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What is the Nutrient Value of Lost Organic Matter by Erosion?

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Abstract
The loss of organic matter and its nutrient value by erosion has significant effect on both the long-term sustainability of the soil nutrient pool and soil productivity. Nutrient availability in the soil to plants is inherently linked to the soil organic matter pool that is replenished through plant-animal-soil-atmosphere interactions, creating different pools of organic matter. These different carbon pools play a significant role in providing nutrients to plants through the decomposition process by the soil microbial community over time (Fig. 1). Thus, loss in soil productivity cannot be decoupled from the loss of organic matter. The removal of soil organic matter through erosion and its associated economic cost far exceeds the estimated cost of the primary nutrient components of the soil: nitrogen, phosphorous, and potassium. Soil organic matter lost to soil erosion contains not only these three primary nutrients, but also other macro and micro nutrients that need to be factored into the calculation of determining the cost of organic matter loss as a nutrient source. Therefore, any attempt to determine the value of nutrient loss, has to take into consideration the long-term impact on soil productivity.

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The loss of organic matter and its nutrient value by erosion has significant effect on both the long-term sustainability of the soil nutrient pool and soil productivity. Nutrient availability in the soil to plants is inherently linked to the soil organic matter pool that is replenished through plant-animal-soil-atmosphere interactions, creating different pools of organic matter. These different carbon pools play a significant role in providing nutrients to plants through the decomposition process by the soil microbial community over time (Fig. 1). Thus, loss in soil productivity cannot be decoupled from the loss of organic matter. The removal of soil organic matter through erosion and its associated economic cost far exceeds the estimated cost of the primary nutrient components of the soil: nitrogen, phosphorous, and potassium. Soil organic matter lost to soil erosion contains not only these three primary nutrients, but also other macro and micro nutrients that need to be factored into the calculation of determining the cost of organic matter loss as a nutrient source. Therefore, any attempt to determine the value of nutrient loss, has to take into consideration the long-term impact on soil productivity.

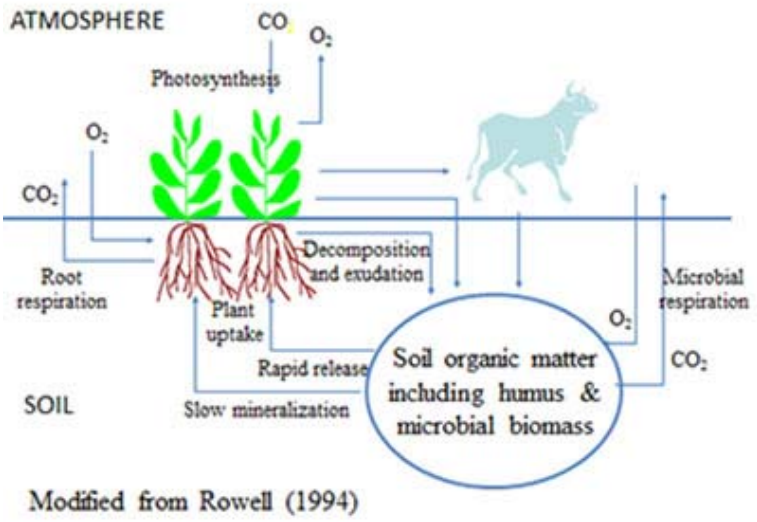

Fig. 1. Soil carbon cycle.

The question that is always asked, “What is the value of organic matter as nutrient source?” To determine the economic value of nutrient loss with organic matter, a market value of a similar composition of a fertilizer source close to the soil organic matter can be used. The best reference source of nutrient value is organic fertilizer from animal manure (i.e., liquid or dry manure).

To calculate the nutrient loss per one ton of soil lost to erosion, the following

assumptions and calculations can be used:

1. Let's assume there are two soils types with organic matter contents of 3% and 5%.
2. Let's also assume the organic matter nutrient value is $0.10/lb (based on the nutrient value of a manure source, which can be higher depending on the hauling distance, application cost, etc.). We chose manure as a reference rather than commercial fertilizer, because liquid or dry manure contains the primary nutrients and other macro as well as micro nutrients. In addition, manure possesses properties that enhance the building of soil quality and improves soil organic matter.
3. **To calculate the cost of nutrient loss by soil erosion based on the above assumptions, the following example is provided:**
    1. **One ton of soil=2,000 lb of soil minerals and organic matter.**
    2. **Amount of organic matter per/one ton or 2000 lb of soil:**
       for 3% O.M.= 0.03 x 2000 = 60 lb of organic matter
       for 5% O.M.= 0.05 x 2000=100 lb of organic matter
    3. **The value for 3% OM =60lb x $0.10 = $6 per ton of soil loss**
       for 5% OM=100lb x $0.10 =$10 per ton of soil loss
    4. **If the soil loss is 5 tons/acre, then the total nutrient loss per acre for each of the two soil types:**
       for 3% and 5% organic matter content, respectively, will be equivalent to $30 and $50 per acre ($6 x5 tons/acre or $10 x 5 tons/acre).

These calculations are an estimate of the nutrient loss, which highlight the economic loss in the short as well as in the long-term of soil productivity. However, the economic value of nutrient loss from soil erosion needs to be coupled with the loss of soil productivity at least in the near term, but it can be permanent from long-term perspectives. The reason for loss of soil productivity stems from the changes and degradation that occur in the physical, biological and chemical properties of the soil, which affect long-term productivity, and impact crop production regardless of how much chemical fertilizer is applied. Also, the loss of organic matter will lead to an increase in input cost of nutrients applied as chemical fertilizer to mitigate or manage the loss of soil productivity.

The economic value of nutrients lost due to soil erosion is only a small indicator of the problem with far reaching effects on soil productivity. Thus, there is continued need and an on-going effort for comprehensive soil conservation measures to improve and sustain soil health and productivity. In addition to the immediate cost of fertility loss from soil erosion, the long-term cost to society in terms water quality and other environmental risks can be significant.

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