc, which can leach into the soil over time. Zinc, in small amounts, is a micronutrient plants need. But like the salt on your fries, too much of a good thing can become, well, toxic.

Excess zinc can lead to stunted plant growth and soil toxicity, disrupting the delicate balance needed for productive land. Farmers have seen firsthand how patches of their fields closest to metal infrastructure yield weaker, less productive crops—a quiet but telling sign of zinc accumulation. Lal's (2003) research in Environment International emphasizes that even small-scale chemical leaching can have prolonged effects on soil health, given how slowly these contaminants are removed from the soil ecosystem.

Shaded Soils: A Dark Dilemma

When fields are blanketed in solar panels, they become shaded, reducing the amount of sunlight that reaches the soil. While some shade-loving plants thrive, many crops do not. Photosynthesis requires sunlight, and without it, plants simply don't produce as much.

But beyond just plant growth, shading has a subtler impact: it alters soil temperature and moisture. Cooler, shaded soil retains moisture differently than sunlit soil, which may sound like a benefit—until you consider the impact on microbial activity. Amundson et al. (2015) in Science describe how microbial life, essential for nutrient cycling, depends on specific temperature and moisture ranges to thrive. Inconsistent moisture levels can disrupt these processes, making it even harder to maintain soil health under solar panels.

So, How Long Does Recovery Take?

Let's say that, hypothetically, a utility-scale solar development is decommissioned and the land is restored to farming. Farmers will still be facing a waiting game. Studies indicate that, depending on the extent of disturbance, it could take 20 to 50 years to restore soil close to its pre-disturbance productivity—and that's with optimal soil management practices, such as cover cropping and organic amendments. Without active management, that timeline stretches even further. As Nearing et al. (2004) describe in Journal of Soil and Water Conservation, soil recovery is notoriously slow, especially when compounded by factors like compaction and chemical contamination.

Not All That Glitters is Green

Leasing farm land is like lending someone your car and getting it back with dents all over it. Sure, you will be getting a check, but when they leave, you are stuck with soil that's compacted, if not stripped, and not ready to grow what you need and at sustainable yields.

Utility-scale solar developments may have a place in our renewable energy future, but their installation on prime farmland comes at a cost that often goes unmentioned. While solar energy itself may be (maybe not) a boon for sustainability, the infrastructure needed to support it can lead to lasting soil health problems—compaction, nutrient loss, chemical leaching, and biological disruption.

As policymakers and communities weigh the benefits of solar energy against its costs, we must consider the value of our soil—the foundation of food security and agricultural livelihoods. After all, the sun might be renewable, but our soil, once disturbed, may never fully recover. So, the next time you see a field of shiny new panels, remember: there's more beneath the surface than meets the eye.