

Ecosystem Services on Connecticut Tobacco Farms

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What are Ecosystem Services?

Farmers across New England have a conservation ethic at the core of their everyday work; sustaining the land for future generations and growing food to sustain themselves and their neighbors are things farmers constantly have at the front of their minds. By continuing and expanding this conservation work, farmers can take advantage of considerable environmental benefits. These *ecosystem services* — things like increased soil water holding capacity, nutrient retention, and carbon sequestration — can provide benefits directly to farmers and their neighbors. In the past two years, New England has experienced historic rainfall and drought. Managing land as a system to enhance its functioning and take advantage of these ecosystem services, valuable in-and-of themselves, is becoming more critical to improving on-farm resilience.

In the face of increasingly unpredictable weather conditions, ecosystem services can help to enhance crop resilience in the face of drought and heavy rains. By managing land to increase soil organic matter, farmers also increase a soil's water holding capacity. Research has shown that for each 1% increase in organic matter, soils can hold up to 3.7% more water (Hudson, 1994). This increase sounds small, but it can be as high as 50,000 gallons of water. Increased soil water holding capacity helps to mitigate the negative effects of extreme weather; crops can go longer between rains, and soils can handle heavy rainfalls better. It also means that more rainwater can infiltrate into the soil before it is saturated. There is a limit to this resilience, however. No soil can withstand the heaviest of rains or driest of droughts.

Many conservation practices improve nutrient retention over winter. As water moves through the soil profile while nothing is growing in it, nutrients are transported into ground or surface water and away from the fields where they are needed. Planting cover crops can help to hold nutrients in place, especially water-soluble nutrients like Nitrogen (N). Reduced tillage can help improve aggregate

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stability to help hold nutrients tightly bound to soils in place. As input costs continue to increase, finding ways to keep nutrients on fields, where they are needed, improves a farm's financial resilience in addition to the water quality benefits shared throughout the watershed. Though conservation practices have the potential for on-farm benefits, they are not without risks. Things like increased pest pressure and nutrient tie up are possible without careful planning. It is important to consider these implications when you are thinking about which practices are worth trying.

Ecosystem services are often *hidden benefits* of conservation practices. Advantages like reduced input costs, avoided losses, and off-farm benefits, like water and air pollution reduction, can be hard to estimate, may not materialize in the first few years of implementation, and in the case of off-farm effects, may not benefit you directly.

Programs offered by state, federal, and private sources can help to offset the risks in the early years of conservation practice adoption. Some examples include opportunities for farmers to take advantage of federal cost-share programs, or new programs that compensate farmers based on ecosystem services. . Regional credit programs are being piloted that pay farmers for specific things like carbon sequestration or for ecosystem services in general. Not all conservation practices will fit every farm. Talking with your trusted advisors is a great first step to learn more about existing funding opportunities.

Tools

Because ecosystem services can be difficult to conceptualize, it is important to use tools to estimate the impact conservation practices can have on your farm. There are many different data-based tools that exist to help. Simple to use tools like COMET-Planner provide general insights into potential carbon sequestration, and complex ones like COMET-Farm can provide more specific information on nutrient and sediment loss. The more complex a tool is, the greater input of time and information is required. COMET-Planner estimates can be generated in a few minutes — all you need to input is field size, type of cropland, conservation practice and location. COMET-Farm, designed to model a specific farm in a specific place, requires much more information. Crop rotations, soil types, amendments, nutrient applications, etc., are required in order to generate estimates. Site-specific information makes these estimates better, and more complex tools like this one are used when generating credits for sale.

COMET-Planner was developed by Colorado State University and the Natural Resource Conservation Service as a planning tool to identify the potential benefits of implementing conservation practices. The values provided by the tool are based on type of crop production, state, and county, but do not include any site-specific information like soil series. Tables 1 and 2 below show COMET-Planner sequestration and emissions reduction estimates for a 100-acre field (as an “average” tobacco field) and for 2,000-acres (close to the total acres in tobacco cultivation in CT). Based on these estimates, adoption of all the practices included in Tables 1 and 2 across all 2,000 acres of tobacco production in CT represents the potential to sequester 3,115 metric tons of carbon dioxide equivalents (CO₂e). That’s the equivalent of taking 727 cars off the road.

AFT has produced a helpful webinar series that covers 14 different tools used to model farm outcomes and ecosystem services. Some of these are region specific and will not be particularly helpful for Connecticut farmers, but deep dives on COMET-Planner, COMET-Farm, the NTT, and several others may be helpful. More information can be found on the [“Guide to Outcomes Estimation Tools”](#) landing page (AFT, 2024). Some tools are focused on economic outcomes, like the NRCS Cover Crop Economics Tool, and others are focused on greenhouse gas reductions, like COMET-Planner. Taking time to explore these resources before collecting all the information needed will save time in the long run.

Social Cost of Carbon

To wrap our heads around the value that ecosystem services provide, using carbon dioxide equivalents (CO₂e) and assigning a dollar value to them can be particularly helpful. CO₂e puts the main gases with warming potential on the same level. As an example, methane has 27-30 times the global warming potential of CO₂, so we can take this into account in our estimations and weight 1 ton of methane as 27-30 tons of CO₂. Unfortunately, the estimations of value for CO₂ and other greenhouse gases are incredibly varied. So much of this variability comes from how uncertainty and permanence are accounted for. Especially in agricultural systems, permanence is challenging — farmers need to be able to adapt to changing conditions to remain profitable and stay in business. Storing carbon in soil also provides benefits not captured in the value of carbon alone, ranging from improved soil organic matter

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to reduced farm equipment emissions. For these reasons, looking just at carbon values in carbon markets does not provide a full picture of potential benefits.

To address this uncertainty, the social cost of carbon attempts to capture all the benefits of reducing CO_{2e} emissions and costs of increasing them. Values are higher than many carbon markets pay, because the social cost of carbon attempts to capture many externalities. The EPA (2023a) produced estimates of the social cost of several greenhouse gases, carbon dioxide (CO₂), nitrous oxide (N₂O), and methane (CH₄). For greenhouse gas reductions between 2020-2030, CO₂ is valued between \$120 and \$340 per metric ton, CH₄ is valued between \$1,300 and \$2,300 per metric ton, and N₂O is valued between \$35,000-\$87,000 per metric ton (EPA, 2023a). In future decades, this value will increase, as it becomes even more important to avoid emissions. Based on these estimates for the social cost of carbon, greenhouse gas reductions on tobacco farms in Connecticut that adopt all the practices in table 2 could be valued between \$373,800-\$1,059,100. Not all these practices are practical to adopt at once, however. If we consider reduced tillage alone, the same farms could generate between \$46,680-\$132,260 in ecosystem services.

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Values from COMET Planner

Table 1: COMET Planner Estimated Carbon Sequestration Values for 100 Acres

| Practice | Carbon Dioxide (metric tons) CO ₂ | Nitrous Oxide (metric tons) N ₂ O | Methane (metric tons) CH ₄ | Carbon Dioxide Equivalent (metric tons) CO ₂ e | Typical Passenger Vehicle Equivalence (# of cars per year) |
|--|--|--|---------------------------------------|---|--|
| Non-Legume Cover Crop (Non-irrigated) | 9 | (-1) | 0 | 8 | 1.74 |
| Non-Legume Cover Crop (No till non-irrigated) | 3 | 15 | 0 | 18 | 3.91 |
| Reduced Tillage (non-irrigated) | 19 | 1 | 0 | 20 | 4.35 |
| No-till (from intensive till, non-irrigated) | 41 | 4 | 0 | 45 | 9.78 |
| No-till (from reduced till, non-irrigated) | 28 | 3 | 0 | 31 | 6.74 |
| Improved N Fertilizer Management – Non-irrigated | Not Calculated | 0 | 0 | 0 | 0 |
| Replace Synthetic N Fertilizer with Compost (25 C:N ratio) | 41 | (-5) | 0 | 36 | 7.83 |

*CO₂e values generated by COMET-Planner on February 18, 2024. Number of cars per year calculated using reference EPA, 2023b.

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Table 2: COMET Planner Estimated Carbon Sequestration Values for 2000 Acres

| | Carbon Dioxide (metric tons) CO ₂ | Nitrous Oxide (metric tons) N ₂ O | Methane (metric tons) CH ₄ | Carbon Dioxide Equivalent (metric tons) CO ₂ e | Typical Passenger Vehicle Equivalence (# of cars per year) |
|---|--|--|---------------------------------------|---|--|
| Non-Legume Cover Crop (Non-irrigated) | 187 | (-20) | 0 | 167 | 36.30 |
| Non-Legume Cover Crop (No till non-irrigated) | 69 | 136 | 0 | 205 | 44.57 |
| Reduced Tillage (non-irrigated) | 371 | 18 | 0 | 389 | 84.57 |
| No-till (from intensive till, non-irrigated) | 824 | 73 | 0 | 879 | 191.09 |
| No-till (from reduced till, non-irrigated) | 559 | 65 | 0 | 624 | 135.65 |

*CO₂e values generated by COMET-Planner on February 18, 2024

Taking relatively small steps can provide significant benefits to your farm, even if they are not always captured in revenue. Reducing fuel and equipment wear-and-tear costs through minimizing field passes for tillage, carrying remaining nutrients forward from year-to-year, and improving the soil's water holding capacity are all ecosystem service benefits that can be realized by adopting conservation practices.

Local offices can play an important role in helping to think through practice adoption and connect with relevant resources. The [North Central Conservation District](#) and the [CT NRCS office](#) can be great resources to connect with programs. The [CT Agricultural Experiment Station](#) has been running no-till trials, breeds new tobacco varieties, and can provide guidance on pest and disease issues.

References

- AFT. (2024). *Guide to outcome estimation tools*. AFT. [Guide to Outcomes Estimation Tools - American Farmland Trust](#)
- EPA. (2023a). *EPA report on the social cost of greenhouse gasses: Estimates incorporating recent scientific advances*. EPA.
- EPA. (2023b). *Greenhouse gas emissions from a typical passenger vehicle*. EPA.
<https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>
- Hudson, B. (1994). Soil organic matter and available water holding capacity. *Journal of Soil and Water Conservation*. 49(2) 189-194.