DRAFT (March 3, 2025)

Pathways for Sequestration and Storing Carbon

Lead Author: Jaiel Pulskamp

Maximum Words: 3000

Estimated Word Count: 2006

Vermont's natural and working lands and waters are among its greatest assets in mitigating climate change. These landscapes play a crucial role in carbon sequestration and storage, helping to offset emissions while enhancing resilience. Natural climate solutions, such as conservation, restoration, and improved land management, play a key role in climate mitigation. These strategies increase carbon storage while preventing greenhouse gas emissions. When combined with aggressive emissions reduction efforts, they provide some of Vermont's most effective tools for addressing climate change[1].

Currently, Vermont's natural and working lands (NWL) store over 2,000 MMT CO_2–e and sequester carbon at an annual rate of -2.91 MMT CO_2–e[2]. Preserving and enhancing this sequestration capacity requires supporting the people who live and work within these ecosystems. Landowners, farmers, and foresters must have the knowledge and resources to make informed decisions that reduce emissions while increasing carbon absorption and storage. Thoughtful land management in forests, wetlands, and agricultural landscapes can ensure Vermont continues to capture more carbon than it emits.

Building a resilient and adaptive Vermont means strengthening the natural resilience of working lands. Priority strategies and actions should enhance sequestration and storage while supporting land stewards—farmers, foresters, and caretakers—who engage with these ecosystems daily. Beyond their climate benefits, these actions provide significant co-benefits, including flood mitigation, biodiversity conservation, water quality protection, and improved soil health.

---

[1] Initial Vermont Climate Action Plan - Pathways for Sequestration and Storing Carbon
m:\vermont_climate_council\for_wrting_report\actual_cc_draft\figures\figure_9_climate_explorer_projections_county_temp_precip.w

[2] Galford et al. 2021. A Carbon Budget for Vermont. Insert link
Carbon Budget for Vermont Sept 2021.pdf

27 Together, these improvements contribute to Vermont's long-term economic and environmental
28 sustainability.

29 However, historical and systemic challenges have shaped Vermont's land management practices.
30 For decades, extractive agricultural and forestry methods—often driven by economic
31 pressures—have led to inequitable land use patterns, disproportionately affecting historically
32 marginalized communities. As Vermont faces more frequent extreme weather events,
33 generational land transfers, and widening economic disparities, it is critical to rethink land-use
34 decisions. A successful climate response must address past land-use inequities by ensuring
35 historically marginalized communities have access to land, decision-making power, and financial
36 support for sustainable land stewardship.

37 Forests play a critical role in Vermont's carbon storage in tree biomass and the organic soil
38 layers beneath them. Protecting these ecosystems from logging and development maximizes their
39 ability to store carbon. Old-growth and mature forests, with their deep root systems and complex
40 fungal networks, are especially effective at long-term carbon sequestration. Restoration efforts
41 should focus on preserving these vital ecosystems, recognizing their importance for both
42 biodiversity and climate resilience. While forests store carbon above ground, below-ground
43 ecosystems—including soil microbial communities and root networks—are equally vital for
44 long-term sequestration.

45 Vermont's landscape has undergone a dramatic transformation over the past century. A hundred
46 years ago, the state was over 80% deforested. Today, it is 80% forested. This recovery highlights
47 the potential for ecosystem regeneration but also reveals a critical gap—many recovering forests
48 lack the structural complexity and biodiversity of old-growth ecosystems. This underscores the
49 need for proactive policies that ensure forests regain their ecological function rather than simply
50 regrowing tree cover. Programs like Act 250 and Act 59 (the 30x30 Initiative) help balance
51 conservation with the economic needs of Vermont's working lands. Public engagement,
52 education, and careful planning are essential to align land-use policies with Vermont's climate
53 goals while supporting local communities.

54 Soil health is another essential but often overlooked aspect of carbon sequestration. Healthy soils
55 store more carbon through the development of soil aggregates, root exudates that feed microbial

56 life, and the formation of stable organic matter. However, industrial agricultural practices such as

57 excessive tillage, monocropping, and synthetic inputs disrupt soil microbial networks, leading to

58 carbon loss. Vermont can prioritize soil health initiatives by supporting farmers in adopting

59 regenerative practices such as no-till agriculture, cover cropping, perennial systems, and

60 managed grazing. These methods enhance soil resilience and contribute to long-term carbon

61 sequestration.

62 To prevent ecological collapse and ensure a livable planet for future generations, Vermont must

63 expand vegetation cover and increase both above- and below-ground biomass to support carbon

64 sequestration. Wetland protection and rehabilitation are also critical to achieving sequestration

65 goals. As some of the most efficient natural carbon sinks, wetlands store vast amounts of carbon

66 in waterlogged soils. Low oxygen levels slow decomposition and prevent carbon from being

67 released as CO_2. Additionally, wetlands continuously accumulate organic material, enhancing

68 their carbon storage capacity. However, when drained or degraded, these ecosystems release

69 stored carbon back into the atmosphere, worsening climate change. Protecting and restoring

70 wetlands is essential for maintaining their function as long-term carbon sinks.

71 Balancing human needs with the limits of natural systems is a major challenge. For generations,

72 Indigenous communities have applied Traditional Ecological Knowledge (TEK) to maintain

73 harmony between people and the environment. Vermont can integrate TEK into land

74 management to enhance carbon sequestration, strengthen biodiversity, and promote sustainable

75 stewardship. By learning from Indigenous ecological principles, Vermont can develop land-use

76 policies that align with natural systems rather than exploit them.

77 At the same time, Vermont must address the challenge of supporting the farm and forest sectors

78 while meeting increasing demands for housing and infrastructure. The state's landscapes provide

79 essential resources—food, fiber, and fuel—while serving as critical carbon sinks. However,

80 growing pressure from land development and competing uses threatens these functions.

81 Expanding housing, food production, and renewable energy projects must be carefully managed

82 to align with conservation goals and climate resilience strategies.

83 Equally important is the need to prioritize food security and equitable land access. Protecting

84 prime agricultural lands from development will sustain food production while simultaneously

85 sequestering carbon. Ensuring that farmers, foresters, and land-based entrepreneurs can access

86 land at affordable rates is critical to keeping Vermont's working landscapes viable. The

87 Intergovernmental Panel on Climate Change (IPCC) emphasizes that sustainable land

88 management can help meet climate goals, slow ecological crises, and provide access to nutritious

89 food. However, education and financial support are essential in helping land stewards adopt

90 regenerative practices that benefit the economy and the environment[3].

91 A strategic, well-supported approach to land stewardship—rooted in climate resilience, equity,

92 and ecological integrity—can position Vermont as a leader in natural climate solutions. The

93 priority actions listed below have been chosen to help align policies, funding, and education to

94 help the state meet its goals of safeguarding the landscape while meeting the needs of residents.

95 Thoughtful planning, community engagement, and proactive conservation efforts will guarantee

96 that Vermont's natural and working lands continue to serve as a cornerstone of the state's

97 climate resilience strategy.

98 **<u>Summary of Priority Pathways, Strategies, and Actions</u>:**

99 **Pathway 10 (Agriculture & Ecosystems): Maintain and expand Vermont's**
100 **natural and working lands' role in the mitigation of climate change through**
101 **human interventions to reduce the sources and enhance the sinks of**
102 **greenhouse gases.**

103   1. Increase funding, enhance, and adapt existing State of Vermont programs that support
104   GHG emissions reductions, soil carbon sequestration, and/or climate adaptation and
105   resiliency on working lands. Enhance and adapt programs to better incorporate climate
106   mitigation, adaptation, resilience, nature-based solutions, and TEK/IK. Example State
107   programs include, but are not limited to: AAFM: Ag-CWIP, BMP, CEAP, CREP, FAP,
108   GWFS, PSWF, VPFP, VFESP; ANR: ... Coordinate with USDA NRCS-VT
109   programming

---

[3] Chapter 6 : Interlinkages between desertification, land degradation, food security and GHG fluxes: synergies, trade-offs and integrated response options — Special Report on Climate Change and Land

110   to accelerate the implementation of federally funded climate mitigation and resilience

111   practices in Vermont.

112 Farmers, loggers, and forest managers are on the front lines of climate action, yet they often face

113 financial and logistical barriers to implementing sustainable practices. Vermont must enhance

114 and adapt existing state programs—such as Ag-CWIP, BMP, CEAP, and CREP—to integrate

115 climate mitigation, adaptation, and resilience measures. Additionally, coordination with USDA

116 NRCS-VT programs will accelerate the adoption of federally funded climate resilience

117 initiatives.

118 To facilitate access to these programs, the state must simplify application processes and

119 eliminate unnecessary barriers to participation. By streamlining support mechanisms, Vermont

120 can ensure that land stewards receive the resources they need to enhance soil health, increase

121 forest resilience, and improve overall ecosystem services.

122 2. Update the Vermont GHG Emission Inventory to account for both carbon sequestration

123   and emission reduction benefits from agriculture.

124 Current emissions tracking and sequestration accounting systems do not fully capture the

125 complex interactions within Vermont's natural and working lands. While extensive datasets exist

126 for water quality, they must be refined to quantify climate mitigation benefits accurately.

127 Additionally, existing tools for measuring carbon sequestration and emissions reductions must be

128 updated to reflect the latest scientific methodologies.

129 A key priority is updating Vermont's GHG Emission Inventory to align with the latest

130 Intergovernmental Panel on Climate Change (IPCC) guidance. This will ensure that the state's

131 climate goals and policies accurately reflect net emissions from agricultural and forest lands.

132 Investing in better data collection and modeling will allow for more precise crediting of climate

133 mitigation efforts, incentivizing land managers to adopt best practices.

134 3. Enhance education, outreach, research, and technical assistance programming to

135   encourage adoption of strategies that increase climate mitigation, adaptation, and

136   resilience on natural and working lands. Education should target farmers and loggers and

137   those providing technical assistance and should incorporate nature-based solutions and

138   Traditional Ecolgical knowldege/Indigenous Knowledge (TEK/IK).

139 Education and outreach are critical to empowering Vermont's landowners, farmers, and forest

140 managers to implement climate mitigation strategies effectively. The state must invest in

141 research and technical assistance programs that integrate Western science with Traditional

142 Ecological Knowledge/Indigenous Knowledge (TEK/IK).

143 Partnering with institutions like UVM Extension and other higher education organizations will

144 help develop training programs tailored to diverse audiences. These efforts should focus on

145 practical strategies for increasing soil carbon sequestration, enhancing forest resilience, and

146 implementing nature-based solutions. Additionally, outreach programs should target landowners

147 who are unaware of available resources and financial incentives.

148   4. Invest in Vermont's natural and working lands owners, managers, and caretakers to

149   enhance farm and forest viability and to support their informed decisions to increase their

150   operation's resilience and adaptation to climate change.

151 Vermont's forests and farmlands are increasingly threatened by development, which can

152 undermine their ability to sequester carbon and provide essential ecosystem services. To

153 counteract this trend, the state must enhance conservation programs such as the Vermont

154 Farmland Conservation Program and Forest Conservation Easements.

155 Conserving working lands safeguards their carbon storage capacity and ensures long-term

156 agricultural and forestry viability. Expanding eligibility for conservation incentives, identifying

157 high-value agricultural soils, and providing financial support for landowners to protect land will

158 strengthen Vermont's resilience against climate change.

159   5. Fund and implement Payment for Ecosystem Services (PES) program(s) for natural and

160   working lands to encourage landowners/managers to implement practices that improve

161   soil health, crop and forest resilience, increase carbon storage, increase stormwater

162   storage capacity, and reduce runoff. Fund existing agricultural PES programs (AAFM

163   VFESP and VPFP) and expand to include or develop new programs for forestry. (PES is

164   payment/compensation for increasing ecosystem services/environmental stewardship

165   achieved through better management of land by farmers and loggers and does not include

166   carbon trading or markets, which is not recommended by this subcommittee).

167 A fundamental shift in how Vermont values land stewards' contributions to climate mitigation is

168 needed. Implementing the Payment for Ecosystem Services (PES) program provides financial

169 incentives for landowners and managers who enhance soil health, increase carbon sequestration,

170 and improve watershed resilience.

171 Unlike carbon markets, which commodify emissions reductions, PES programs recognize

172 sustainable land management's broader social and environmental benefits. Vermont should fund

173 and expand existing agricultural PES programs—such as VFESP and VPFP—and develop new

174 programs specifically for forestry. PES programs will ensure that Vermont's natural and working

175 lands continue to provide essential ecosystem services by compensating farmers and loggers for

176 adopting climate-friendly practices.

177 <u>Shared Pathway</u>

178   6. Enhance education, outreach, research, and technical assistance programming to

179   encourage the adoption of strategies that increase climate mitigation, adaptation, and

180   resilience by farmers, foresters and other land and water caretakers. State agencies shall

181   work with and fund partners and higher education, such as UVM Extension. These efforts

182   should be incorporated into current programs, developed using braided Western science

183   and Traditional Ecological Knowledge/Indigenous Knowledge (TEK/IK), and designed

184   to represent diverse perspectives while addressing a diversity of audiences and age

185   groups.

186 Vermont has a unique opportunity to lead in climate action by embracing land-based

187 sequestration strategies while acknowledging the finite capacity of its ecosystems. The state can

188 build a more resilient and sustainable future by prioritizing investment in working lands,

189 supporting conservation efforts, and integrating TEK/IK.