Supplementary

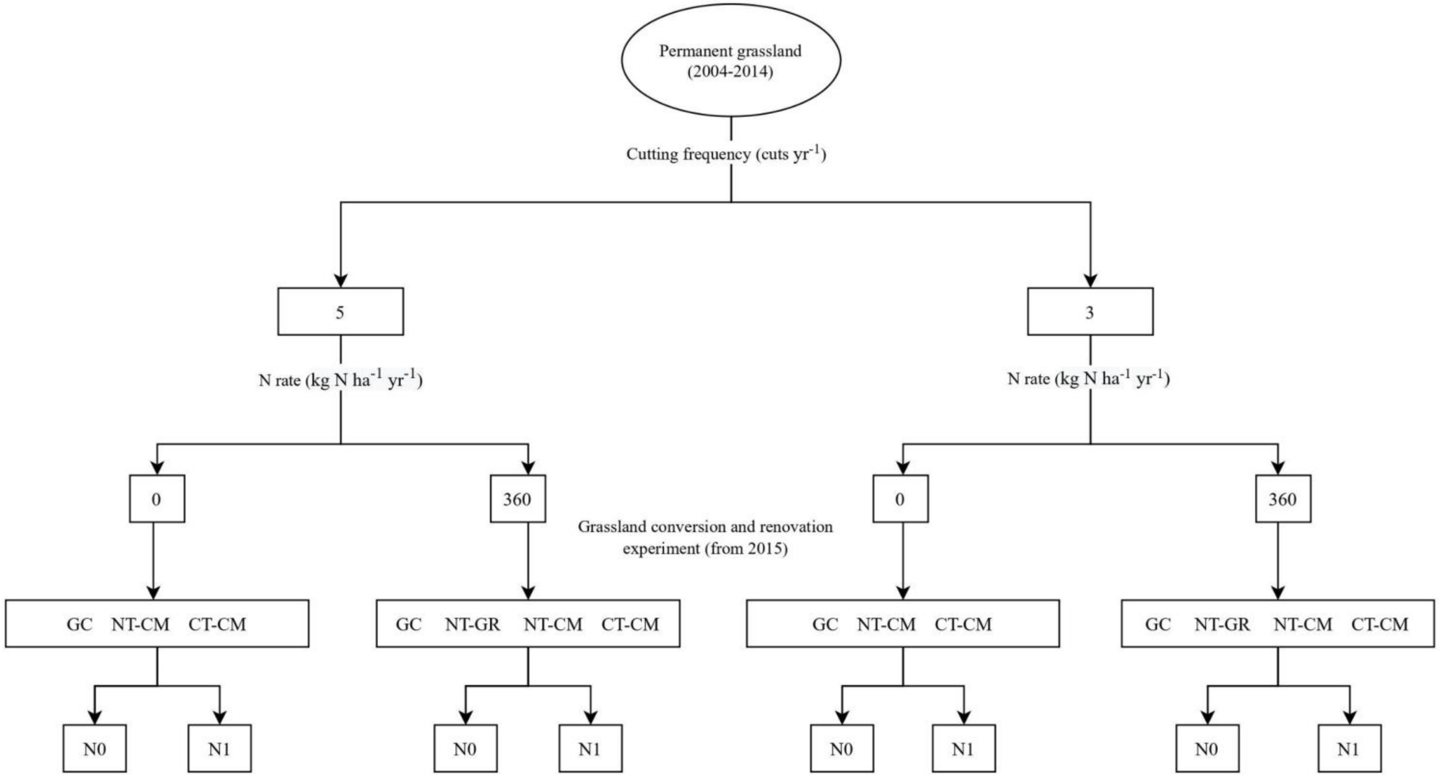

Figure S1. Diagram of pre-management factors existing in the permanent grassland (2004 – 2014) and the treatments introduced with the grassland conversion and renovation experiment from 2015. GC stands for undisturbed grassland control, NT-GR for no-till grassland renovation, NT-CM for no-till continuous silage maize, and CT-CM for conventionally tilled continuous silage maize. The N0 and N1 refer to the non-fertilized and fertilized systems using CAN, respectively, based on a crop demand of 380 kg N ha^{-1} yr^{-1} for the grassland systems, and 180 kg N ha^{-1} yr^{-1} for the silage maize systems.

Table S1. Mean legume share (%) in the different grassland treatments measured annually between 2005 and 2014, given in ascending order. Before conversion in 2014, the dominating legume species were alfalfa (*Medicago sativa*) and white clover (*Trifolium repens*), whereas the dominating grass species were orchard grass (*Dactylis glomerata*) and perennial ryegrass (*Lolium perenne*) in the 3- and 5-cut treatments, respectively. Source (Nüsse et al., 2018; Schmeer et al., 2014).

Cutting frequency *(cuts yr^{-1})*	**N rate** *(kg N ha^{-1} yr^{-1})*	**Legume and grass share** Mean *(%)*	**Dominant species** *(legume, grass)*
5	360	2	*Trifolium repens,*
		98	*Lolium perenne*
3	360	28	*Medicago Sativa,*
		72	*Dactylis glomerata*
5	0	43	*Trifolium repens,*
		57	*Lolium perenne*
3	0	64	*Medicago Sativa,*
		36	*Dactylis glomerata*

Table S2. Mean soil organic carbon (SOC) stocks and standard deviations (S.D.) measured at the end of the year 2014, in the different pre-management levels of the permanent grassland . Values are ordered from smallest to largest mean SOC by soil depth.

Soil depth *(cm)*	**Cutting frequency** *(cuts yr^{-1})*	**N rate** *(kg N ha^{-1} yr^{-1})*	**Mean SOC stock (S.D.)** *(Mg C ha^{-1})*
0-30	3	0	71.2 (6.1)
	5	360	72.2 (6.8)
	5	0	72.8 (6.2)
	3	360	72.9 (7.0)
30-60	3	0	34.6 (10.1)
	3	360	37.2 (10.2)
	5	360	40.8 (11.8)
	5	0	41.6 (9.0)
60-90	3	0	13.2 (5.3)
	3	360	13.4 (5.6)
	5	360	13.8 (6.8)
	5	0	16.6 (7.7)

Table S3. Analysis of Variance (ANOVA) evaluating the effects of cutting frequencies and N application rates on the soil organic carbon (SOC) stocks at different soil depth in the 10-year-old grass sward, at the end of the year 2014. The *, **, ***, and **** indicate significant P values < 0.05, 0.01, 0.001, and 0.0001 respectively.

Fixed effects	Degrees of freedom†	F-value	P-value	
(Intercept)	1, 147	485.99	<.0001	****
Cutting frequency	1, 1	0.19	0.74	
N rate	1, 38	0.49	0.49	
Soil depth	**2, 147**	**275.46**	**<.0001**	****
Cutting frequency × N rate	1, 38	0.43	0.51	
Cutting frequency × Soil depth	2, 147	0.70	0.49	
N rate × Soil depth	2, 147	0.28	0.75	
Cutting Frequency × N rate × Soil depth	2, 147	0.02	0.98	

†Degrees of freedom (numerator, denominator)

Table S4. Mean annual yields (Y_P) with standard deviations (S.D.) measured for the period 2015 - 2020.

Cropping system	N rate	Mean Y_P (S.D.) *(Mg ha^{-1} yr^{-1})*
GC	N0	8.6 (3.4)
GC	N1	13.0 (3.0)
NT-GR	N0	7.8 (3.6)
NT-GR	N1	11.3 (3.0)
NT-CM	N0	12.4 (3.4)
NT-CM	N1	16.9 (4.2)
CT-CM	N0	14.3 (4.1)
CT-CM	N1	19.2 (2.9)

GC: grassland control (undisturbed permanent grassland); NT-GR: grassland renovation with no-tillage; NT-CM: continuous maize with no tillage; CT-CM: continuous maize with conventional tillage;

N0: non-fertilized; N1: fertilized with CAN with application rates of 380 kg N ha^{-1} yr^{-1} for the grassland systems, and on basis of a crop demand of 180 kg N ha^{-1} yr^{-1} for the maize systems.

Table S5. Yield-based allocation coefficients and fixed inputs used to calculate the annual soil C inputs (C_i) from plants, during and after the growing season, respectively.

Crop	**Cropping System**	**N rate**	**Yield-based allocation coefficients**[1]				**Fixed inputs**[2]	
			HI¶	**SI**#	**ACDM AGB***	**R:S**§	**AW–AG$_i$**	**AW–BG$_i$**
			(Fraction)			*(Ratio)*	*(Mg C ha^{-1})*	
Grassland	GC	N0	0.78	0.15	0.91	0.89	0.40	0.60
		N1	0.78	0.15	0.91	0.31	0.46	0.38
	NT-GR	N0	0.78	0.15	0.91	0.81	0.40	0.60
		N1	0.78	0.15	0.91	0.34	0.46	0.38
Maize	NT-CM	N0	0.95	0.05	0.95	0.13		
		N1	0.95	0.05	0.95	0.08		
	CT-CM	N0	0.95	0.05	0.95	0.08		
		N1	0.95	0.05	0.95	0.06		

[1]: Obtained from Struck (2018); [2]: obtained from Loges et al. (2018)

¶: Harvest index is the yield to total aboveground biomass (AGB) ratio

#: Stubble index is the stubbles to total aboveground biomass (AGB) ratio (see text for details)

*: Fraction of ash-corrected dry matter (ACDM) in total AGB

§: Root:shoot ratios are ash-corrected

The AW–AG$_i$ and BG$_i$ stand for the ash-corrected crop residue inputs in the grassland systems from above- and belowground biomass, respectively.

GC: grassland control (undisturbed permanent grassland); NT-GR: grassland renovation with no tillage; NT-CM: continuous maize with no-tillage; CT-CM: continuous maize with conventional tillage;

N0: non-fertilized; N1: fertilized with CAN with application rates of 380 kg N ha^{-1} yr^{-1} for the grassland systems, and on basis of a crop demand of 180 kg N ha^{-1} yr^{-1} for the maize systems.

Table S6. Steps and equations used to calculate annual soil C inputs in each cropping system, using the annual yields (Y_P) from Tables S4, and using the yield-based allocation coefficients and fixed inputs from Table S5. See text for details.

Steps	**Equations**
1	$AGB = Y_P/HI \times ACDM_{AGB}$
2	$Stubbles = AGB \times SI$
3	$BGB = AGB \times R:S$
4	$AG\ C_i = (Stubbles + AW–AG_i) \times 0.48$ $BG\ C_i = [BGB + AW–BG_i + (BGB + AW–BG_i) \times 0.5] \times 0.48$
6	$Total\ C_i = AG\ C_i + BG\ C_i$

For crops without fixed inputs (See Table S5), AW–AG$_i$ and AW–BG$_i$ = 0

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