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Letter to the Editor

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Response to the Letter to the Editor Regarding Our Viewpoint "Sequestering Soil Organic Carbon: A Nitrogen Dilemma"

We welcome the response by Soussana et al.[1] to our viewpoint article; it is important to have a broad discussion within the scientific community on the feasibility and nature of the 4p1000 goal. In particular, we welcome the explicit acknowledgment that the 4p1000 goal should be recast as "aspirational", rather than actually achievable in a quantitative sense, as originally stated. Although this may be an increasingly common realization within the scientific community, it is certainly not common knowledge within the policy-making community and appears to represent a shift from the wording at the official 4p1000 site (http://4p1000.org). We suggest that the Web site wording be made clearer.

We disagree with the statement by Soussana et al. that the 4p1000 goal is already sufficiently spatially diversified because it is related to the local soil organic C (SOC) stock. This implies that soils with a large SOC stock will normally have a larger nitrogen (N) (and phosphorus, P) surplus than those containing less SOC. We fail to see the rationale for their statement in two ways. First, at the global scale, many soils with a large SOC stock will be (extensively) grazed grasslands,[2,3] which typically have small inputs of N[4] and P inputs and small surpluses. In contrast, many intensively managed arable soils, which typically have lower SOC stocks,[5] have large inputs of N and P leading to large surpluses.[6] Second, in general, soils with a low SOC stock (e.g., old arable soils, degraded lands, mine wastes) have greater potential for increasing SOC than soils with high SOC stocks.[7,8] Focusing C sequestration efforts on these soils would seem advantageous, both for climate change mitigation and for improving soil quality.[9]

As Soussana et al. state, the aspirational 4p1000 goal is an incentive for more judicious soil management that may reduce N losses from the soil, through for example planting cover crops and legumes as well as implementing measures to reduce soil erosion. We welcome these efforts which certainly would contribute to increased C storage and improved soil quality, but as we argued in our viewpoint article, the additional N required to meet the 4p1000 goal is so high that it is impossible to reach the goal with these measures.

We agree with Soussana et al. that not only N but also P plays an important role with respect to the 4p1000 goal. Whereas it is true that legumes are often better able to acquire P from P-depleted soils than cereals and vegetables, we are not aware of any conclusive evidence in the literature that this would contribute substantially to the 4p1000 goals. There is certainly a need to study the interactions between P availability, plant growth and C sequestration for a range of crops. Nutrient (N or P) limitations to C sequestration cannot be ignored.

The 4p1000 aspirational goal is a powerful reminder of the enormous importance of soil. It should serve as a wake-up call for judicious soil management. However, as a soil scientific community we have to be careful not to oversell our story as we might have done in the past (e.g., by overpromoting the benefits of soil biochar amendment) as it may hurt our credibility and work counter-productively.[9] The good news is that there is no need for that, as the case for increasing soil carbon storage, preventing soil erosion, and improving soil quality, is strong enough as it is.

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