

Natural Climate Solutions Literature Review

N&WL Sector	Activity/Pathway	Description and/or examples, if needed	GHG Reductio	GHG Storage	Citation
Forest/shrublands	Reduced degradation: forest and shrubland	Stopping further spread of invasive species and pathogens, managing for drought and extreme weather Avoided carbon emission resulting from changing forest types after deforestation; increasing carbon storage through continued forest and shrub growth	x	x	1, 2, 12, 26, 27
Forest/shrublands	Avoided conversion of forest and shrubland	Additional CO ₂ (and other GHG) sequestration by managed forest fire (prescribed fire or fire control) compared to unmanaged wildfire. Regeneration of biomass after fires.	x	x	1, 3, 4, 13, 14, 16, 17, 19, 20, 23, 25, 34
Forest/shrublands	Fire management	Reducing harvests, extending harvest rotation length, and improving the disposal of logging residues/slash through mulching/chipping of slash	x	x	1, 3, 9, 12, 13, 19, 25, 34
Forest/shrublands	Improved plantations	Natural regeneration of natural forests and the reduction of CO ₂ emissions to the atmosphere due to the cessation of natural forest logging; extension of logging rotations; reduced-impact logging practices that avoid damage to non-commercial trees; voluntary	x	x	1, 3, 9, 12, 13, 14, 16, 19, 34
Forest/shrublands	Improved/natural forest management in logged forest		x	-	1, 2, 3, 4, 9, 12, 14, 16, 19, 20, 24, 25, 34

		certification programs; regulatory requirements that limit impacts from logging; improved land tenure				
Forest/shrublands	Reduced deforestation: forest and shrubland conservation; forest and shrubland protection	Includes all forms of deforestation not included in other activities/pathways; conservation of old-growth forest	x	x	2, 9, 14, 24	
Forest/shrublands	Reforestation; restoration of forest and shrubland	Additional CO ₂ sequestration potential from restoring forest (including slash land, barren land, mountain, sloping cropland, or after wildfire) or shrubland to areas that were previously forest or shrubland. Improving forest and shrubland quality (e.g. replanting with native species). Also includes restoring tidal and riparian forest.	-	x	1, 2, 3, 4, 9, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 30, 34	
Forest/shrublands	Afforestation	Encouraging conversion of other land cover types, including urban, to forest or shrubland	-	x	2, 8, 9, 12, 16, 24, 34	
Urban forest	Reduced urban forest degradation	Stopping further spread of invasive species and pathogens, managing for drought and extreme weather	x	x	2, 4, 9, 31, 32, 33	

Urban forest	Afforestation in developed areas	Encouraging conversion of other land cover types within urban areas to urban forest; incorporating more trees in urban areas	-	x	1, 9, 15, 18, 19, 31, 33
	Avoided wetland/peatland conversion; wetland/peatland protection	Avoided CO ₂ emission of above- and belowground biomass and soil carbon due to avoided loss of wetlands and peatlands	x	x	1, 2, 3, 4, 9, 14, 17, 34
Wetland	Reduced wetland, peatland, seagrass degradation	Improved water quality; improved development practices like reduction of sediment loads and temperature controls; avoiding hydrological disturbance	x	x	2, 9, 12, 17, 23, 24, 25
Wetland	Peatland restoration	Avoided oxidation and leaching of soil carbon balanced against methane emission due to soil rewetting	x	x	1, 2, 3, 13, 16, 17, 18, 22, 23, 24
Wetland	Reduced seagrass degradation and conversion; seagrass protection	Improved water quality; implementing sustainable coastal development practices and fisheries practices; reducing risk of disturbance	x	x	2, 9, 12, 19, 36, 37, 38, 39, 40
Wetland	Coastal and terrestrial wetland restoration	Avoided oxidation of soil carbon and enhanced ecosystem carbon sink due to soil rewetting in mangroves, salt marshes, and seagrass beds.	x	x	1, 2, 3, 4, 9, 12, 17, 18, 22, 33
Wetland	Seagrass restoration	Additional carbon sequestration in below-ground biomass and soil carbon by restoring seagrass	x	x	19, 37, 39, 40

Grassland/rangeland	Avoided grassland conversion; grassland protection	Avoided CO ₂ emissions of belowground biomass and soil carbon by avoiding the conversion of grassland to urban or cropland	x	x	1, 2, 3, 9, 16, 19, 23, 34
	Improved/rotational grazing	Optimizing grazing intensity, planting legumes in pastures, improving feed (inclusion of energy-dense feeds (e.g., cereal grains) in the ration), animal management (e.g., improved livestock breeds, increased reproductive performance, health, and liveweight gain); additional carbon sequestration in above- and belowground biomass and soil carbon by grassland fencing management and pasture sowing	x	x	1, 3, 9, 12, 15, 16, 19, 23, 34, 54
Grassland/rangeland	Reduced grassland degradation	Prevent conversion to invasive annual plant-and juniper-dominated systems	x	x	9, 13, 35, 42, 43, 44, 45, 46, 54
Grassland/rangeland	Grassland fire management	Additional CO ₂ (and other GHG) sequestration by managed fire; other practices that contribute to lower fire risk not captured by other activities/pathways	x	x	24, 25, 34, 44, 45, 47
Grassland/rangeland	Grassland restoration	Additional carbon sequestration in below-ground biomass and soil carbon by restoring deep-rooted native perennial grasses to areas impacted by invasive species. Restoring native riparian grass species.	x	x	3, 9, 12, 13, 15, 16, 19, 34

<p>Converting idle or unproductive cropland to native grasses.</p>					
Croplands	Nutrient management	Improving crop nutrient management can reduce N ₂ O emission by reducing the overuse of fertilizer and improvement in N fertilizer use efficiency. Improve N application timing; replace N fertilizer with soil amendments such as compost or manure	x	-	1, 3, 4, 9, 12, 13, 16, 19, 25, 34
Croplands	Improve irrigation strategies and efficiencies	Irrigating at appropriate times reduces overall GHG emissions from soils	x	-	9, 10, 48, 49
Croplands	Prescribed/rotational grazing	Managing the harvest of vegetation with grazing and/or browsing animals to reduce crop residue and reduce GHG of providing other feed to livestock; increase organic carbon stocks in soils	x	x	9, 12, 15, 19, 25, 34
Croplands	No-till/reduced tillage	Limiting soil disturbance to manage amount, orientation, and distribution of crop and plant residue on the soil surface year-round	x	x	4, 9, 11, 12, 13, 14, 15, 57

Croplands	Conservation agriculture/cover crops/strip cropping	<p>Additional soil carbon sequestration by cover crops (i.e., green manure crops), crop rotation, edge-of-field herbaceous conservation practices, and strip cropping.</p> <p>Area suitable for planting cover crops includes cropland already planted with a perennial or winter crop.</p>	-	x	1, 3, 4, 9, 12, 13, 15, 16, 18, 19, 20, 21, 22, 34, 57
	Biochar/compost amendments	<p>Amending agricultural soils with biochar can increase the soil carbon pool by converting labile carbon to recalcitrant carbon through pyrolysis. Biochar mainly comes from crop residue.</p> <p>Applying composted organic wastes to cropland or pastures.</p>	-	x	3, 4, 12, 14, 15, 16, 19, 23, 24, 34, 48, 55, 56, 57
Croplands	Legume crops/legumes in pastures	<p>Increase carbon sequestration in soils and reduce need for application of N; growing forage grasses and legumes in a way that provides food sources for livestock while increasing soil carbon storage</p>	-	x	4, 5, 15, 16, 23, 34
	Trees in croplands/agroforestry	<p>Trees in windbreaks and riparian areas, alley cropping, and farmer-managed natural regeneration (FMNR)</p>	-	x	1, 2, 4, 9, 12, 15, 16, 18, 19, 20, 23, 24, 25, 28, 34
Croplands	Avoid conversion of agriculture	Avoid conversion to urban land cover	x	x	9, 50, 51, 52

Croplands	Silvopasture	Integrating trees, forage crops, and livestock systems on the same land through planting of trees and forages on same lands that animals graze	-	x	4, 6, 9, 12, 15, 53
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