Table S1. Average carbon sequestration potential for each management practice; soil depth, region as well as the references are given; Agricultural management practice had been applied for at least 20 years, and in some cases for more than 20 years.

Management practice	mean carbon sequestration rate (kg C ha^{-1} y^{-1})	Soil depth (cm)	Region	Publication
mineral fertilizer	58	0- 25/30	Lower Austria	[1]
	-198	0- 20	Lower Austria	[2]
	320	0- 15	Meta- analysis	[3]
	-280	0- 40	South- East UK	[4]
	0	0- 20	Meta- analysis	[5]
organic amendments				
farm yard manure	300	0- 40	South- East UK	[4]
	409	0- 25/30	Meta- analysis	[6]
	450	0-25	Meta- analysis	[3]
	160	0- 20	Germany	[7]
	60	0- 20	EU + UK	[8]
	267	0- 25/30	Lower Austria	[1]
	400	0- 20	Meta- analysis	[5]
compost	1010	0- 25/30	Lower Austria	[1]
	558	0- 20	Lower Austria	[2]
	1410	0- 40	South- East UK	[4]
	400	0- 20	Meta- analysis	[5]
	180	0- 20	EU + UK	[8]
	730	0-15	Meta- Analysis	[3]
retention of crop residues				
	200	0- 25/30	Lower Austria	[1]
	200	0- 15	Meta- analysis	[3]
	250	0- 40	Mediterranean regions	[9]
	110	0- 40	South- East UK	[4]
	50	0- 20	EU + UK	[8]
	200	0- 20	Meta- analysis	[5]
plant cultivation				
diversified crop rotation	200	0- 25/30	Meta- analysis	[10]
	30	0- 30	Meta- analysis	[3]
	320	0- 25/30	Meta- analysis	[11]
	168	0- 25/30	Sweden	[12]
	360	0- 25/30	Sweden	[13]
deep-rooting crop	320	0- 40	South- East UK	[4]
	240	0- 30	Midwest US	[14]
	360	0- 20	Sweden	[15] clay- texture
	590	0- 20	Sweden	[15] loam- texture
	360	0- 25/30	Sweden	[13]
catch crop	320	0- 25/30	Meta- analysis	[11]

	550	0- 25/30	Southern Italy	[16]
	185	0- 25/30	US	[17]
	560	0- 30	Meta- analysis	[18]
	400	0- 25	Denmark	[19]
no-tillage*				
	300	0- 30	Meta- analysis	[3]
	400	0- 30	Mediterranean regions	Mazzoncini et al 2016
	400	0- 20	Meta- analysis	[5]
	570	0- 20	Meta- analysis	[10]
	450	0- 20	Meta- analysis	[3]
	100	0- 30	Meta- analysis	[20]
	60	0- 30	Meta- analysis	[21]
	460	0- 15	Review	[22]
reduced tillage*				
	340	0- 15	Meta- analysis	[3]
	400	0- 20	Meta- analysis	[5]
	372	0- 25/30	Lower Austria	[1]
	480	0- 20	Switzerland	[23]
	310	0- 20	EU + UK	[8]
	40	0- 20	Meta- analysis	[24]
irrigation				
	-114	25- 30	Lower Austria	[1]
	75	0- 20	Review	[25]
	0	0- 20	Meta- analysis	[5]
organic farming				
	250	0- 20	Meta- analysis	[5]
	170	0- 15	Nebraska US	[26]
	216	0- 20	Review	[27]
	450	0- 15/20	Meta- analysis	Gattinger et al 2012
	400	0- 25	Denmark	[19]
	238	0- 30	Northern France	[28]
bare fallow				
	-189	0- 30	Lower Austria	[1]
	-580	0- 25	Russia-Kursk	[29]
	-365	0- 20	Sweden-Ultuna	[29]
	-541	0- 20	Denmark-Askov B3	[29]
	-507	0- 20	Denmark-Askov B4	[29]
	-453	0- 25	France-Grignon	[29]
	-535	0- 25	France-Versailles	[29]
	-880	0- 23	UK-Rothamsted	[29]
	-520	0- 20/30	NorthEast China	[30]
	-1000	0- 20/30	Finland-Jokionen	[21]

	-560	0- 20/30	Uzbekistan-Almalybak	[21]
	-310	0- 20/30	Italy_Lombriasco	[21]
	-510	0- 25	North New Zealand	[31]
	-480	0- 25	South New Zealand	[31]

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Table S2. The most compelling statements (benefit, trade-offs and research gaps) of current and future agricultural management practices are given as a summary.

Management practice	Benefit(s)	Trade-off(s)	Research gap(s)
Mineral nitrogen fertilization	• Enhanced crop primary (PP) production	• Production: CO_2 emissions • Application: N_2O losses	• Linkages between N fertilization (including P, K) and the stabilization of organic carbon
Organic amendments *(farmyard manure + compost application)*	• Enhanced crop PP • Additional carbon (C)-source (compost)	• Transportation: CO_2 emissions (local availability) • Livestock: CH_4 and N_2O emission • Redistribution of organic carbon (losses at donor sites)	• Impact of fresh or pre-processed (composting) organic fertilizer on the stabilization of SOC
(Retention of) Crop residues	• Minimize deliberate C/ nutrient removal; • Prevent soil erosion	• Crop incorporation: CH_4 and N_2O emissions	• Pest and diseases control (soil borne diseases)
Plant cultivation *Crop rotational diversity* *Cultivation of deep rooting crops* *Catch crop*	 • C4 plants assimilate more CO_2/ additional C source • Prevent soil erosion • enhance subsoil SOC • enhance soil infiltration • Additional period of C assimilation • prevent soil erosion/ nitrate leaching	• legumes: self- intolerant (breaks in cultivation) • catch crops: priming effect could reduce SOC • lower yields (?) of deep rooting crops • cover crops: (CO_2, N_2O emissions)	• long- term effect of deep rooting crops on subsoil SOC • stability of carbon excreted via rhizodeposition • impact of arbuscular mycorrhizae on C sequestration
Practice of reduced/ no tillage	• prevent soil erosion • soil aggregate stability	• weed control • reduced tillage soil becomes anaerobic (N_2O)	• SOC stocks calculated based on fixed depths vs equivalent soil mass • weed persistence and alternations of tillage practices (permanent seed bank)
Organic farming	• prevention of mineral fertilizers • diverse crop rotations with legumes and cover crops • low primary energy consumption	• tillage for weed control	• yield based assessments of GHG emissions • difficult delimitation of SOC effects between organic and conventional farming
Irrigation	• Enhanced crop PP	• enhanced SOM mineralization (CO_2) and denitrification (N_2O) • pumping: (CO_2) • water scarcity: conflict between agriculture, industry and human needs • leaching: nitrate + agrochemicals	• deep root irrigation
Biochar	• increase recalcitrant fraction of SOC • enhanced primary production	• availability, costs • can enhance soil pH • viticulture: copper immobilization/ accumulation	• long- term field studies including management and environmental factors

			• sorption of organic pollutants (e.g pesticides) or heavy metals/ trace elements
Lignocellulosic crops *Agroforestry/ Bioenergy production*	• Additional (woody) biomass integration • high primary production (lignocellulosic crops) • increase subsoil SOC • lessen erosion/ nitrate leaching	• economic restrictions (investment costs, lack of market for timber, high work load) • land competition (food/ fodder vs bioenergy production)	• long- term field studies • evaluation of status quo current state / spatial extent • trade-off between cultivation of crops for energy or food/ fodder production
Application of inorganic carbon *Carbonate minerals (liming)*	• enhanced primary production • ameliorate soil structure	• increased SOM mineralization • liming can reduce the availability of P; Zn, Mg • production, transportation, application: CO_2 emissions • environmental damage at extraction sites	• long- term field studies • SOM stabilization? • Soil aggregation/ structure?
silicate minerals	• CO_2 fixation through chemical weathering		• long- term field studies • life cycle assessments