Table S1. Conflicts between goals of soil restoration and agricultural production with the detailed compilation of statements and references. Agricultural goals in bold are those with stronger potential conflicts or more direct impacts and agricultural goals not in bold are those with weaker potential conflicts or indirect impacts from soil-oriented restoration techniques. The selection of listed restoration actions is those suggested by the group of authors (stemming from different disciplines of soil and restoration ecology) and recent publications of the topic to improve the most pressing soil threats suggested by the FAO[1]and reach the restoration goals suggested by this review. The list of restoration actions albeit not exhaustive should reflect the most straight forward and most applied soil restoration actions.

Goals of soil restoration	**Restoration actions,**	**Potential conflicts with goals of agricultural production**[2] *Productivity (yield, profitability)* *Resource-use efficiency (nutrients, water, labor)* *Soil health (i.e. production stability)*
Restoration of soil quality	**- Restoring soil physical quality: enhancing soil structure through erosion control and reducing soil compaction and disturbance**	
	Increasing vegetation cover as erosion control	(+) ***productivity/soil health****:* preservation of productive soils with sufficient organic matter (org. C) content[3,4] (-) ***productivity****/resource use efficiency:* extra labor of cover-cropping, enhanced weed-cover, reduced yield through crop plant competition with weeds[5] (but *see* [6])
	Decreasing use of heavy machinery to reduce compaction	(+) ***resource-use efficiency****:* preservation of soils with high capacity of water regulation and nutrient cycling[7] (-) *productivity/****resource-use efficiency****:* slower/smaller/less profitable production through use of lighter machinery and higher labor

	Reducing soil disturbance	(+) **soil health**/*resource-use efficiency:* less carbon mineralization and increased functioning and resource-efficiency in well-structured soils[8] (-) ***productivity****:* reduced yield due to short cropping cycles (e.g., low tillage)
Restoration of soil quality	**- Restoring soil chemical quality: reducing soil eutrophication, contamination, and salinization**	
	Reducing eutrophication through reducing fertilizer inputs	(-) ***productivity****:* reduced yield, if not compensated by biological or high precision fertilizer application (+) ***resource-use efficiency****:* reduced costs, less leaching risks and groundwater contamination[9.10] (+) ***resource-use efficiency****:* stronger, more effective microbially assisted nutrient cycling (partially replacing lower fertilizer inputs)[8]
	Reducing contamination/nutrient levels through topsoil removal or bioremediation	(-) *productivity/**soil health**:* if achieved through topsoil removal, reduction of organic carbon content and associated effects on yield and stability of production, similar to effects of soil erosion[11,12,13] (+/-) ***productivity****:* if achieved through bioremediation, only temporal extra labor and pause of the production during the amendment[14]
	Reducing salinization through effective water management	(+) ***productivity****:* maintenance of livable, potentially productive soils (-) ***resource-use efficiency****:* installation and maintenance costs and labor, as adjusted water management might require irrigation from external water sources

	- Restoring soil biological quality: increasing soil organic matter content and soil biodiversity	
	Enhancing/stabilizing soil organic matter content through increasing vegetation cover or afforestation	(+) ***soil health****:* increase of soil organic matter content[15] (+) ***productivity****:* improved soil structure and functioning (-) ***productivity****/resource-use efficiency:* if achieved through increasing vegetation cover[11] likely leading to extra labor of cover-cropping and enhanced weed cover, and reduced yield through crop plant competition with weeds[16,17] (but *see* [6] for positive weed effects on yield). (-) ***productivity****:* if achieved through afforestation, reducing area for agricultural crops, or reducing yields through crop plant competition with tree species
	Enhancing soil biodiversity through reduction of biochemicals, inoculation with microorganism or diversification of vegetation cover	(+) ***productivity****:* improved pest-control with diverse vegetation and soil communities and thus production stability[18] (+) ***productivity****/resource-use efficiency:* inoculum from less diverse, targeted taxon groups (e.g., mycorrhizal fungi), with benefits of crop plant performance (growth, nutrient and water uptake); but less diverse soil communities[19] (-) ***productivity****:* inoculum from diverse, natural mixtures (e.g., native soils), potentially with increased availability of pathogenic soil organisms in diverse soils reducing crop plant performance[20] (-) ***productivity****:* increased availability of pathogenic soil organisms in due to reduction of biochemicals (-) ***productivity****:* extra labor of cover-cropping and intercropping, enhanced weed-cover, reduced yield through competition of crop plant with weeds/surrounding plants or intercrops [16,17] (but *see* [6] for positive weed effects on yield).

Goals of soil restoration	Restoration techniques	Potential conflicts with goals of agricultural production[2] *Productivity (yield, profitability)* *Resource-use efficiency (nutrients, water, labor)* *Soil health (i.e. production stability)*
Improve soil health (i.e. soil multifunctionality)	*Increasing multiple functions instead of maximizing single functions*	(+) ***productivity/resource-use efficiency****/soil health:* healthy, resilient, well-functioning soils with stability of production[21] (-) ***productivity****:* impairment of maximizing multifunctionality with maximizing one function locally, e.g., yield[22]
Acknowledge and use the interdependence of soil biodiversity and functioning	*Use synergies between restoration measures for biodiversity and functioning*	(+) ***productivity****/resource-use efficiency:* several positive effect of soil biodiversity on productivity through assisted nutrient uptake and increased pathogen resistance lower the need/costs of adding fertilizers and pesticides[18,20] (-) ***productivity****:* frequent trade-off between increase in soil biodiversity and yield[16]
Acknowledge and use the interdependence of vegetation and soil	*Use synergies between restoration measures for vegetation and soil*	(+) *productivity/resource-use efficiency/****soil health****:* several positive effects of vegetation restoration on soil and vice versa (e.g., vegetation cover stabilizes soil organic matter content allowing for high productivity; vegetation diversification increases soil biodiversity; soil microbial diversity enhances vegetation establishment and efficient nutrient cycling) (-) *productivity/resource-use efficiency:* extra labor of vegetation-centered measures like cover-cropping and intercropping, enhanced weed-cover, reduced yield through competition of crop plant with weeds/surrounding plants or intercrops [16,17] (but *see* [6] for positive weed effects on yield).
Halt soil degradation through changing land use and maintaining landscape-scale soil diversity	*Reducing land use intensity and diversifying land use at the landscape scale*	(+) ***productivity****:* if applied in the land-scape scale surrounding the agricultural sites, with positive spill-over effects on the agricultural sites without direct impact[23,24] (-) ***resource-use efficiency****:* increased labour costs for establishment/maintenance

Table S2: Overview of the synergies between strategies of sustainable agriculture, improvement of soil threats and soil-related threats to the ecosystem and soil restoration actions with detailed compilation of the statements and references Impact strength of sustainable agriculture on soil threats and restoration actions is differentiated as main impacts i.e. those directly addressed by sustainable agricultural strategies, and side impacts i.e. those not directly prioritized by the agricultural strategy and/or occurring indirectly alongside the intended agricultural measures. Statements in bold are stronger or more direct impacts and statements in not-bold are weaker or indirect impacts. Intended, direct measures are expected to have generally stronger impact than indirect side impacts. The selection of listed soil threats is based on those published by the FAO[1] and the restoration actions are those suggested by the group of authors (stemming from different disciplines of soil and restoration ecology) and recent publications of the topic to improve these soil threats and reach the restoration goals suggested by this review. The list of restoration action albeit not exhaustive should reflect the most straight forward and most applied soil restoration actions.

Strategies for sustainable agriculture	**Improvement of soil/ecosystem threats**	**Synergies with soil restoration strategies**
Organic Agriculture *Goal: enhancement of soil fertility and biological diversity without addition of chemical inputs or mineral fertilizers*[25,26]	• **Soil organic matter loss** • **Loss of soil biodiversity** • **Soil contamination** • Soil erosion • Decline in Pollinators	• **Reduced soil disturbance** • **Diversification of vegetation cover** • **Reduced fertilizer inputs** • **Reduced chemical inputs** • Increased vegetation cover • Inoculation of microbes • Bioremediation
Regenerative Agriculture *Goal: Soil conservation (reduced soil disturbance, increased soil cover, support of soil diversity and integration of livestock* [9,27]	• **Soil organic matter loss** • **Soil erosion** • **Loss of soil biodiversity** • Soil contamination • Soil compaction	• **Reduced soil disturbance** • **Increased vegetation cover** • **Reduced chemical inputs** • Reduced use of heavy machinery • Improved water management • Diversification of vegetation cover • Reduced fertilizer inputs • Inoculation with microbes
Conservation Agriculture *Goal: Similar to that of regenerative agriculture but with focus on using the positive interaction of biodiversity and ecosystem functioning*[28]	• **Soil erosion** • **Loss of soil biodiversity** • Soil contamination • Soil compaction • Loss of soil organic matter	• **Increased vegetation cover** • **Diversification of vegetation cover** • **Inoculation with microbes** • Reduced soil disturbance • Reduced use of heavy machinery • Improved water management • Reduced fertilizer inputs • Reduced chemical inputs
Solving specific problems	• **Soil erosion** • **Soil contamination**	• **Increased vegetation cover** • **Bioremediation** • **Topsoil removal** • **Improved water management**
Restoration of Matrix Ecosystems *Goal: Surrounding agricultural production sites with buffer and connection patches*[11,29]	• **Loss of soil biodiversity** • **Decline in pollinators**	• **Diversification of vegetation cover**

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