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**Comments on the Soil Enrichment Protocol from World Resources Institute's Food Program**
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To Whom It May Concern:

The World Resources Institute recently published the *World Resources Report: Creating a Sustainable Food Future* (www.sustainablefoodfuture.org), in partnership with the World Bank and the UN. The report highlights a range of potential agricultural mitigation strategies to meet global climate targets while feeding 10 billion people by 2050. In this report, we analyzed the literature surrounding claims of the mitigation potential of soil carbon sequestration and found many uncertainties limiting its potential benefit at scale. Having reviewed the Soil Enrichment Protocol Guidance document, our comments regard the following three topics:

- Uncertainty regarding leakage of food production (and carbon) due to changes in yield for both livestock and crops
- Incomplete carbon accounting with regards to counterfactual uses of soil amendments (e.g., crop residues and manure)
- Uncertain benefits with regards to the permanence of sequestration from no-till

**Uncertainty Regarding Leakage and Yields:**

The guidance document cites a meta-study claiming that a long-term credit system would "erase [any] short-term potential yield declines." However, a study from SYSTEMIQ, which cites a 2015 paper by the same author (Pittelkow) finds that no-till results in yields of 86%-101% relative to baseline (i.e., a range of yield decline to slight yield gain). The 2014 paper from Pittelkow that is cited in the SEP guidance document reached the conclusion that "the potential contribution of no-till to the sustainable intensification of agriculture is more limited than often assumed," and "overall, [their] results show that no-till reduces yields, yet this response is variable and under certain conditions no-till can produce equivalent or greater yields than conventional tillage." We find that, given the uncertainty and highly circumstantial nature of yield benefits as determined in Pittelkow, 2014, and the mixed yield effects found in other studies summarized in Table 8 of the linked SYSTEMIQ paper, assuming no loss in yields and thus not accounting for leakage (i.e., carbon losses elsewhere to replace foregone food production where yields fall) is inconsistent with the evidence in the literature.

Along those lines, we also find that the concept of monitoring livestock leakages through "animal-grazing days" should be supplemented with a consideration for the change in beef or dairy produced per hectare. Animal production is not just a function of grazing days, but also population and feed quality (which affects amount of weight gain per day). Thus, feed quality and product output should also be monitored in addition to feed consumed through grazing.

We feel that "you can't manage what you don't measure." By that logic, if the goal is to encourage efficient agricultural production, accounting for leakage due to yield changes would do just that.

**Incomplete Carbon Accounting:**

We recently published a blog based on the findings of the World Resources Report, which focused on the need for more strict carbon accounting of the indirect impacts of soil amendments. Manure is filled with the carbon and nutrients absorbed originally by plants and eaten by animals. For that reason, adding manure to a

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field increases soil carbon where it is applied. But because there is a limited supply of manure in the world, using it in one place almost always means taking it from elsewhere, so no additional carbon is added to the world's soils overall (and there is no additional climate benefit). The global supply of crop residues is also limited. For example, if residues were previously used as animal feed and are now used to increase soil carbon on a farm, farmers may need to expand cropland into forests or grasslands to replace the animal feed, releasing carbon stored in these natural ecosystems' soils and plants.

Converting cropland to grazing can build soil carbon, and might be advisable where cropping is marginal. But if the crops replaced by grazing are ultimately grown elsewhere by cutting down forests or grasslands, it can result in a net increase in greenhouse gas emissions or at least reduce the climate benefits of the conversion from cropland to grazing. The failure to count these off-farm effects especially matters if soil carbon benefits are claimed as carbon offsets.

**Uncertainty of No-Till:**

We feel that a discussion on the impermanence of benefits of no-till is necessary. No-till farming, along with many other practices mentioned in this document, undoubtedly has benefits with regards to soil health. However, researchers have found that in many areas where no-till is practiced, farmers also plow up their soils at least every few years, reversing most, if not all, of any short-term carbon storage benefit. While we recognize that your guidance document deals with permanence and monitors for reversals, more emphasis on ground-truthing with physical samples to a depth of 1 meter rather than remote and modeled monitoring of the top 30 cm would greatly improve the validity of any results, and would better capture long-term trends.

**In conclusion**, while we recognize the benefits of building soil carbon for soil health and other environmental benefits, we are skeptical of its potential for large-scale GHG emissions reductions. Soil carbon sequestration with uncertain impacts on yields in a world with ever-increasing food demand could have significant off-farm carbon impacts (e.g., exacerbating agriculture's expansion into forests) that would not be counted under this current framework. Off-farm carbon impacts of any soil amendments should also be accounted for. Finally, monitoring of practices (e.g., no-till) over time and their real-world (not just modeled) effects on soil carbon will be necessary to ensure that the program delivers benefits not only for soil health but also for the climate.

Thank you for the opportunity to comment on this document, and we look forward to discussing these points in greater detail.

Sincerely,

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