

# MoCo Sequestration WorkGroup

## Agricultural Methods & Solutions

### About

This document has been created and developed by Dorcas Robinson, Betsy Taylor, Doug Boucher, Ellen Gordon, Mike Turner, Cynthia Mackie, Evan Notman, and Sylvia Tognetti. It is based on multiple discussions and builds heavily on a workgroup meeting on November 19, 2019 focused on Agricultural Methods and Solutions for sequestration, facilitated by Sara Via.

## Agriculture for 'Carbon Farming,' Healthy Soil, and Resilience

### Overview

Protecting and restoring agricultural soils in Montgomery County can help address the climate threat while achieving many other co-benefits. Changes in land management, combined with farmland conservation and broader efforts to reduce greenhouse gas emissions, can help Montgomery County achieve its net zero emission target by 2035, and the commitment to remove excess carbon from the atmosphere<sup>1</sup>.

Increasingly referred to as 'carbon farming', actions to sequester carbon are critical and complementary to strategies for reducing emissions of GHGs through agricultural production. The concept of climate-smart agriculture (CSA) provides a framework for taking a comprehensive approach to agriculture as a driver of emissions, opportunity for carbon sequestration and a focus for important adaptation actions (e.g. to protect food and nutrition security). The UN's Food and Agriculture Organization (FAO) is a leading proponent of CSA<sup>2</sup>, which integrates the economic, social and environmental dimensions of agriculture, with the aim of:

1. Sustainably increasing agricultural productivity and incomes;
2. Adapting and building resilience to climate change
3. Reducing and/or removing greenhouse gases emissions, where possible.

All agricultural production produces a level of emissions. Depending on the type of practices used to reduce emissions and sequester carbon, *net* agricultural emissions can be significantly reduced, and some land-use and agricultural practices may enable farming to act as a net carbon sink in some contexts. The actions associated with carbon farming can also support economic resilience and profitability of the farms, key to incentivizing the adoption of these practices. These changes are also vital for enhancing ecological and social resilience as people and places adapt to the impacts of climate change (e.g. healthy soils support better water management, and more productive and nutritious crops).

### How does it work?

Plants take in carbon dioxide, extracting it from the air by photosynthesis to make roots, stems, and leaves. Through processes involving plants and microorganisms, the carbon is then transferred to the soil. Living organisms and fresh organic matter provide short term carbon storage, and a small percentage becomes persistent carbon that can reside in the soil for decades, centuries or even millennia, providing long term carbon storage. The amount of soil organic carbon stored in a given soil is dependent on the equilibrium

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<sup>1</sup> Montgomery County Council, Emergency Climate Mobilization, [Resolution 18-974](#), December 2017.

<sup>2</sup> [Climate Smart Agriculture Sourcebook](#) (2013), FAO

between the amount of carbon entering the soil and the amount of carbon leaving the soil from respiration. Soil respiration is a measure of carbon dioxide released from the soil from decomposition of organic matter by soil microbes and respiration from plant roots and soil fauna. As long as we are sequestering more than we are respiring, we are storing carbon to help cool the planet. Historically, we have lost an estimated 133 gigatons of carbon from our global lands. The United States is #2 after China with its biophysical potential to sequester carbon and put carbon back into the land where it will help increase yields, retain water in the soil, and bolster plant resilience.

Arbuscular mycorrhizal fungi are essential for moving carbon into soil. The most common mycorrhizal fungi are marked by threadlike filaments called hyphae that extend the reach of a plant, increasing access to nutrients and water. These hyphae are coated with a sticky substance called glomalin, discovered only in 1996, which is instrumental in soil structure and carbon storage. The U.S. Department of Agriculture advises land managers to protect glomalin by minimizing tillage and chemical inputs and using cover crops to keep living roots in the soil.

“Rebuilding soil organic matter on a global scale is essential for food, water, and climate security. The multiple benefits of healthy soil are incalculable for: improved crop yields; a greater availability and variety of nutrients in food; increased retention and supply of fresh water; and, as more carbon is stored in soil, reduced greenhouse gases in the atmosphere. Soil erosion is an issue of global concern and widespread disregard for soil as the basis of our food system has led to desertification, hunger, and climate instability. Conversely, rebuilding soil health by increasing its carbon content will make communities more resilient in the face of escalating climate-related challenges<sup>3</sup>”

## Practices for carbon farming in agriculture

The United States Department of Agriculture (USDA), in part through the [National Resources Conservation Services](#) (NRCS), provides guidance and tools for the agricultural and land use practices that can be used to sequester carbon, including the [COMET-Planner](#) (with Colorado State University) for evaluating the carbon sequestration and GHG emissions reductions from adopting NRCS conservation practices.

However, the USDA’s approach to climate change and the food and agriculture system focuses on applying the more commonly used conservation practices. **Montgomery County must be significantly more innovative and ambitious in order to reach the bold targets of the Climate Action Plan.** For example, there are a number of exciting research and learning initiatives that are demonstrating the added value of other key practices, such as applying organic soil amendment (compost) as seen in the example of [Marin County](#), California<sup>4</sup> and integration of high sequestering and high revenue nut trees into ag lands.<sup>5</sup>

At the Maryland state level, a number of the NRCS practices are already used and incentivized for their water quality benefits, to reduce nutrient flows into the Chesapeake Bay. A menu of recommended practices, accompanied by estimates of GHG reductions from agriculture, developed by Dr Sara Via at the

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<sup>3</sup> [http://www.centerforfoodsafety.org/files/soil-carbon-pamphlet\\_finalv2\\_88688.pdf](http://www.centerforfoodsafety.org/files/soil-carbon-pamphlet_finalv2_88688.pdf)

<sup>4</sup> Reduction of food and green waste in landfills reduces methane emissions while providing key inputs for compost production. In 2019, the Urban Sustainability Directors Network, Carbon Neutral Cities Alliance, and C40 each identified and launched a new “game changing” effort to capture municipal and suburban green and food waste to generate compost for application on nearby agricultural land to improve soils and sequester carbon. Montgomery County could join the USDN initiative to gain key knowledge on ramping up composting in the county.

<sup>5</sup> <http://www.savannainstitute.org/>

University of Maryland, using Comet Planner<sup>6</sup>, is included as [Appendix K](#) in the Maryland [2019 Greenhouse Gas Emissions Reduction Act Draft Plan](#). These practices are supported by the Maryland Healthy Soils Act, and recognition of the carbon benefits is likely to be included in a broadening of the [Maryland Agricultural Water Quality Cost-share \(MACS\) Program](#). Additional practices are being identified by NRCS, the state of California, and others.

## **The potential contribution of agricultural carbon farming to sequestering carbon in MoCo**

Montgomery County has 558 farms and 350 horticultural enterprises.<sup>7</sup> There are a range of farms from commodity grain, soybean and corn growers to diversified vegetable farms, horse farms and plant nurseries, among others.<sup>8</sup> There are many agricultural land-uses practiced in MoCo. Each type of farm has some potential to sequester carbon. For example, many acres of the County are dedicated to horse production. Proper management and composting of horse manure<sup>9</sup> as well as silvopasture (adding trees and shrubs to grazed pastures > 20 plants per acre) could contribute a minimum of 1.34 Mt in CO<sub>2</sub>e/ acre/ year, according to the estimates generated by Dr Via (just from silvopasture.) According to recent modeling by Colorado State, the County's agricultural lands in commodity crops could sequester on the order of two tons CO<sub>2</sub>-e/ha/yr with basic conservation agriculture practices. Adding conservation buffers - narrow strips of land in permanent cover of perennial grasses - could double this estimate. Adding additional practices such as compost applications or selective silviculture would increase the sequestration further.

## **Realizing the potential contribution: important considerations and potential partners**

In order to maximize the potential of soil carbon sequestration through agriculture, the County needs to get a firmer picture of current baseline carbon in the soil and recognize that farming practices will only shift with technical and educational support, and in some cases, with financial incentives at least for a period of transition. Many farmers struggle to sustain profitable operations in the face of changing trade and farm policies and escalating climate impacts. We need farming to be and remain viable, and to be part of the MoCo economy; this was a key rationale for forming the Agriculture Reserve in 1980. The actual uptake of these conservation and farming practices, depends on the willingness and ability of farmers to integrate them. It is critical that relevant incentives are in place at the levels needed to promote rapid adoption<sup>10</sup>. Increased support for carbon farming technical assistance, including equipment (through grants or cooperative exchanges) and farmer-led demonstration and training is also vital. The County could explore partnerships with Annie's Organics and other companies paying farmers a premium for regenerative, organic practices.<sup>11</sup>

- **[The MoCo Office of Agriculture](#)**: The Agricultural Advisory Committee; Agricultural Preservation Advisory Board; Montgomery Soil Conservation District Board of Supervisors, are important potential leaders in integrating sequestration into the mainstream of MoCo agriculture in the coming

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<sup>6</sup> <http://www.comet-planner.com/>; [http://bfuels.nrel.colostate.edu/beta/COMET-Planner\\_Report\\_Final.pdf](http://bfuels.nrel.colostate.edu/beta/COMET-Planner_Report_Final.pdf)

<sup>7</sup> <https://www.montgomerycountymd.gov/AgServices/agfacts.html>

<sup>8</sup> <https://www.montgomerycountymd.gov/agServices/Resources/Files/Ag%20Census/cp24031.pdf>

<sup>9</sup> [https://www.marincounty.org/-/media/files/departments/pw/mcstoppp/residents/a\\_horse\\_keepers\\_guide\\_to\\_compost.pdf](https://www.marincounty.org/-/media/files/departments/pw/mcstoppp/residents/a_horse_keepers_guide_to_compost.pdf)

<sup>10</sup> 'We need to make it so that farmers make more money drawing down carbon than generating emissions'. Comment from workgroup member.

<sup>11</sup> <https://www.annies.com/regenerative-agriculture/>

few years. The opportunity is for a robust process of learning and consultation with these groups around how to realize the scale of MoCo's sequestration capacities in agriculture.

- **MoCo and Maryland NGO partners** - Maryland has a growing number of non-profit organizations dedicated to helping advance soil carbon sequestration. Future Harvest, Fair Farms, Chesapeake Bay Foundation, American Farmland Trust, Montgomery Countryside Alliance, Institute for Local Self Reliance, Sugarloaf Citizens' Association and others can help advance this agenda.
- **The Agricultural Reserve:** The 93,000 acres in the protected County Agricultural Reserve - almost a third of the County's land resources - includes both private and public lands. The opportunity to advance carbon farming and land stewardship for climate mitigation, adaptation, and rural economic development is significant. The County must also factor in new research<sup>12</sup> that includes dire warnings about potential disruption of global food supplies. The Ag Reserve must be protected for local food security.<sup>13</sup> This makes it critical to protect and even expand the Agricultural Reserve, and to focus on land-use within the reserve. Further, the carbon farming practices that sequester carbon also protect pollinators, secure water resources, and after a period of transition, increase yields for producers. There are synergistic opportunities for promoting native and diverse species, supporting pollinators that are crucial to a secure food web, bird conservation, and to biodiversity.
- **Mapping and building understanding of agricultural land-use in MoCo:** It will be important to more clearly map how much land is under agricultural management, and the type of agriculture that is practiced to inform potential land-use changes<sup>14</sup>. Only about 1% of MoCo crop land is used for orchards, and another 1% for vegetables. On the other hand, 38% is used for corn, 34% for soybeans, 21% for hay and haylage, and 11% for wheat, with the standard rotation being among corn, soy and winter wheat (USDA, 2019, *Census of Agriculture 2017*) In contrast, 70% of land in Maryland is used to grow crops for animal feed and biofuel. A serious commitment to both sequestration and to food security and resilience will require active efforts to transform how land is used over the coming decade (e.g. emphasis on [multi-tier restoration agriculture](#); e.g. potential to [transform food waste into compost at scale](#)). In this context, diversified systems also have a greater per acre potential for soil carbon drawdown.
- **MoCo residents as tax-payers, workers, consumers, and impact investors in the local food system:** Engage people in the challenges and opportunities for strengthening the role of farmers and agriculture as a critical climate solution (reduce emissions, increase sequestration, enhance resilience). Studies such as [What our region grows to eat and drink](#) (Metropolitan Washington Council of Governments, 2019) and [2019 Chesapeake Foodshed Assessment](#) make important recommendations related to valuing and deepening engagement with the local food system, including promoting people's purchase of local foods and investing in agriculture workforce development. Since the Montgomery County Food Council is already working on plans for the local food system and they are a major stakeholder, they can be tapped as partners to analyze and create local production and procurement plans. By incentivizing local production of more food for human consumption, MoCo can also reduce the transportation climate impacts of global food chains, and enhance food security resilience through greater diversity in food sources.

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<sup>12</sup> <https://www.ipcc.ch/srccl/>

<sup>13</sup> <https://www.nytimes.com/2019/08/08/climate/climate-change-food-supply.html?auth=login-email&login=email>

<sup>14</sup> [MCATLAS](#) provides maps of MoCo e.g. soils are under Environmental Features. Also Mike Scheffel from the MoCo Office of Agriculture is a key resource.

## A vision, goal, and objectives for sequestering carbon through agriculture

### Vision

**Draft Vision Statement** : Agriculture remains essential to a prosperous and healthy county by producing food, contributing to our economy, increasing resilience to the impacts of climate change, preserving our rural legacy and storing carbon. The crown jewel is the Agricultural Reserve, a 93,000 acre landscape of both private and public lands for farming, open space, land conservation, rural lifestyles and source-water protection. In order to respond to the climate crisis, Montgomery County should accelerate the adoption of healthy soil and other climate smart practices in the Agricultural Reserve. It should also take concrete steps to strengthen the beneficial linkages between county consumers, businesses, community college campuses, investors, and farms - bolstering a circular regional economy. Above all, MoCo must avoid additional conversion of agricultural land to development.

We envision MoCo as a national leader advancing regenerative agriculture, expanding conservation farming, and demonstrating the beneficial sequestration and adaptation impacts of newer practices such as silviculture, composting, managed grazing, multi-tiered cropping systems and vegetable, fruit and nut production.

With robust policy choices, visionary programs and creative financial incentives, MoCo could directly sequester a significant amount of carbon pollution in the coming decade. In this way, MoCo can contribute to its net zero emissions by 2035 goal, and aim to move into negative emissions thereafter, in part through this contribution of sequestration in agricultural systems. [It is a principle of the workgroup that efforts to sequester carbon are not be used as an excuse not to address moving to net zero emissions through direct emissions reductions].

An ambitious effort to promote healthy soils and agricultural sequestration will provide vital co-benefits for adaptation to climate change, if linked intentionally to the ways in which MoCo conceives of food and farming resilience over time. A vibrant local food system - with more nutritious food, accessible to all residents, with food waste returned at scale to soil through composting - will be increasingly important as climate impacts challenge the wider food supply chains. In order to build and promote this system, MoCo will place increased emphasis on farming livelihoods: continuing to address social equity by creating access for diverse groups to farming; and working to develop more creative ways to support farmers to adopt and scale 'carbon farming' and related practices for resilience. [The workgroup notes that agriculture is a major employer in MoCo<sup>15</sup>, and that many farmers struggle to operate at a profit. They need predictable support to function as effective custodians of the soil/ ecosystems].

The system for sequestering carbon through agricultural practices in MoCo will link strategically and creatively with other important activities designed to reduce emissions, sequester carbon and adapt to climate change. For example, MoCo's zero waste strategy will invest in supporting the generation of organic

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<sup>15</sup> The County's diverse agricultural industry's 558 farms and 350 horticultural enterprises produce more than \$281 million in economic contribution from agricultural products and operations. The majority of Montgomery County farms are family-run operations, many reaching back several generations, which employ more than 10,000 residents. Of the County's 558 farms, 39% are farmed as a primary occupation. <https://www.montgomerycountymd.gov/agservices/agfacts.html>

compost that the carbon farming system requires, in addition to promoting backyard and community composting around the county<sup>16</sup>.

## Goal and Objectives

According to the IPCC and the National Academies of Sciences, ambitious efforts to sequester carbon through agriculture are essential in efforts to restore a safe, livable climate.<sup>17</sup>

At the same time, the UN Food and Agriculture Organization and the UN Development Program have urged restoration of soils for other co-benefits, including food, biodiversity, rural jobs, and water security.<sup>18</sup>

An expansive focus on sequestration is fairly new in climate action planning; as yet, approaches and methods for measuring and evaluating these actions to inform and inspire policy-makers, investors, taxpayers, key actors in the system etc, are nascent though momentum in the United States is high with major corporate and government interest.<sup>19</sup>

The MoCo sequestration plan should be developed with a goal and a set of linked objectives, as follows:

- **Goal for sequestration** (such as targets for increases of 15% by 2027/30% by 2035) based on existing baseline data on soil carbon wherever possible. Benchmark our soils as we will benchmark our buildings for energy efficiency.
- **Objective for co-benefit 1 - Other emissions reductions** (e.g. net avoided emissions due to organic waste management to reduce methane emissions from landfills and provide on-farm compost that greatly boosts soil carbon drawdown; reduced emissions from reduced use of nitrogen fertilizer, from tilling and transportation.)
- **Objective for co-benefit 2 - Adaptation/ ecological resilience gains** (e.g. managing for floods and droughts through improved water retention capacity of improved soils<sup>20</sup>; preventing further increases in water treatment costs associated with sediment runoff from both agricultural and urban areas)
- **Objective for co-benefit 3 - Social equity/ resilience gains** (e.g. increased local and nutritious food and overall food access/ food security/ access to farmland for historically disadvantaged producers.)
- **Objective for co-benefit 4 - Well-being and prosperity gains** (e.g. market system and good jobs created around organic waste management, silviculture, and other practices)
- **Objective for co-benefit 5 - National and global recognition as a trendsetter** (attracting federal dollars and private investment to enhance MoCo as a model for climate action.)
- **Objective for co-benefit 6 - Education and engagement of youth and consumers** (creating climate beneficial certification programs and school-based gardens, for example.)

A potential goal for the Agriculture Methods and Solutions could be something like, X% of 2019 acres on which the various NCRS practices (or a MoCo-prioritised list) are adopted by 2027. The COMET-Planner can be used to estimate how much GHG-reduction the county would get/ year. It could be helpful to actively

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<sup>16</sup> Noting that the [County strategic plan to advance composting](#) (2018) recommends backyard and community composting programs. However, there is much to be done in order to take these practices to scale.

<sup>17</sup> <https://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=25259>

<sup>18</sup> <https://www.scientificamerican.com/article/only-60-years-of-farming-left-if-soil-degradation-continues/>

<sup>19</sup> <https://www.indigoag.com/>; <https://insideclimatenews.org/news/19072019/agriculture-climate-solution-election-2020-biden-warren-sanders-soil-carbon-conservation>

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[http://www.fao.org/fileadmin/templates/lon/World\\_Soil\\_Day\\_2017/UN\\_Didi\\_Pershouse\\_World\\_Soil\\_Day\\_2017\\_Statement\\_FINAL.pdf](http://www.fao.org/fileadmin/templates/lon/World_Soil_Day_2017/UN_Didi_Pershouse_World_Soil_Day_2017_Statement_FINAL.pdf); <https://www.sciencedirect.com/science/article/pii/S0016706103000946>

participate in the Million Acre Challenge, a partnership between Chesapeake Bay Foundation, Future Harvest and others to bring 1 million acres of Maryland farmland into regenerative agriculture by the end of this decade.

The objectives for co-benefits then add additional rationale for investments that achieve this.

## Decision-making considerations for MoCo

### Criteria for decision-making

There will be important co-benefits of certain actions (some are reflected in the vision and objectives), which should be explicitly recognized and estimated. This will help decision-makers to make the case for those actions where the sequestration value alone is not considered sufficient. There are also potential trade-offs between different actions, as discussed below.

Therefore, the sequestration workgroup proposes that a set of decision-making criteria are developed to ensure that co-benefits and trade-offs are well considered when policies and programs are being developed. These criteria should reflect the principles and values discussed below, and could be applied through a form of check-list that is required for all future policy and legislative decisions.

### Trade-offs - and cross-cutting opportunities

It is not possible in advance to list out all the potential trade-offs that could occur as policies and legislation are further developed to support the Climate Action Plan, and other MoCo priorities. However, it is important to make the existence of trade-offs explicit, and to establish ways in which these could be managed e.g. by applying a set of principles like those below.

For example, in efforts to meet the County's ambitious emission reduction goals, consideration is being given to expanding solar power generation on agricultural land. This use may prove to be essential, yet it must be balanced against a number of other potential values for such land (e.g. rewilding for biodiversity restoration, sequestration through farming as well as planting trees and shrubs, promoting the creation of food forests with diverse products, etc). At a minimum, the County should establish clear legislation for the placement of solar arrays, including careful research into the impacts of mixed uses such as joint agricultural and solar energy production, and including the advancement of biodiversity. To ensure the promotion of agricultural land for carbon sequestration, consideration by the County of sites of land in the Ag Reserve should only come after every effort is made to site solar in more appropriate locations, e.g., rooftops, parking lots, brownfields, public and private campuses with large scale non recreational lawns, utility-zoned easements inside the Reserve, etc.'

### Principles and Values

- **Foster systems thinking and adaptive management:** Actively identify and evaluate the social, ecological and economic co-benefits and potential trade-offs of policy and legislative decisions, and how these will impact the County's emissions, sequestration and adaptation targets. Design programs and partnership to ensure a high level of interaction and learning among key actors

stimulating adaptive management capacities through incentivizing innovation, rapid feedback loops, taking small bets etc.

- **Apply systems analysis to design plans and programs:** Identify the “levers” or the approaches to changing underlying drivers of change in the system, such as legislation and regulations, tax mandates and incentives, programmatic services, market forces, voluntary actions, etc. The levers of change need to target the drivers, e.g. what motivates people to take action, what factors cause emissions increases, in order to dramatically change the system’s performance. Climate Plan strategies need to be selected based upon criteria designed to take into consideration such factors such as cost efficiency, emissions reduction potential, degree of county control, speed at which impact can be achieved, and other relevant factors that relate to deep and sustained systems change.
- **Prioritize producers.** Recognize that farmers, land-owners and farm-based businesses will only plant trees or adopt regenerative practices if it works for them logistically and financially.
- **Promote social equity, climate and restorative justice:** Prioritise benefits and opportunities for disadvantaged groups, address systemic and historical discriminations, and protect the right of future generations to a safe and secure climate. In the context of sequestration, explore how to generate rural jobs, economic opportunities and land access for disadvantaged residents.
- **Protect and enhance biodiversity and ecological resilience:** Value each nature-based sequestration system for its wider role in enabling critical ecosystems to recover, and to maintain the redundancy and diversity that supports ecosystem resilience over time.
- **Do not count sequestration as a way of off-setting lack of progress on emissions reductions:** Efforts to sequester carbon should not be used to off-set limited progress on the County’s emissions reduction targets. They should be valued as an independent contribution to negative emissions and enhanced biodiversity, ecological and social resilience.
- **Base decisions on resilience/ adaptation principles:** Resilience/ adaptation practice has shown the importance of certain [principles](#) that need to be considered in policy-making and business contexts for enhanced resilience. These include the principles of promoting flexibility and learning, maintaining diversity and redundancy, and expanding participation
- **Take actions commensurate with the magnitude of the challenges we face:** The lists of recommendations from this taskforce are voluminous. Don’t let the scale and scope inhibit action but rather consider these as a menu of ample opportunities that must be seized in the very near term.

## Metrics and articulating value

To be developed - the co-benefits link to metrics, not only related to drawdown, but importantly to avoided emissions, biodiversity, adaptation, and resilience in social ecological systems. The metrics are important for targets (tracking and accounting for progress), and for supporting business cases for investment. However, there are also financial and nonfinancial aspects of value that are more descriptive/ narrative in nature, which also help to make the case for change e.g. capturing public engagement.

## MoCo Greenhouse Gas Inventory

- <https://www.montgomerycountymd.gov/green/climate/ghg-inventory.html>



In 2015, the following to note:

- Overall County emissions estimated at 11.34 MMTCO<sub>2</sub>e
- Of which agriculture is estimated at 0.042
- But solid waste at 0.267 (of which combustion of waste - think food waste included which could be compost!) is 0.212

COMET Planner estimate (Mike Scheffel extracted, December 2019)

- Acreage under NCRS practices, contributing around 1314 tons of CO<sub>2</sub>e (Cumulative reductions, perennial practices) when compared with agriculture emissions above (MMTCO<sub>2</sub>e)

## Recommendations for sequestration through agriculture

### Quick wins, small bets and no regrets actions for 2020

These are actions that can and should be taken now by MoCo, even while the Climate Action Plan is being finalized. They are actions that fit with on-going policies and programs and/or can be justified in light of the County’s Climate Emergency Mobilization Resolution and will likely generate a range of co-benefits and no ‘bads’.

Overarching Recommendation	Specific Recommendations	Comments
<p>Integrate the commitment to carbon sequestration through nature-based solutions across MoCo’s departments and programs.</p>	<p>Hold orientation sessions among County departments and key stakeholders to review the outputs from the Climate Action Plan workgroups - building engagement.</p> <p>Implement all recommendations from the 2018 Climate Mobilization Report, particularly programs and incentives highlighted for agriculture, food waste management and composting. (See Annex 1)</p>	<p>Example of cross department coordination: Managing food/ yard waste into compost and into organic fertilizer at a larger scale will enable MoCo to reduce emissions (waste incineration, waste to energy, methane from landfill, transport), increase carbon sequestration on farms (organic fertilizer deepens the drawdown value of conservation practices), improve the nutrient value of food from healthy soils, and reduce water pollution from agricultural run-off. Capturing edible food waste from the waste stream can help alleviate hunger in the county.</p>
<p>Protect MoCo’s Agriculture Reserve against further development</p> <p>Expand existing programs to incentivize regenerative agriculture, reforestation, silviculture, and the restoration of other kinds of natural ecosystems, such as wetlands.</p>	<p>Reinforce existing policies, zoning laws and other measures to avoid additional conversion of agricultural land to residential or commercial development in the Reserve.<sup>21</sup></p> <p>Ensure a careful review of potential solar installations in the Reserve to ensure, at a minimum, permanent protection of agriculturally productive lands.</p> <p>Partner with technical assistance groups such as Soil Health Academy<sup>22</sup> to support a transition to regenerative</p>	<p>The reserve provides multiple benefits that are critical to the County’s emissions, sequestration and adaptation goals. As global food supplies face increasing disruption due to trade wars and climate impacts, local food production will become increasingly vital.</p> <p>There may be an opportunity and need to place some solar arrays in the reserve.<sup>25</sup> This must be done with enormous deliberation and with an eye to drawing a line in the sand against opening the Reserve to harmful commercial or residential development or to the</p>

<sup>21</sup> [https://www.montgomerycountymd.gov/COUNCIL/Resources/Files/doc/aggroup\\_finalreport.pdf](https://www.montgomerycountymd.gov/COUNCIL/Resources/Files/doc/aggroup_finalreport.pdf)

<sup>22</sup> <https://soilhealthacademy.org/>

<sup>25</sup> <https://bethesdamagazine.com/bethesda-beat/government/amendment-would-allow-larger-solar-farms-on-ag-land/>

	<p>farming practices in the Reserve.</p> <p>Substantially increase both tree and shrub planting and natural forest regeneration on both private and public lands in the Agricultural Reserve such as expanding the Re-Leaf the Reserve program, providing incentives to plant hedgerows and trees in pasture and lawns, and accelerating riparian reforestation. Prioritize durable, indigenous species and those that maximize soil carbon sequestration and support of insects and pollinators.<sup>23</sup> Explore nut bearing trees as high sequestration/high revenue options for producers.<sup>24</sup></p>	<p>ill-advised placement of solar panels on productive lands for food production for humans, and for increased carbon sequestration. .</p> <p>We need to emphasize greening the County everywhere! And this includes promoting diverse and indigenous species for reforestation which also supports other needs e.g. diversity for pollinators.</p>
<p>Cross-cutting: Maintain and expand permanent local farmer-producer markets. These support local food producers, and provide produce closer to consumers. Could be linked to a 'carbon-saved' or climate beneficial label.</p>	<p>Conduct an analysis of areas in the county that are missing a farmers market. Work to meet unmet needs for local healthy food. Provide support to local producers to diversify products offered at markets while incentivizing regenerative agriculture practices.<sup>26</sup></p> <p>Consider a rewards-based system for use at farmers markets to educate consumers and reward producers. For example, a regenerative organic certified farm gets a "soil platinum" rating they can display at farmers' markets;</p>	<p>Permanent Local Farmer-Producer Markets applies not just for Reserve but all of the County's "built environment." A challenge to their development might be current farmers markets, grocers and associated owners.</p>
<p>Cross-cutting - Land-use: Focus on medians, roadsides and all transportation easements</p>	<p>Maryland State Highway Administration (MDSHA) maintains roadside spaces</p>	<p>These areas support foliage and minimize gas mowing. The more trees and above ground biomass we have, the more carbon we</p>

<sup>23</sup> [https://extension.umd.edu/sites/extension.umd.edu/files/\\_docs/programs/master-gardeners/Montgomery/2016Novemberconference/Native%20Plant%20handout%20Nov%202016.pdf](https://extension.umd.edu/sites/extension.umd.edu/files/_docs/programs/master-gardeners/Montgomery/2016Novemberconference/Native%20Plant%20handout%20Nov%202016.pdf)

<sup>24</sup> <http://www.savannainstitute.org/>

<sup>26</sup> <https://www.montcopa.org/DocumentCenter/View/17837/2019-FARMERS-MARKETS?bidId=>

<p>maintained by the Maryland State Highway Administration. Seek MoCo maintenance autonomy.</p>	<p>where more plants and trees can grow! MDSHA has a process for municipalities to apply for “maintenance autonomy”. Get County-wide Autonomy, and allocate to Montgomery Parks, maximize greening all roadside surfaces.</p>	<p>sequester.</p> <p>There may be MDSHA barriers e.g. requirement that growth cannot be higher than 6” in the easement, for vehicle safety. However, there are options for soft thicket multi-stem trees like staghorn sumacs, witch hazel, hazel, viburnum, smaller cultivars and coppiced trees. This also helps to reduce particulate emissions.</p>
<p>Build multi-stakeholder partnerships to accelerate progress and learning.</p>	<p>Partner with philanthropies<sup>27</sup> and existing learning platforms like the <a href="#">Carbon Cycle Institute</a> and <a href="#">Rodale Institute</a> to create more opportunities for farmers and gardeners to learn about innovations in soil carbon drawdown.</p> <p>Connect with the state to ensure integration of all these goals into the training of those working with the SCD and Extension services in MoCo.</p> <p>Connect now with bold initiatives such as the launching regional Million Acres Challenge or Indigo Agriculture - for regenerative agriculture.</p> <p>Develop <a href="#">outreach programs</a> to communicate the agronomic and economic benefits of using these practices; examples:</p> <ul style="list-style-type: none"> <li>- increased soil health</li> <li>- reduced flooding from improved infiltration</li> <li>- better crop growth with fewer inputs</li> <li>- economic benefits of cover crops</li> <li>- fuel, time and maintenance savings from using no-till</li> </ul>	<p>There are several foundations and impact investors interested in promoting regenerative agriculture. Explore outreach to the Funders for Regenerative Agriculture, Climate &amp; Land Use Alliance, Chesapeake Bay Funders, Packard Foundation, Climateworks Foundation, and Rockefeller Foundation for a partnership in the county. Indigo Ag is a start up for-profit investing 600 million dollars into the field. Explore a pilot with this group. Congresswoman Chelli Pingree will soon be releasing a federal bill on climate change and agriculture. Explore potential financial incentives that could be brought to the county’s farmers.</p> <p>One highly successful outreach program worthy of replication is the Common Ground Country Fair held annually in Maine to showcase the state’s organic, regenerative products and farmers.<sup>28</sup> The Office of Agriculture for MOCO could organize this in partnership with local NGOs and producers.</p>

<sup>27</sup> <https://www.chesbayfunders.org/>; <http://regenerativeagriculturefoundation.org/wordpress/>

<sup>28</sup> <https://www.mofga.org/The-Fair>

	<ul style="list-style-type: none"> <li>- Improved nutritional value of food grown from healthy soils</li> <li>- Support for pollinators and birds</li> </ul> <p>Recruit farmers who want to try these (or who are already doing them) to demonstrate them on their farms, and through Extension or Soil Conservation Districts), hold field days to show other farmers how they work (peer-to-peer education)</p> <p>Engage with local science institutions to support analysis of carbon sequestration projects in partnership with farmers.</p> <p>Promote the benefits of carbon farming and soil health by integrating information and encouraging carbon farming practices through Master Gardeners and Koiner Center for Urban Farming and the MCPS curriculum.</p>	
<p>Identify the most promising practices from the MDA Menu of Recommended Practices that</p>	<ul style="list-style-type: none"> <li>- Provide technical assistance, outreach, and where possible -</li> </ul>	<p>20 trees an acre, or any number of the sort, is an immediately accessible goal.</p>

<p>could be increased for each commodity and for the new diversified farming systems in the county - see notes on extracted pages from COMET-Planner provided by Sara Via and practices endorsed by the state of California.</p>	<p>financial incentives -</p> <ul style="list-style-type: none"> <li>- to all corn/soybean/grain farmers to use no-till, crop rotations, cover crops, and newer practices that will help them build healthy soils and drawdown carbon.<sup>29</sup></li> <li>- to vegetable/fruit producers to increase or start use of no-till and cover crops. Work for reduced use of pesticides in the context of no-till strategies.</li> <li>- for diversifying crops and regenerative local production of fruits, nuts, and vegetables</li> <li>- To help/require farmers to reduce the use of nitrogen fertilizer (NRCS CPS 590) to reduce nitrate and nitrous oxide emissions by using split applications, nitrification inhibitors, and substituting compost applications.</li> <li>- To showcase the yield and water management</li> </ul>	<p>Consider incentives e.g. Ag. Reserve property owners get .5 percent off annual property tax for each number of specified-species tree or shrub greater than the number 20 per acre.</p>
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<sup>29</sup> <https://crops.extension.iastate.edu/encyclopedia/carbon-sequestration>

	<p>benefits of utilizing compost (food scraps, yard waste, and composted manure) to meet nitrogen needs in place of synthetic nitrogen (NRCS CPS 590).</p> <ul style="list-style-type: none"><li>- To encourage farmers to have either herbaceous or woody buffers on every stream.</li><li>- To encourage planting of conservation cover or trees on marginal cropland</li><li>- To provide motivation for planting hedgerows on farm margins to buffer from residential areas; one or more rows of trees/shrubs can be combined with a row of pollinator meadow (ie. Conservation cover) to draw pollinators and natural pest predators</li><li>- Encourage multistory cropping (NRCS CPS 379) and establishment of permaculture industry in County; include outreach and incentives for demonstrations</li><li>- Encourage planting of</li></ul>	
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	<p>warm season grasses in pastures</p> <ul style="list-style-type: none"> <li>- Encourage horse farm operators to use silvopasture (NRCS CPS 381)—plant at least 20 trees/acre. Can be nut or timber trees. Seek species that might serve as wind breaks and not interfere with pasture.</li> <li>- Encourage the few dairy farmers in MOCO to adopt holistic grazing.</li> <li>- Work to integrate fruit and nut trees into agricultural operations.</li> <li>- Commission a consultant to help expand on the practices that should be incentivized, from integration of kelp into cow feed to reduce methane to use of perennial hay for farms.</li> </ul>	
<p>Prioritize funding for these practices by estimating potential for GHG reduction:</p> <p>How much each practice reduces GHG (see menu of practices or COMET-Planner).</p> <p>Number of new acres on which each carbon-sequestering practice can be adopted</p>	<p>Explore all funding and finance flows for producers to maximize incentives to shift practices. There are state and federal incentives and private sector ones. Consider a revolving loan fund to help front load the cost to producers of shifting to regenerative practices. See the <a href="#">Perennial Fund</a> in Colorado as a possible model.</p>	
<p>Leadership by example: Explore joining bold new platforms</p>	<p>E.g. Find out more about the <a href="#">Urban Drawdown Initiative</a>, and how MoCo could partner</p>	<p>MoCo - as the first County jurisdiction to declare a Climate Emergency; as a rural/ urban/ suburban county; as a County with a number of growing cities; as one of the wealthier Counties in the USA etc - can both gain through selecting such bold initiatives and become a leading</p>



		inspiration to others. Apply for various prizes and awards in the field of soil carbon drawdown.
Leverage the county's considerable political clout by advocating for financing from Congress for cities and counties to maximize nature based solutions.	The County's legislative representatives should be in touch with Congresswoman Chelli Pingree's staff on this.	EarthJustice, NRDC, Union of Concerned Scientists, and the California Climate and Agriculture Network have developed a range of key policy concepts that the county could become more familiar with and help advocate for.

Mulch correctly to maximize tree success	<b>Mulch Correctly</b> Campaign to eliminate mulch mounds in the county infrastructure. Break down mulch mounds, spread the mulch correctly, leave simple (funny?) signage explaining how mulch mounds kill trees. Penalty to identified landscaping companies is posting of county signage at the time clock, or highest placement visibility.	<a href="https://u.osu.edu/knoxcountyag/2018/04/10/mulch-volcanoes-are-erupting/">https://u.osu.edu/knoxcountyag/2018/04/10/mulch-volcanoes-are-erupting/</a>  Mulch builds surface moisture where applied. We need it's services for roots. Placed against a tree trunk, mulch can disable the bark and kill the tree in a few years. Since we realize we need tree successes now, we have to nix the habit!
Zone Carbon Sequestration	Create Carbon Sequestration Zones. These can also be important for education purposes, show-casing how sequestration works and what it achieves. Carbon Sequestration Zones could overlap with sourcewater protection areas - the upcounty watersheds should be given an official designation as source water areas to justify a higher level of protection, for which Carbon Sequestration would be a key practice.	Designate campuses, key land strips, urban canopies, etc. in "Zoning" for max innovative remediation and sequestration projects. Educate consumers through signage in multiple languages and with use of simple graphics.

## Scaling-out 2021-27

Overarching Recommendation	Specific Recommendations	Comments
Establish a County-wide composting system, ensuring a supply of quality organic soil amendment/ compost to farms and gardens.	See other references and details embedded in other recommendations.	
Increase incentives and support for farmer-to-farmer programs that sequester carbon and benefit farmers such as healthy soil practices (MDA recommended), regenerative agriculture and permaculture by providing educational programs, teaching farms, tax incentives, equipment sharing or coops, and opportunities for information sharing.	<p>Help farmers gain access to specialized equipment needed to allow cover crops to be planted earlier, before corn or soybeans are harvested (Interseeders, Highboys), and also equipment to terminate cover crops without herbicides (roller-crimpers)</p> <p>Be creative about linking soil health and soil carbon practices with local producer markets.</p> <p>Help stables develop draft-horse industry. Horse-logging coppice, etc. Consider power line corridors for transporting hauled trailers and carts.</p>	<p>Might explore financing options used in other places for the roller crimpers - contact Rodale Institute.</p> <p>Local producers markets increase incentive for local farmers and increase carbon-sequestration consumer options. One example: 5mile radius markets (Pogo's idea). All producers are within a 5mile radius. Fuel emissions are cut with suppliers and consumers commuting less. Markets can be hosted on the infrastructures of montgomery parks, mncppc.</p> <p>Consider tourism and educational links for horse-related carbon emissions reductions.</p>
Learn, innovate and scale approaches that drive finance and other incentives to farmers. In particular, review how the county applies the property tax to agricultural land and how it could be modified to encourage sequestration as well as changes in land use that reduce net emissions	Undertake a review of/ build learning partnerships with states/ counties that are piloting and scaling such programs. See Boulder County, Colorado and the many experiments with NORI, blockchain and more.	There are innovations that could be trialed at smaller scale e.g. the County buys SRECs to offset emissions - how about a mechanism to pay for sequestration actions? Encourage private sector actors in the County who are buying offsets to input into local sequestration incentives? But be aware of concerns that are rising globally about offset schemes. <sup>30</sup>
Assess policies (such as purchasing/procurement policies of the county, building standards, etc.) that will increase the local market for wood	Consider working with the Good Food Purchasing Campaign to maximize procurement by schools, prisons, government agencies of foods produced from regenerative producers. Explore	<p><a href="https://goodfoodpurchasing.org/">https://goodfoodpurchasing.org/</a></p> <p>Montgomery County Food Council has a "MoCo Made" (<a href="https://mocofoodcouncil.org/moco-made/">https://mocofoodcouncil.org/moco-made/</a>) program that</p>

<sup>30</sup> <https://www.propublica.org/article/united-nations-agency-criticizes-carbon-offsets>

<p>products, fruit and nut farms, and other industries tied to perennial crops and climate friendly farming practices.</p>	<p>creating a local label or certification for farmers and producers using regenerative practices or alternatively adopting a small percentage of county procurement for farms using the organic regenerative label. <a href="https://regenorganic.org/">https://regenorganic.org/</a> <i>Mandate a certain percentage of procurement for local regenerative food? (Not sure if this is doable.)</i></p>	<p>promotes County produced foods and they are working on local procurement related to local farms. Local co-packing and production and distribution facilities are also needed to assist farmers with aggregating, storage, processing and distribution of their product.</p>
<p>Develop creative financing for nature based solutions in Montgomery County.</p>	<p>Work with the Montgomery County Green Bank to incorporate financing and revolving loan funds for reforestation, silviculture and regenerative agriculture programs where appropriate. Market this to impact investors<sup>31</sup> in the state, working in partnership with foundations and high wealth donors.</p>	
<p>Take a whole systems approach to our climate action plan and nature-based solutions.</p>	<ul style="list-style-type: none"> <li>● Reduce food and paper waste and excess, and increase recycling of paper and other wood products</li> <li>● Support construction of affordable housing and commercial and municipal buildings with sustainably-harvested wood—replacing carbon-intensive concrete and steel</li> </ul>	<p>Use of FSC certified wood for construction has to be balanced against the sequestration potential of trees.</p>
<p>Maximize the engagement of young people in all that we do.</p>	<ul style="list-style-type: none"> <li>● Partner with our state and Congressional delegates to seek funding for a statewide youth Climate Conservation Corps as a possible pilot for the nation - to assist with urban garden development, urban tree</li> </ul>	

<sup>31</sup> [https://ssir.org/articles/entry/foundations\\_can\\_unlock\\_a\\_food\\_system\\_to\\_feed\\_the\\_world](https://ssir.org/articles/entry/foundations_can_unlock_a_food_system_to_feed_the_world)

	<p>planting, and restoration projects that can help sequester carbon.</p> <p>Employ youth in summer jobs, focusing on disadvantaged and low income youth as a priority.</p>	
Utilize all dying and infested trees and manage waste ecologically for sequestration and compost whenever possible	<ul style="list-style-type: none"> <li>MoCo is experiencing severe storms and insect infestations of trees. Consider utilizing the downed trees for biochar production or compost based on a risk and benefit assessment.</li> </ul>	Understanding of how to manage infested trees is still emergent but this is a huge area - both as a threat and an opportunity. Work with local experts at UMD and arborists to best understand management of dying large trees.
Recognize the already-widespread use of climate-friendly techniques by Montgomery County farmers and reward innovators who are adding stacked practices and moving beyond basic conservation practices.		Mike Scheffel and Jeremy Criss <sup>32</sup> have provided information on the extent to which county farmers are already using methods that are beneficial to the climate as well as having other advantages environmentally (e.g. reducing eutrophication). They can also serve as resources for determining the best way to choose award recipients.
Encourage farmers to shift to lower-emissions cropping and livestock systems.	These systems should be based on an assessment of the emissions and sequestration rates of the whole farm system, including all forms of emissions, not just a single component (e.g. soil carbon)	Examples of lower-emission systems include perennial crops (compared to annual row crops such as corn, soy and wheat) and non-ruminant livestock (chickens, turkeys, pigs) compared to ruminants (e.g. beef cattle)

**Bold new ideas and future thinking**

Overarching Recommendation	Specific Recommendations	Comments
Explore new ways to build markets in support of carbon sequestration through	County and MCPS purchase locally produced food	For a look at Coppice and

<sup>32</sup> <https://montgomerycountymd.gov/AgServices/aboutus.html>

<p>agriculture land-use practices</p>	<p>Coppice for root-intensive lumber material, coppice and pollard for leaf-hay/tree-hay.</p>	<p>Pollard industry doing well for woodland and woodlanders, read arborist William Bryant Logan's 2019 book "Sprout Lands"</p>
<p>Be a trendsetter, adopting some of the newest emerging strategies for nature based pathways that have additional co-benefits for quality of life.</p>	<ul style="list-style-type: none"> <li>• Explore incentives and mandates for vertical gardens and green walls in all county facilities and encourage partnerships in the private sector.</li> <li>• Explore how to help local craft breweries utilize perennial grains and soil carbon sequestration in their processes for growing and composting hops.</li> <li>• Maximize urban tree foliage. It is incredible to our health for scrubbing air pollutants, mental stability for individuals and for the community, and the healing can be realized with simple signage.</li> <li>• Consider a compensated work community camp(s) for lower income youth and adults in the reserve - doing activities that increase net carbon sequestration rate. Mulching fallen branches, increasing biodiversity, waste conversion, applying biochar, etc.</li> </ul>	<p><a href="https://www.researchgate.net/publication/265211839_Carbon_dioxide_sequestration_model_of_a_vertical_greenery_system">https://www.researchgate.net/publication/265211839_Carbon_dioxide_sequestration_model_of_a_vertical_greenery_system</a></p> <p><a href="https://www.sciencedirect.com/science/article/pii/S0048969718341433">https://www.sciencedirect.com/science/article/pii/S0048969718341433</a></p> <p><a href="https://www.mprnews.org/story/2018/05/10/kernza-beer-perennial-grain-climate-change">https://www.mprnews.org/story/2018/05/10/kernza-beer-perennial-grain-climate-change</a></p> <p><a href="https://northcoastbrewing.com/sustainability/carbon-farming/">https://northcoastbrewing.com/sustainability/carbon-farming/</a></p> <p>"Work community" can be landscaper-logger-academia-scientist-parks, or such. Emergency workers of a sort - soilcarbon accelerator medics.</p>
<p>Promote soil carbon sequestration through our Moco urban gardens</p>	<ul style="list-style-type: none"> <li>• Require/encourage all gardeners to be organic and stop tilling; educate residents about drawdown yards; ramp up education on gardens and composting; provide workshops on how to</li> </ul>	<p><a href="https://www.thenatureofcities.com/2016/02/07/carbon-capture-gardens-a-nature-based-solution-for-managing-urban-brownfield-soils-for-biodiversity-and-ecosystem-services/">https://www.thenatureofcities.com/2016/02/07/carbon-capture-gardens-a-nature-based-solution-for-managing-urban-brownfield-soils-for-biodiversity-and-ecosystem-services/</a></p>

	use alternative approaches to loosening and building soils.	
Explore partnerships with the MOCO Community College and public schools system.	<ul style="list-style-type: none"> <li>• Provide reforestation and compost job training and placement programs,</li> <li>• Explore food production food businesses to build consumer demand for farm products and wood products coming from nature-based sequestration producers.<sup>33</sup></li> </ul>	
Explore methane reduction in ruminant farming	<ul style="list-style-type: none"> <li>• Contact Penn State researchers who are championing field tests that incorporate seaweed/kelp into cow feed. Initial results show a 80% decline in methane emissions.</li> </ul>	<p>Identify dairy and beef farmers who may want to partner in an early field trial in partnership with University of Maryland.</p> <p><a href="https://www.technologyreview.com/s/612452/how-seaweed-could-shrink-livestocks-global-carbon-hoofprint/">https://www.technologyreview.com/s/612452/how-seaweed-could-shrink-livestocks-global-carbon-hoofprint/</a></p>
Motorless hauling	<p>Draft horse network through the county power line easements.</p> <p>Log, woodchip, lumber, hay, manure, a trailer of eco goats, etc.</p>	<p>Carbon sanity, local stables supportive, and for when petroleum might cut out.</p> <p>Pulled cart animal husbandry can be built into the mnc-ppc and Montgomery Parks structures.</p> <p>Some of the private stables in the Reserve can be rewarded for allowing such pulled cart projects.</p>
Delineate upcounty watersheds as sourcewater protection areas and leverage complementary funding sources for protecting water quality to sequester carbon	As indicated by Dr Via, several water quality measures already incentivized also sequester carbon.	Master plans for the upcounty justify the Ag Reserve and Rural Low density zoning in part because they are public water supply areas. This fact needs to be common knowledge rather than be buried in ancient master plans.

<sup>33</sup> <https://www.zerofoodprint.org/>



## Facing Uncertainties

The amount of carbon that can be sequestered through protection of existing forests and urban/suburban trees, through reforestation and through regenerative agriculture cannot be perfectly quantified and is a matter of debate. Some of this debate is tied to our rapidly changing planet and the new threats posed by warming soils, fires, pests, droughts, intense storms, and floods in our region. Still, there is no debate about the critical role of all land-based sequestration strategies as key pathways for greater adaptation and mitigation. Policy makers will sometimes need to weigh conflicting scientific data as they weigh the relative merits as well as ease of adoption for sequestration recommendations.

Sequestration through agriculture in any given landscape is dependent on many variables, including types of soils, how widely practices are adopted, depth of soil affected, diversification of farming systems, and use of organic versus chemical inputs. Reforestation is affected too by type of tree, type of soil, invasive pests, extreme weather events, fire, and diversity of forested stands. Climate action plans inherently face uncertainties. This section highlights on-going debates raised and discussed by workgroup members, and focuses primarily on the discussion about what is best for net sequestration, mitigation, and adaptation in general. These debates are in part rooted in divergent perspectives, but also in response to our changing climate and a steady flow of new research and developments that must be monitored for effective decision making by policy makers. These debates are not resolved, but serve to highlight the challenges of determining the 'best' use of land or the 'ultimate' list of sequestration practices. And the key conclusion is that an adaptive process of decision-making, informed in partnership with scientists and implementers, with capacities to shift focus, is critical. Our forests, fields, water systems, and plants are being heavily impacted by a changing climate. Facing uncertainties requires a vigilant focus on emerging knowledge and science and a willingness to change perspective as new information emerges.

What follows are reflections from workgroup members on the science and potential of different land-based sequestration strategies.

### An Argument for Reforestation of Agricultural Land (submitted by Doug Boucher)

The case for reforestation of some agricultural land in Montgomery County is based on the scientific fact that reforestation leads to net sequestration -- at a rate considerably higher than any of the agricultural alternatives -- while agriculture leads to net emissions of greenhouse gases. In the case of our county, the estimate is that these emissions totaled about 42,000 tons CO<sub>2</sub>equivalent in 2015, with  $\frac{2}{3}$  of this coming from agricultural soils. Forests on the other hand sequester carbon, and the scientific literature shows clearly that reforestation is the natural climate solution with the highest potential, both in the United States and globally (Fargione et al. 2018 *Science Advances*). This is confirmed by estimates of potential climate benefits in Maryland agriculture calculated by Dr. Sara Via (Appendix K, Draft 2019 Greenhouse Gas Reduction Act Plan), which show that the largest benefits come from adding trees (silvopasture, alley cropping, tree and shrub establishment, conversion to farm woodlots). Overall, forests in the eastern U.S. tend to sequester about 10 to 15 tons CO<sub>2</sub>eq per acre, compared to 1-2 tons for even the best agricultural systems. The only use of agricultural land that is more beneficial than reforestation is to combine farming with solar panels, which leads to net sequestration of about 200 tons CO<sub>2</sub>eq per acre.

Another reason that the potential benefit from changing farming practices is limited, is that the majority of Montgomery County farmers are already using the climate-beneficial practices -- in particular: cover cropping, no-till, and rotational grazing. This means, ironically, that the additional sequestration that could be achieved by promoting these practices is not large, because the additional area on which they could be newly implemented is not large.



It is also worth mentioning that Montgomery County's agricultural production does very little to "feed a hungry world", or even to feed our own residents. Only about 1% of our food is produced in the county, and the primary use of county agricultural land is crop production, rotating corn, soy and wheat. Of these, corn and soy are overwhelmingly used to feed livestock and generate biofuels, resulting in very small amounts of human-edible food per acre. Indeed, a considerable amount of our agricultural land does not produce food at all, but rather horses and landscaping plants. The county's 2015 greenhouse gas inventory showed that we had about 9,100 horses on county farms, compared to just 2,200 beef cattle and 600 dairy cattle.

We do not need to reforest all the county's agricultural land -- far from it. The recommendations are for increasing our forest area from 34% currently to 37% in 2027 and 45% in 2035. But to exclude agricultural land from reforestation would deliberately forgo the change in land use with the highest climate mitigation potential -- as well as very important co-benefits for wildlife, recreation, biodiversity, water, and prevention of climate-driven disasters.

**An Argument for Adoption of Cutting Edge Regenerative Agricultural Practices, Plus Protection of Existing Forests and Trees (submitted by Ellen Gordon and Betsy Taylor)**

Reforestation does offer a great deal of promise for confronting climate change, but more so in the long run. We support selective reforestation efforts in Montgomery County and in fact feel they are very important. Reforestation is particularly suited for conservation buffers or marginal land or habitat enhancement..However, the biggest difficulty with reforestation as a strategy is simply that it takes so much time to reap the benefits for global warming. There are debates <sup>34</sup>over the role of densely planted saplings absorbing more carbon versus older mature trees and their role. But, in the short and medium term, reforestation may not offer as much benefit as limiting deforestation in the first place and adding new practices in the agricultural sector, including practices that reduce on-farm emissions as well as sequester carbon through regenerative practices. Perhaps the most complicating factor in reforestation as a means to combat climate change, however, is climate change itself. Across large parts of western North America, forests are already in serious climate-related trouble. Years of prolonged drought in California have turned the forests of the Sierra Nevada and North Coast into "tinderboxes of highly combustible debris," according to [a New York Times article](#). In Canada, forest fires and industrial development have destroyed [almost two million acres](#) of boreal forest since 2000. And in the mid-Atlantic, mature oaks, beeches and other trees are facing sudden death from opportunistic pests, including ambrosia beetles, Armillaria root rot and Hypoxylon canker. Urban and suburban trees are being hit hard.<sup>35</sup>Up and down the mid-Atlantic coast, sea levels are rising rapidly, creating stands of dead trees — often bleached, sometimes blackened — known as ghost forests.

The numbers cited above by Mr. Boucher do not include all the potential sequestration from many additional farming practices beyond no till, cover crops and crop rotations. For example, according to experts at Colorado State (home of the Comet-Planner tool), merely adding conservation buffers - strips of perennial grasses - to row cropping in the County would potentially double the sequestration rates. Adding compost would add additional sequestration potential for up to 100 years through a single application. Eric Toensmeier, author of [The Carbon Farming Solution](#), has peer reviewed data demonstrating up to **30-40 tons of CO2E/hectare** from diversified systems including trees, crops and animals. These practices are

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<sup>34</sup> <https://news.mongabay.com/2019/05/tall-and-old-or-dense-and-young-which-kind-of-forest-is-better-for-the-climate/>,<https://science.time.com/2014/01/15/study-shows-older-trees-absorb-more-carbon/>,<https://www.frontiersin.org/articles/10.3389/ffgc.2019.00027/full>,

<sup>35</sup> <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0215846>

not reflected in most studies in part because of an assumption that the world will largely move forward with export commodity crops and row crops. If the County encourages diversified agricultural systems, more local food production, and a range of practices not currently in use, from effective composting of horse manure to planting of perennial grasses, sequestration rates for agriculture rise. We urge the County to embrace soil carbon sequestration through diversified farming systems that in many cases might include reforestation and protection of existing tree stands.

Nature cycles carbon and is both a source as well as a sink. Methane from ruminants, nitrous oxide from fertilizers, and rising carbon emissions from an acceleration of death of older trees due to insect infestations can tip the scale against sequestration unless regenerative practices, reforestation, and protection of existing trees outpace negative trends. The potential of soil carbon sequestration in agriculture and forestry is constrained by government subsidies to damaging practices and in some cases by the costs or risks for land owners in transitioning to climate smart practices. As public officials make tough choices, it is vital to take an inclusive rather than reductionist view of all of this. Nature-based strategies need to be done in such a way that they support biodiversity, resilience against extreme weather, food security, and places of solitude for an ever rising and stressed human population. Diverse systems of agriculture and forestry are vital just as diverse financial investments provide greater security for any portfolio of investments. These and other challenges must be faced forthrightly as the County makes hard decisions about resources and pathways forward.

## Questions for further research

### 1. What could MoCo's sequestration ambition through nature-based solutions be?

- **Today's capacity:** What is the current baseline for agricultural land use, forests, wetlands, and sub-urban landscapes, in terms of estimated sequestration in CO<sub>2</sub>e? Do we have this data in the state and if not, what would it take to get it? Is the data holding the complexity of recent climate impacts and their effect on sequestration and other potential co-benefits.
- **Today's emissions:** What is the current baseline of emissions through agricultural land use, forests, wetlands, and sub-urban landscapes, in terms CO<sub>2</sub>e? What contribution could the sequestration actions proposed make toward reducing these emissions? (a co-benefit of these actions)
- **Scaling-up current and additional practices capacity:** What could the potential sequestration be by 2027, if some percentage of the proposed practices for each of these landscapes (assuming no change in land use, and scale-up of practice from 2021-27)?
- **Setting bold targets for 2035 and 2050:** What is the potential (likely due to land-use changes) to increase the sequestration capacity of MoCo? What are the likely challenges to this (e.g. reaching maximum sequestration capacity, actions that cycle carbon back out of soils/ forests/ wetlands etc)?

### 2. What are the current forms of land-use in MoCo? What are the services and products that are currently generated through this land-use? What are the economic benefits of this land-use (employment, income, profits)?

- How is land used within the Agriculture Reserve? We know there is some data but it needs to be more granular. There is concern that there are large homes and plots which are primarily lawn-based.
- 3. What are the critical scenarios projected for MoCo in the coming 10-15 years, particularly in relation to population growth, development pressures, and climate impacts (including on agriculture, forests, wetlands)?**
- For example, how will MoCo's food supply chain likely be affected in this period? Is there a case for increasing local-level food sufficiency?
- 4. Who are MoCo's farmers (by size/ type of agriculture), and what practices are they using now, and why/ why not?**
- Are farmers of type X applying the NCRS practices, which ones, to what extent? [The MoCo Office of Agriculture as a source]
  - Are farmers (which ones) adopting more cutting edge practices such as silvopasture or permaculture, and to what extent?
- 5. Are our reforestation practices supporting healthy forests or monocultures? How can we maximize support for birds, insects, and resilient, diverse forests?**
- 6. To what extent are we protecting our existing tree canopies and what improvements are essential given the vital role of older trees in holding carbon?**

# Annex 1: Excerpts from MoCo Climate Mobilization Report Recommendations, 2018

## **Food and Farming Strategies**

*(Reduced Food Waste, Plant-Rich Diet, Conservation and Regenerative Agriculture, Nutrient Management and Composting)*

The growth, consumption and management of excess food encompasses a variety of activities that involve the County's agricultural sector, restaurants and other food service establishments, and residents.

### **Current Status/Activity**

#### ***Conservation and Regenerative Agriculture, Nutrient Management***

- Maryland Cover Crop Program and Maryland Agricultural Water Quality Cost Share grants.
- Technical and financial assistance through the USDA Natural Resources Conservation Service (NRCS). Technical assistance for developing conservation plans through Montgomery County Soil Conservation District (MSCD).
- MSCD equipment rental program (e.g., No Till Drill).
- University of Maryland Extension Nutrient Management Program provides farmers with technical assistance for nutrient management plan development.
- Sustainable farms included in the Green Business Certification Program.

#### ***Reducing Food Waste and Encouraging Plant Rich Diets***

- MCPS' Division of Food and Nutrition Services (DFNS) features daily meatless items; working with manufacturers to develop plant-based protein offerings that meet the required meat/meat alternative equivalent.
- The Strategic Plan to Advance Composting, Compost Use and Food Scraps Diversion in Montgomery County (April 2018) provides direction, framework and recommended strategies to reduce wasted food, channel excess food to others with unmet needs and increase the amount of food scraps recycled through composting and/or other technologies, such as anaerobic digestion.
- County supports Community Food Rescue, a Manna Food program that receives food donations from local businesses that would have been thrown away and delivers it to agencies serving those in need.
- The Montgomery County Food Council is creating a comprehensive list of all current hunger relief resources and emergency food providers in the County to highlight existing efforts and gaps; the Council also created a Food Security Plan which addresses who is at risk, where they are and what their barriers are to food security.
- Food waste composting taking place at cafeterias in three County buildings – Executive Office Building, Council Office Building and Public Safety Headquarters.
- Live Well initiative incorporates messaging and campaigns for plant based diets.

Appendix A: Potential Solutions or Actions 21

**Potential Next Steps:**

### ***Policy Changes***

- Provide farmers with subsidized compost to help sequester carbon in soil.
- Require all restaurants and caterers to compost food scraps and disposable food serviceware.
- Explore local options to reduce packaging and single-use items (bags, utensils, condiments, napkins) in restaurants and food service operations.
- At MCPS cafeteria lines, display fruit/vegetables at the beginning and make them default side dishes.
- Provide expedited permitting for rooftop vegetable gardening.
- Support amendments to Maryland's Lawn Fertilizer Law to ease restrictions on the application of compost to turf.

### ***Programs***

- Develop incentives to encourage increased separation of commercially-generated food scraps for recycling.
- Establish a Regenerative Agriculture staff position to train farmers and assist them in becoming certified through the Rodale Institute's new Regenerative Organic Certification program (in pilot stage).
- Secure processing capacity for commercially-generated food scraps to facilitate and increase the amount of food scraps separated for recycling, delivered to processing facilities for composting and/or anaerobic digestion and recycled.
- Refine and implement the recommendations of the Strategic Plan to Advance Composting, Compost Use and Food Scraps Diversion in Montgomery County.
- Establish training programs around no/low till, cover cropping, crop rotation, etc.
- Launch Meatless in March campaign, similar to the City of Santa Monica.
- At MCPS, increase the variety of plant-based entrees to include home style dishes using beans, lentils and dried peas; develop marketing strategies to educate students on plant-based protein entrées and how they can be part of a healthy school meal; continue student based focus groups at all levels to assess acceptability of new plant-based protein sources as part of the reimbursable meal.
- Expand the number of edible gardens at MCPS and other County government facilities.

### ***Financial Incentives***

- Incentivize farmers to use cover crops and practice crop rotation and no/low till.
- Provide property tax credits to farmers who achieve Regenerative Organic Certification.
- Provide financial incentives to restaurants with all-vegetarian or vegan menus.
- Provide farmers with subsidized compost to help sequester carbon in soil.