

Supplementary Materials

SM 1. Details of Displacement Factor derivation

Nutritive capacity balance under a LUC:

$LUC_i * (1000 * Nutri_C) * Yd_i^C = LUC_i * (1000 * Nutri_G) * Yd_i^G + \alpha * (1000 * Nutri_C) * Yd_{PDO}^C$ where Yd_{PDO}^C is the average yield of cropland in the PDO area.

We can derive that $Yd_i^C = \frac{Nutri_G}{Nutri_C} * Yd_i^G + \frac{\alpha}{LUC_i} * Yd_{PDO}^C$

Thus, $\frac{\alpha}{LUC_i} * Yd_{PDO}^C = Yd_i^C - \frac{Nutri_G}{Nutri_C} * Yd_i^G$

And $ConversionFactor_i = \frac{\alpha}{LUC_i} = \frac{Yd_i^C - \frac{Nutri_G}{Nutri_C} * Yd_i^G}{Yd_{PDO}^C}$

SM 2. Descriptive Statistics of the farms' characteristics and practices.

Variables	Description	Mean	St. Dev.	Min	Max
Net Environmental Performance per L	Net environmental performance per liter, in kg CO ₂ eq (opposite of net GHG emissions per liter). ^{a, c}	-1.12	0.43	-2.16	-0.26
Gross Environmental Performance per L	Gross environmental performance per liter, in kg CO ₂ eq (opposite of gross GHG emissions per liter). ^{a, c}	-1.20	0.18	-1.65	-0.75
Economic Performance per L	Economic performance per liter, in € (gross profit per liter). ^b	0.32	0.11	-0.10	0.49
Net Environmental Performance per Ha	Net environmental performance per hectare, in kg CO ₂ eq (Opposite of net GHG emissions per ha). ^{a, c}	-3,554.76	2,060.45	-5,149.29	-222.33
Gross Environmental Performance per Ha	Gross environmental performance per hectare, in kg CO ₂ eq (Opposite of gross GHG emissions per ha). ^{a, c}	-3,539.75	1,386.20	-6,479.32	-945.42
Economic	Economic Performance per hectare, in €	997.15	488.60	-119.23	2,080.15

Performance per Ha	(Gross profit per ha). ^b				
Labor Use per cow	Number of persons working on the farm, owner included, divided by the herd size. ^a	0.03	0.01	0.01	0.11
Fuel per Ha	Fuel consumption per hectare per year in liter. ^a	67.50	35.28	9.91	185.24
Electricity per cow	Electricity consumption per cow per year in Kwh. ^a	366.10	179.49	84.88	1,030.07
Concentrate per cow	Concentrate feed bought per year in kg. ^a	988.23	360.33	0.00	2,081.81
Share protein in the diet	Share of protein matter in cows' diet. ^a	0.14	0.01	0.12	0.18
Share grass in the diet	Share of grass in the diet. ^a	0.01	0.02	0.00	0.09
Share hay in the diet	Share of hay in the diet. ^a	0.96	0.06	0.78	1.00
Age first calving	Age of the cows when they give birth to their first calf and start producing milk, in months. ^a	32.13	2.96	26	36
Stocking rate	Number of cow per hectare. ^a	0.81	0.26	0.31	1.41
Herd's Renewal	Ratio of the number of cows on the number of heifer, proxy for the	0.31	0.09	0.00	0.60

Rate	renewal rate of the herd. ^a				
Ecological Focus Area	Amount of Ecological Focus Area ^{a, d}	3.24	2.02	0.19	10.17
Farm's size	Number of cows. ^a	91.81	50.93	18.61	249.00
Mineral N spread on pasture	Amount of mineral Nitrogen spread per ha and per year on pastures, in N unit. ^a	13.89	15.28	0.00	65.25
Mineral N spread on cereals	Amount of mineral Nitrogen spread per ha and per year on cropland, in N unit. ^a	38.91	59.61	0.00	224.00
Organic N on pasture	Amount of organic fertilizers (manure, slurry) per ha and per year on pastures in N unit. ^a	73.68	26.50	23.99	156.74
Organic N spread on cereals	Amount of organic fertilizers (manure, slurry) spread per ha and per year on cropland, in N unit. ^a	3.93	7.14	0.00	29.05
Mineral P spread on pasture	Amount of mineral Phosphorus spread per ha and per year on pastures, in N unit. ^a	5.16	8.60	0.00	44.00
Mineral P spread on cereals	Amount of mineral Phosphorus spread per ha and per year on cropland, in N unit. ^a	7.65	20.86	0.00	110.00

Mineral K spread on pasture	Amount of mineral Potassium spread per ha and per year on pastures, in N unit. ^a	6.60	10.96	0.00	62.60
Mineral K spread on cereals	Amount of mineral Potassium spread per ha and per year on cropland, in N unit. ^a	8.83	25.14	0.00	119.00
Share manure in organic fertilizers	Share on manure over the total organic fertilizers spread. ^a	0.47	0.08	0.23	0.68
Manure Composing	The farm practices manure composting or not. ^a	0.32	0.47	0	1
Yields of grass	Yields of grass, ton per hectare. ^a	4.42	1.63	0.93	8.92
Yields of forrage	Yields of forrage, ton per hectare. ^a	2.85	3.38	1.54	16.00
Yields of cereals	Yields of cereals, ton per hectare. ^a	2.28	2.87	0.00	7.90
Share of Cambisol	Share of Cambisol, communal level.	0.49	0.27	0.01	1.00
Share of Podzoluvisol	Share of Podzoluvisol, communal level.	0.00	0.00	0	0
Share of Luvisol	Share of Luvisol, communal level, %	0.19	0.25	0.00	0.70
Average Slope	Average slope, communal level, %	20.30	14.56	0.41	58.75
Rainfall	Annual precipitation, communal level, mm	1,136.75	207.05	418	1,569

Temperature	Annual temperature, communal level, °C	8.38	2.13	0	12
-------------	--	------	------	---	----

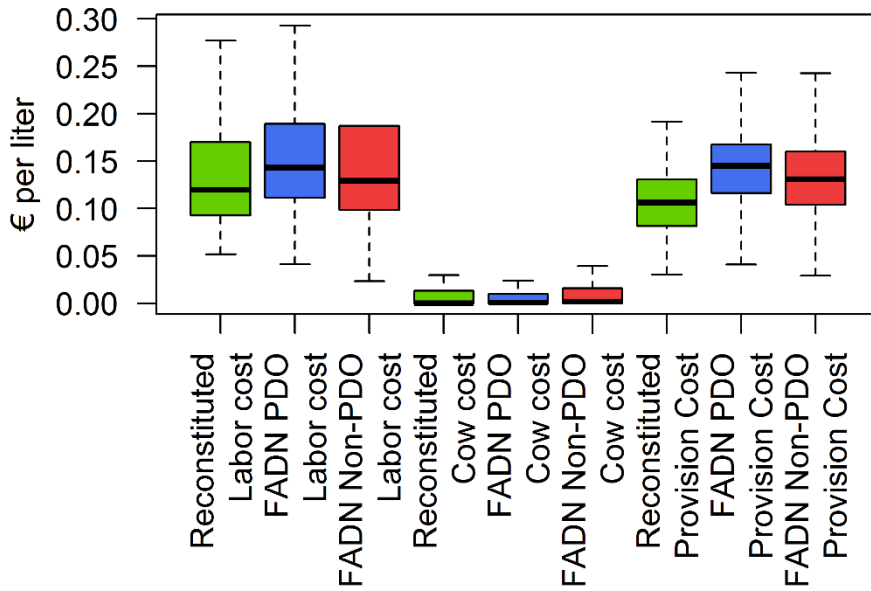
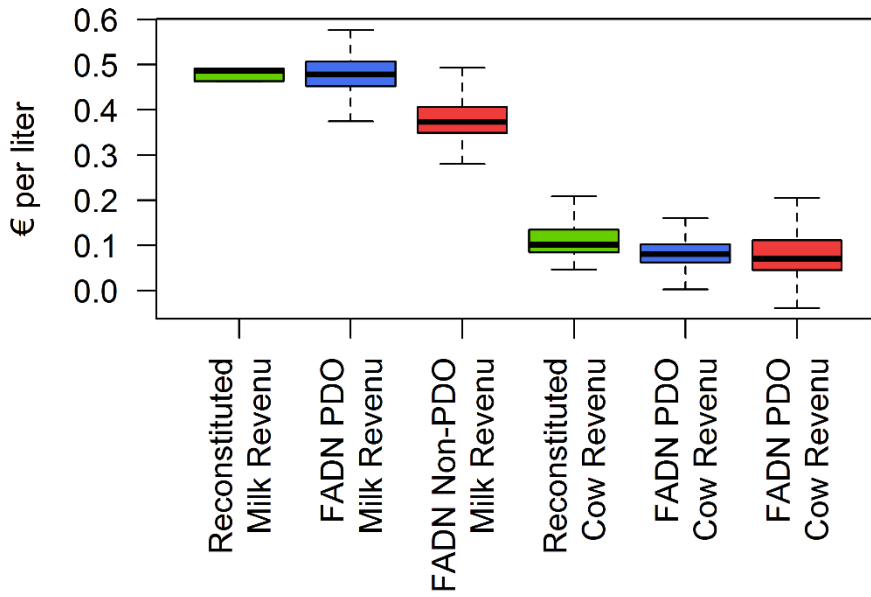
Sources: a. (Institut de L'Élevage, 2013; Michaud, 2016; Perrard, 2016)

b. FADN; (Ministère de l'Agriculture et de l'Alimentation, 2015a, 2017); (Eurostat, 2017).

c. CAP'2ER (Institut de l'Élevage, 2013)

d. The Ecological Focus Area is computed by aggregating all natural elements creating biodiversity (trees, hedge, terraces, and ponds) after applying a biodiversity coefficient to each type. For example, 1 linear meter of hedge corresponds to 10m² of Ecological Focus Area, while 1m² of pond correspond to 1m² of Ecological Focus Area (Ministère de l'Agriculture et de l'Alimentation, 2015b).

SM 3. Detailed revenue and cost reconstitution



SM 4. Complete OLS results

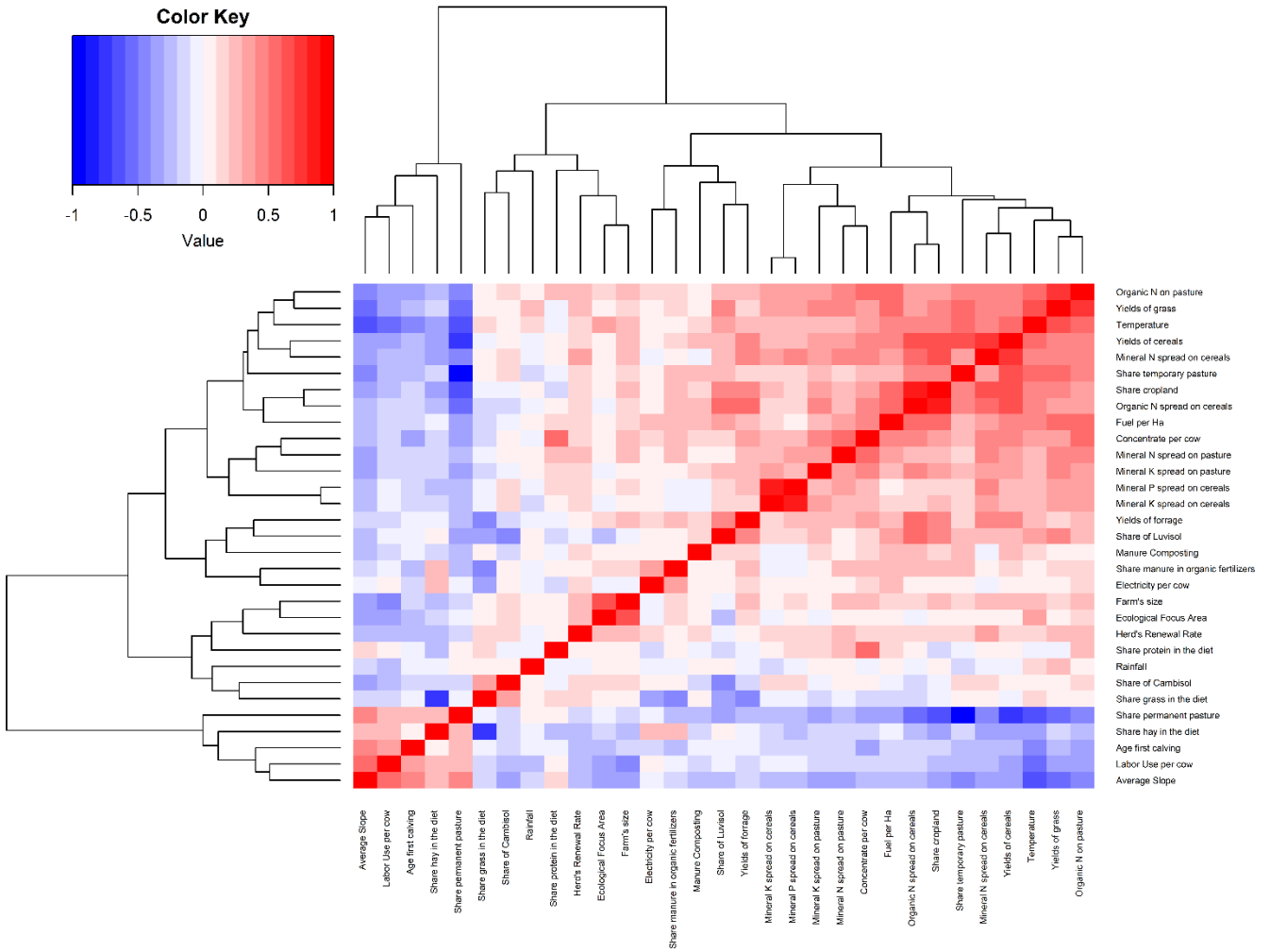
	Net Environmental performance per L (1)	Gross Environmental performance per L (2)	Economic performance per L (3)	Net Environmental performance per Ha (4)	Gross Environmental performance per Ha (5)	Economic performance per Ha (6)
Labor Use per cow	-5.00 (3.38)	-1.04 (2.24)	-6.08*** (0.70)	1,745.81 (11,773.86)	6,819.09 (5,484.13)	-15,319.7*** (2,878.36)
Fuel per Ha	-0.002* (0.001)	-0.001 (0.001)	0.0002 (0.0002)	-4.31 (4.15)	-5.22*** (1.93)	0.61 (1.01)
Electricity per cow	0.0004** (0.0002)	0.0003** (0.0001)	-0.0000 (0.0000)	-0.03 (0.67)	-0.54* (0.31)	0.17 (0.16)
Concentrate per cow	-0.0000 (0.0001)	0.0000 (0.0001)	-0.0000 (0.0000)	-0.14 (0.46)	-0.42* (0.21)	0.02 (0.11)
Share protein in the diet	3.50 (3.99)	-1.91 (2.64)	-2.91*** (0.83)	2,058.35 (13,888.51)	-5,106.24 (6,469.11)	-8,415.21** (3,395.33)
Share grass in the diet	-0.004 (0.01)	-0.002 (0.01)	0.0002 (0.002)	8.48 (28.57)	12.12 (13.31)	-7.58 (6.98)
Share hay in the diet	-0.002 (0.01)	-0.002 (0.01)	-0.001 (0.002)	10.87 (27.10)	6.35 (12.62)	-8.58 (6.63)
Age first calving	-0.01 (0.01)	0.01 (0.01)	0.003 (0.003)	-22.89 (42.06)	-1.11 (19.59)	8.17 (10.28)
Herd's Renewal Rate	-0.26 (0.36)	-0.30 (0.24)	0.003 (0.07)	338.87 (1,254.81)	-241.20 (584.48)	58.94 (306.76)
Ecological Focus Area	-0.0001 (0.0002)	-0.0002 (0.0001)	-0.0001** (0.0000)	0.69 (0.69)	-0.17 (0.32)	-0.43** (0.17)
Farm's size	-0.001 (0.001)	-0.0001 (0.001)	0.0001 (0.0002)	-1.64 (2.96)	0.78 (1.38)	0.29 (0.72)
Mineral N spread on pasture	0.003 (0.003)	-0.0002 (0.002)	0.0001 (0.001)	-14.56 (9.10)	-19.47*** (4.24)	6.68*** (2.23)
Mineral N spread on cereals	-0.001 (0.001)	-0.0001 (0.0005)	-0.0001 (0.0001)	-1.89 (2.49)	-0.45 (1.16)	-0.40 (0.61)
Organic N on pasture	-0.004** (0.002)	0.0005 (0.001)	0.0000 (0.0003)	-38.55*** (5.81)	-32.19*** (2.71)	7.57*** (1.42)

Organic N spread on cereals	-0.003 (0.01)	0.001 (0.005)	0.001 (0.001)	-1.28 (24.51)	14.40 (11.42)	1.59 (5.99)
Mineral P spread on pasture	-0.003 (0.005)	0.004 (0.003)	0.001 (0.001)	-15.15 (16.25)	1.86 (7.57)	3.70 (3.97)
Mineral K spread on pasture	-0.001 (0.004)	-0.002 (0.002)	-0.001 (0.001)	-4.31 (13.03)	-1.82 (6.07)	-4.56 (3.19)
Mineral K spread on cereals	0.001 (0.001)	0.0004 (0.001)	0.0002 (0.0003)	0.79 (4.59)	-1.22 (2.14)	1.76 (1.12)
Share manure in organic fertilizers	-0.69 (0.49)	-0.08 (0.32)	0.01 (0.10)	-3,593.83** (1,705.98)	-305.90 (794.63)	222.04 (417.06)
Manure Composting	-0.14** (0.07)	-0.09** (0.04)	-0.01 (0.01)	-306.13 (235.60)	-84.75 (109.74)	-97.04* (57.60)
Share of Cambisol	-0.28** (0.14)	-0.05 (0.09)	-0.01 (0.03)	-837.91* (476.74)	-76.30 (222.06)	-138.32 (116.55)
Share of Luvisol	0.31 (0.21)	0.05 (0.14)	-0.004 (0.04)	-197.33 (721.91)	-347.88 (336.26)	94.57 (176.49)
Average Slope	-0.002 (0.004)	-0.002 (0.002)	-0.001 (0.001)	1.65 (12.25)	6.38 (5.71)	-6.09** (3.00)
Year 2014	0.25* (0.15)	0.05 (0.10)	0.07** (0.03)	466.74 (519.56)	-216.89 (242.01)	265.60** (127.02)
Year 2015	0.23** (0.10)	0.03 (0.07)	0.08*** (0.02)	385.91 (364.97)	-123.96 (170.00)	334.65*** (89.23)
Rainfall	0.0001 (0.0002)	-0.0001 (0.0001)	0.0000 (0.0000)	0.93* (0.55)	-0.35 (0.26)	-0.17 (0.14)
Temperature	-0.14*** (0.03)	-0.01 (0.02)	0.001 (0.01)	-286.19*** (101.57)	49.36 (47.31)	-16.25 (24.83)
Constant	1.01 (1.23)	-0.53 (0.81)	0.81*** (0.25)	2,645.66 (4,267.82)	-43.49 (1,987.90)	2,579.30** (1,043.36)
Observations	95	95	95	95	95	95
R ²	0.75	0.35	0.82	0.87	0.94	0.86
Adjusted R ²	0.65	0.09	0.75	0.81	0.91	0.80

Note: *** p < 0.001, ** p < 0.01, * p < 0.05

SM 5.

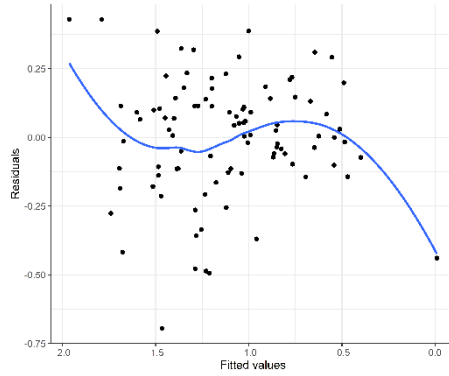
Correlation Matrix of the explanatory variables



Correlation Matrix of the explanatory variables

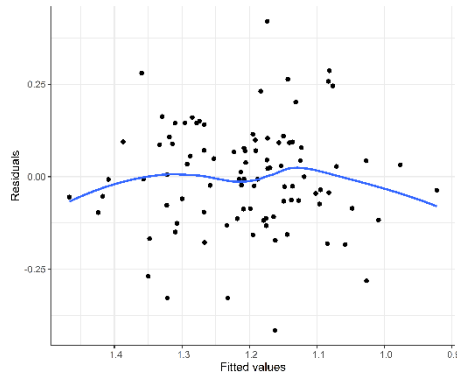
SM 6.

Heteroscedasticity's correction Check of the OLS model

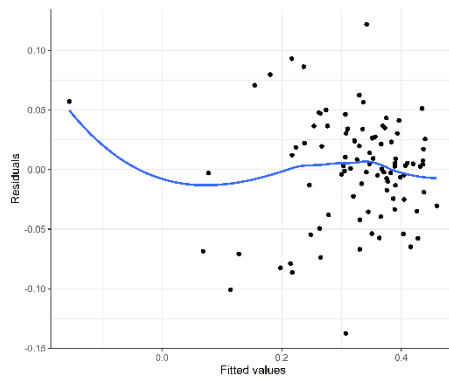


Residual vs fitted values' plot for Model 1

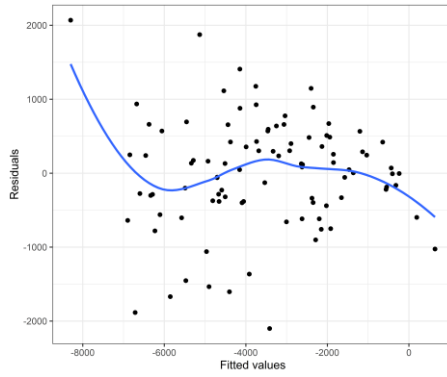
Residual vs fitted values' plot for Model 2



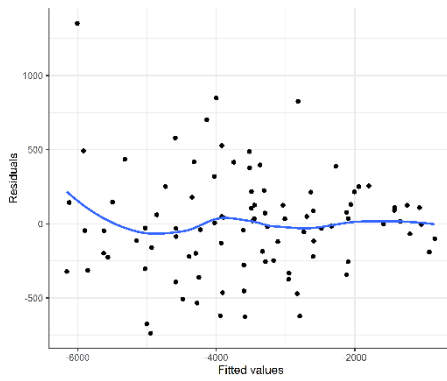
Residual vs fitted values' plot for Model 3



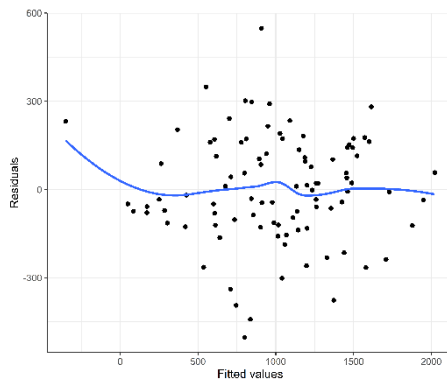
Residual vs fitted values' plot for Model 4



Residual vs fitted values' plot for Model 5



Residual vs fitted values' plot for Model 6



SM 7. Sensibility Analysis: GHG emissions without allocation to milk

	Net Environmental performance per L (1)	Gross Environmental performance per L (2)	Economic performance per L (3)	Net Environmental performance per Ha (4)	Gross Environmental performance per Ha (5)	Economic performance per Ha (6)
Labor Use per cow	-7.21 (4.41)	-2.47 (2.99)	-6.08*** (0.70)	-42.63 (13,602.61)	6,518.86 (5,457.78)	-15,319.70*** (2,878.36)
Fuel per Ha	-0.003* (0.002)	-0.001 (0.001)	0.0002 (0.0002)	-6.02 (4.79)	-6.79*** (1.92)	0.61 (1.01)
Electricity per cow	0.001** (0.0002)	0.0004** (0.0002)	-0.0000 (0.0000)	0.10 (0.77)	-0.62** (0.31)	0.17 (0.16)
Concentrate per cow	0.0000 (0.0002)	0.0001 (0.0001)	-0.0000 (0.0000)	0.02 (0.53)	-0.35 (0.21)	0.02 (0.11)
Share protein in the diet	5.95 (5.20)	-0.59 (3.53)	-2.91*** (0.83)	6,254.37 (16,045.71)	-4,081.04 (6,438.03)	-8,415.21** (3,395.33)
Share grass in the diet	-0.004 (0.01)	-0.0005 (0.01)	0.0002 (0.002)	4.44 (33.00)	10.27 (13.24)	-7.58 (6.98)
Share hay in the diet	-0.003 (0.01)	-0.002 (0.01)	-0.001 (0.002)	5.39 (31.31)	1.68 (12.56)	-8.58 (6.63)
Age first calving	-0.02 (0.02)	0.005 (0.01)	0.003 (0.003)	-40.69 (48.59)	-12.71 (19.50)	8.17 (10.28)
Herd's Renewal Rate	-0.60 (0.47)	-0.56* (0.32)	0.003 (0.07)	-266.71 (1,449.71)	-806.63 (581.67)	58.94 (306.76)
Ecological Focus Area	-0.0001 (0.0003)	-0.0002 (0.0002)	-0.0001** (0.0000)	0.88 (0.80)	-0.13 (0.32)	-0.43** (0.17)
Farm's size	-0.001 (0.001)	-0.0003 (0.001)	0.0001 (0.0002)	-1.76 (3.42)	0.97 (1.37)	0.29 (0.72)
Mineral N spread on pasture	0.004 (0.003)	0.0002 (0.002)	0.0001 (0.001)	-15.95 (10.52)	-22.43*** (4.22)	6.68*** (2.23)
Mineral N spread on cereals	-0.0000 (0.001)	0.0004 (0.001)	-0.0001 (0.0001)	-0.79 (2.88)	0.64 (1.16)	-0.40 (0.61)
Organic N on	-0.005**	0.0003	0.0000	-48.76***	-40.88***	7.57***

pasture	(0.002)	(0.001)	(0.0003)	(6.72)	(2.69)	(1.42)
Organic N spread on cereals	-0.01 (0.01)	-0.002 (0.01)	0.001 (0.001)	-8.81 (28.32)	12.19 (11.36)	1.59 (5.99)
Mineral P spread on pasture	-0.005 (0.01)	0.004 (0.004)	0.001 (0.001)	-20.52 (18.78)	0.65 (7.53)	3.70 (3.97)
Mineral K spread on pasture	-0.001 (0.005)	-0.002 (0.003)	-0.001 (0.001)	-6.56 (15.06)	-2.67 (6.04)	-4.56 (3.19)
Mineral K spread on cereals	0.001 (0.002)	0.0003 (0.001)	0.0002 (0.0003)	0.02 (5.30)	-2.36 (2.13)	1.76 (1.12)
Share manure in organic fertilizers	-0.54 (0.64)	0.39 (0.43)	0.01 (0.10)	-3,881.26* (1,970.96)	384.25 (790.81)	222.04 (417.06)
Manure composting	-0.16* (0.09)	-0.10* (0.06)	-0.01 (0.01)	-318.37 (272.19)	-75.90 (109.21)	-97.04* (57.60)
Share of Cambisol	-0.33* (0.18)	-0.07 (0.12)	-0.01 (0.03)	-971.54* (550.79)	-114.34 (220.99)	-138.32 (116.55)
Share of Luvisol	0.34 (0.27)	0.05 (0.18)	-0.004 (0.04)	-483.26 (834.04)	-678.24** (334.64)	94.57 (176.49)
Average Slope	-0.004 (0.005)	-0.01* (0.003)	-0.001 (0.001)	-5.36 (14.16)	-0.93 (5.68)	-6.09** (3.00)
Year 2014	0.29 (0.19)	0.10 (0.13)	0.07** (0.03)	434.54 (600.26)	-298.46 (240.84)	265.60** (127.02)
Year 2015	0.34** (0.14)	0.14 (0.09)	0.08*** (0.02)	540.41 (421.66)	-49.06 (169.18)	334.65*** (89.23)
Rainfall	0.0002 (0.0002)	0.0001 (0.0001)	0.0000 (0.0000)	1.16* (0.64)	-0.22 (0.26)	-0.17 (0.14)
Temperature	-0.19*** (0.04)	-0.02 (0.03)	0.001 (0.01)	-388.64*** (117.35)	25.89 (47.08)	-16.25 (24.83)
Constant	1.01 (1.60)	-1.34 (1.09)	0.81*** (0.25)	4,129.21 (4,930.71)	504.55 (1,978.35)	2,579.30** (1,043.36)
Observations	95	95	95	95	95	95
R ²	0.71	0.35	0.82	0.88	0.95	0.86
Adjusted R ²	0.60	0.09	0.75	0.83	0.93	0.80

Note: *** p < 0.001, ** p < 0.01, * p < 0.05

SM 8. Sensitivity Analysis: changing the LCA's perimeter

Regression output without accounting for GHG emission from the production and transportation off-farm

	Net Environmental performance per L (1)	Gross Environmental performance per L (2)	Economic performance per L (3)	Net Environmental performance per Ha (4)	Gross Environmental performance per Ha (5)	Economic performance per Ha (6)
Labor Use per cow	-7.08** (3.34)	-3.12 (2.49)	-6.08*** (0.70)	-1,428.72 (11,738.04)	3,644.56 (6,336.61)	-15,319.70*** (2,878.36)
Fuel per Ha	-0.002 (0.001)	-0.001 (0.001)	0.0002 (0.0002)	-4.47 (4.13)	-5.39** (2.23)	0.61 (1.01)
Electricity per cow	0.0004** (0.0002)	0.0002 (0.0001)	-0.0000 (0.0000)	-0.54 (0.67)	-1.05*** (0.36)	0.17 (0.16)
Concentrate per cow	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0000 (0.0000)	-0.51 (0.46)	-0.79*** (0.25)	0.02 (0.11)
Share protein in the diet	-2.50 (3.94)	-7.90*** (2.94)	-2.91*** (0.83)	-12,795.90 (13,846.26)	-19,960.49*** (7,474.70)	-8,415.21** (3,395.33)
Share grass in the diet	-0.001 (0.01)	0.001 (0.01)	0.0002 (0.002)	22.00 (28.48)	25.64* (15.37)	-7.58 (6.98)
Share hay in the diet	-0.0003 (0.01)	-0.0003 (0.01)	-0.001 (0.002)	19.89 (27.02)	15.37 (14.58)	-8.58 (6.63)
Age first calving	-0.01 (0.01)	0.004 (0.01)	0.003 (0.003)	-28.97 (41.93)	-7.19 (22.64)	8.17 (10.28)
Herd's Renewal Rate	-0.48 (0.36)	-0.51* (0.27)	0.003 (0.07)	295.07 (1,250.99)	-285.00 (675.33)	58.94 (306.76)
Ecological Focus Area	-0.0001 (0.0002)	-0.0002 (0.0001)	-0.0001** (0.0000)	0.57 (0.69)	-0.29 (0.37)	-0.43** (0.17)
Farm's size	-0.0004 (0.001)	0.0002 (0.001)	0.0001 (0.0002)	-0.33 (2.95)	2.09 (1.59)	0.29 (0.72)
Mineral N spread on pasture	0.002 (0.003)	-0.002 (0.002)	0.0001 (0.001)	-21.76** (9.08)	-26.66*** (4.90)	6.68*** (2.23)

Mineral N spread on cereals	-0.0001 (0.001)	0.0003 (0.001)	-0.0001 (0.0001)	-0.64 (2.49)	0.80 (1.34)	-0.40 (0.61)
Organic N on pasture	-0.003** (0.002)	0.001 (0.001)	0.0000 (0.0003)	-45.00*** (5.80)	-38.65*** (3.13)	7.57*** (1.42)
Organic N spread on cereals	0.0002 (0.01)	0.004 (0.01)	0.001 (0.001)	9.17 (24.44)	24.86* (13.19)	1.59 (5.99)
Mineral P spread on pasture	-0.002 (0.005)	0.005 (0.003)	0.001 (0.001)	-12.19 (16.20)	4.82 (8.75)	3.70 (3.97)
Mineral K spread on pasture	-0.001 (0.004)	-0.001 (0.003)	-0.001 (0.001)	-3.89 (12.99)	-1.40 (7.01)	-4.56 (3.19)
Mineral K spread on cereals	0.001 (0.001)	0.0004 (0.001)	0.0002 (0.0003)	-0.33 (4.57)	-2.35 (2.47)	1.76 (1.12)
Share manure in organic fertilizers	-0.59 (0.48)	0.02 (0.36)	0.01 (0.10)	-3,006.53* (1,700.79)	281.41 (918.15)	222.04 (417.06)
Manure Composting	-0.15** (0.07)	-0.10* (0.05)	-0.01 (0.01)	-306.01 (234.88)	-84.62 (126.80)	-97.04* (57.60)
Share of Cambisol	-0.34** (0.14)	-0.12 (0.10)	-0.01 (0.03)	-919.79* (475.29)	-158.18 (256.58)	-138.32 (116.55)
Share of Luvisol	0.24 (0.20)	-0.01 (0.15)	-0.004 (0.04)	-458.03 (719.72)	-608.58 (388.53)	94.57 (176.49)
Average Slope	-0.004 (0.003)	-0.004 (0.003)	-0.001 (0.001)	-1.15 (12.22)	3.58 (6.59)	-6.09** (3.00)
Year 2014	0.25* (0.15)	0.05 (0.11)	0.07** (0.03)	419.99 (517.98)	-263.65 (279.63)	265.60** (127.02)
Year 2015	0.28*** (0.10)	0.08 (0.08)	0.08*** (0.02)	399.49 (363.86)	-110.38 (196.43)	334.65*** (89.23)
Rainfall	0.0003 (0.0002)	0.0000 (0.0001)	0.0000 (0.0000)	1.08* (0.55)	-0.20 (0.30)	-0.17 (0.14)
Temperature	-0.14*** (0.03)	-0.01 (0.02)	0.001 (0.01)	-268.17** (101.26)	67.38 (54.67)	-16.25 (24.83)
Constant	1.43 (1.21)	-0.11 (0.90)	0.81*** (0.25)	3,728.14 (4,254.84)	1,038.99 (2,296.91)	2,579.30** (1,043.36)
Observations	95	95	95	95	95	95

R ²	0.72	0.47	0.82	0.89	0.94	0.86
Adjusted R ²	0.61	0.26	0.75	0.85	0.92	0.80

Note: *** p < 0.001, ** p < 0.01, * p < 0.05

SM 9. Sensitivity Analysis: accounting for the impact of management practices on carbon sequestration

	Net Environmental performance per L (1)	Gross Environmental performance per L (2)	Economic performance per L (3)	Net Environmental performance per Ha (4)	Gross Environmental performance per Ha (5)	Economic performance per Ha (6)
Labor Use per cow	-8.22** (3.82)	-1.04 (2.24)	-6.08*** (0.70)	-4,422.44 (11,278.95)	6,819.09 (5,484.13)	-15,319.70*** (2,878.36)
Fuel per Ha	-0.001 (0.001)	-0.001 (0.001)	0.0002 (0.0002)	-4.50 (3.97)	-5.22*** (1.93)	0.61 (1.01)
Electricity per cow	0.001** (0.0002)	0.0003** (0.0001)	-0.0000 (0.0000)	0.18 (0.64)	-0.54* (0.31)	0.17 (0.16)
Concentrate per cow	-0.0000 (0.0001)	0.0000 (0.0001)	-0.0000 (0.0000)	-0.46 (0.44)	-0.42* (0.21)	0.02 (0.11)
Share protein in the diet	7.54* (4.50)	-1.91 (2.64)	-2.91*** (0.83)	12,473.64 (13,304.71)	-5,106.24 (6,469.11)	-8,415.21** (3,395.33)
Share grass in the diet	0.005 (0.01)	-0.002 (0.01)	0.0002 (0.002)	39.48 (27.37)	12.12 (13.31)	-7.58 (6.98)
Share hay in the diet	-0.001 (0.01)	-0.002 (0.01)	-0.001 (0.002)	14.87 (25.96)	6.35 (12.62)	-8.58 (6.63)
Age first calving	-0.02* (0.01)	0.01 (0.01)	0.003 (0.003)	-83.01** (40.29)	-1.11 (19.59)	8.17 (10.28)
Herd's Renewal Rate	-0.38 (0.41)	-0.30 (0.24)	0.003 (0.07)	-312.01 (1,202.07)	-241.20 (584.48)	58.94 (306.76)
Ecological Focus Area	0.0001 (0.0002)	-0.0002 (0.0001)	-0.0001** (0.0000)	1.23* (0.66)	-0.17 (0.32)	-0.43** (0.17)
Farm's size	-0.0003 (0.001)	-0.0001 (0.001)	0.0001 (0.0002)	0.35 (2.84)	0.78 (1.38)	0.29 (0.72)
Mineral N spread on pasture	0.01* (0.003)	-0.0002 (0.002)	0.0001 (0.001)	-2.81 (8.72)	-19.47*** (4.24)	6.68*** (2.23)
Mineral N spread	-0.0003	-0.0001	-0.0001	-0.61	-0.45	-0.40

on cereals	(0.001)	(0.0005)	(0.0001)	(2.39)	(1.16)	(0.61)
Organic N on pasture	-0.003 (0.002)	0.0005 (0.001)	0.0000 (0.0003)	-41.49 ^{***} (5.57)	-32.19 ^{***} (2.71)	7.57 ^{***} (1.42)
Organic N spread on cereals	-0.01 (0.01)	0.001 (0.005)	0.001 (0.001)	-19.38 (23.48)	14.40 (11.42)	1.59 (5.99)
Mineral P spread on pasture	-0.004 (0.01)	0.004 (0.003)	0.001 (0.001)	-21.30 (15.57)	1.86 (7.57)	3.70 (3.97)
Mineral K spread on pasture	-0.001 (0.004)	-0.002 (0.002)	-0.001 (0.001)	0.69 (12.48)	-1.82 (6.07)	-4.56 (3.19)
Mineral K spread on cereals	0.0003 (0.001)	0.0004 (0.001)	0.0002 (0.0003)	-1.31 (4.39)	-1.22 (2.14)	1.76 (1.12)
Share manure in organic fertilizers	-0.52 (0.55)	-0.08 (0.32)	0.01 (0.10)	-2,737.76 [*] (1,634.27)	-305.90 (794.63)	222.04 (417.06)
Manure Composting	-0.07 (0.08)	-0.09 ^{**} (0.04)	-0.01 (0.01)	-97.83 (225.69)	-84.75 (109.74)	-97.04 [*] (57.60)
Share of Cambisol	-0.14 (0.15)	-0.05 (0.09)	-0.01 (0.03)	-665.29 (456.70)	-76.30 (222.06)	-138.32 (116.55)
Share of Luvisol	0.50 ^{**} (0.23)	0.05 (0.14)	-0.004 (0.04)	370.53 (691.57)	-347.88 (336.26)	94.57 (176.49)
Average Slope	-0.004 (0.004)	-0.002 (0.002)	-0.001 (0.001)	-4.04 (11.74)	6.38 (5.71)	-6.09 ^{**} (3.00)
Year 2014	0.25 (0.17)	0.05 (0.10)	0.07 ^{**} (0.03)	258.25 (497.72)	-216.89 (242.01)	265.60 ^{**} (127.02)
Year 2015	0.16 (0.12)	0.03 (0.07)	0.08 ^{***} (0.02)	45.04 (349.63)	-123.96 (170.00)	334.65 ^{***} (89.23)
Rainfall	0.0001 (0.0002)	-0.0001 (0.0001)	0.0000 (0.0000)	0.43 (0.53)	-0.35 (0.26)	-0.17 (0.14)
Temperature	-0.10 ^{***} (0.03)	-0.01 (0.02)	0.001 (0.01)	-221.89 ^{**} (97.30)	49.36 (47.31)	-16.25 (24.83)
Constant	-0.22 (1.38)	-0.53 (0.81)	0.81 ^{***} (0.25)	1,453.74 (4,088.43)	-43.49 (1,987.90)	2,579.30 ^{**} (1,043.36)
Observations	95	95	95	95	95	95

R ²	0.50	0.35	0.82	0.85	0.94	0.86
Adjusted R ²	0.30	0.09	0.75	0.79	0.91	0.80

Note: *** p < 0.001, ** p < 0.01, * p < 0.05

SM 10. Sensibility Analysis: accounting for indirect land-use changes (upper-bound estimate of iLUC effect)

	Net Environmental performance per L (1)	Gross Environmental performance per L (2)	Economic performance per L (3)	Net Environmental performance per Ha (4)	Gross Environmental performance per Ha (5)	Economic performance per Ha (6)
Labor Use per cow	25.08 (23.31)	-1.04 (2.24)	-6.08 ^{***} (0.70)	24,218.63 (44,896.55)	6,819.09 (5,484.13)	-15,319.70 ^{***} (2,878.36)
Fuel per Ha	0.01 (0.01)	-0.001 (0.001)	0.0002 (0.0002)	-2.44 (15.81)	-5.22 ^{***} (1.93)	0.61 (1.01)
Electricity per cow	-0.0000 (0.001)	0.0003 ^{**} (0.0001)	-0.0000 (0.0000)	-1.41 (2.54)	-0.54 [*] (0.31)	0.17 (0.16)
Concentrate per cow	0.001 (0.001)	0.0000 (0.0001)	-0.0000 (0.0000)	-1.01 (1.74)	-0.42 [*] (0.21)	0.02 (0.11)
Share protein in the diet	-37.39 (27.50)	-1.91 (2.64)	-2.91 ^{***} (0.83)	-36,921.72 (52,960.21)	-5,106.24 (6,469.11)	-8,415.21 ^{**} (3,395.33)
Share grass in the diet	-0.01 (0.06)	-0.002 (0.01)	0.0002 (0.002)	-31.26 (108.93)	12.12 (13.31)	-7.58 (6.98)
Share hay in the diet	-0.02 (0.05)	-0.002 (0.01)	-0.001 (0.002)	-73.91 (103.34)	6.35 (12.62)	-8.58 (6.63)
Age first calving	0.09 (0.08)	0.01 (0.01)	0.003 (0.003)	12.79 (160.39)	-1.11 (19.59)	8.17 (10.28)
Herd's Renewal Rate	-0.66 (2.48)	-0.30 (0.24)	0.003 (0.07)	-5,490.30 (4,784.90)	-241.20 (584.48)	58.94 (306.76)
Ecological Focus Area	0.0005 (0.001)	-0.0002 (0.0001)	-0.0001 ^{**} (0.0000)	-2.85 (2.64)	-0.17 (0.32)	-0.43 ^{**} (0.17)
Farm's size	0.002 (0.01)	-0.0001 (0.001)	0.0001 (0.0002)	11.79 (11.29)	0.78 (1.38)	0.29 (0.72)
Mineral N spread on pasture	-0.02 (0.02)	-0.0002 (0.002)	0.0001 (0.001)	-45.80 (34.72)	-19.47 ^{***} (4.24)	6.68 ^{***} (2.23)
Mineral N spread	0.002	-0.0001	-0.0001	8.81	-0.45	-0.40

on cereals	(0.005)	(0.0005)	(0.0001)	(9.51)	(1.16)	(0.61)
Organic N on pasture	0.03** (0.01)	0.0005 (0.001)	0.0000 (0.0003)	-0.89 (22.17)	-32.19*** (2.71)	7.57*** (1.42)
Organic N spread on cereals	0.02 (0.05)	0.001 (0.005)	0.001 (0.001)	123.63 (93.46)	14.40 (11.42)	1.59 (5.99)
Mineral P spread on pasture	0.05 (0.03)	0.004 (0.003)	0.001 (0.001)	110.32* (61.98)	1.86 (7.57)	3.70 (3.97)
Mineral K spread on pasture	-0.03 (0.03)	-0.002 (0.002)	-0.001 (0.001)	-63.91 (49.69)	-1.82 (6.07)	-4.56 (3.19)
Mineral K spread on cereals	-0.001 (0.01)	0.0004 (0.001)	0.0002 (0.0003)	-2.14 (17.49)	-1.22 (2.14)	1.76 (1.12)
Share manure in organic fertilizers	-0.13 (3.38)	-0.08 (0.32)	0.01 (0.10)	6,831.58 (6,505.31)	-305.90 (794.63)	222.04 (417.06)
Manure Composting	0.19 (0.47)	-0.09** (0.04)	-0.01 (0.01)	1,070.51 (898.38)	-84.75 (109.74)	-97.04* (57.60)
Share of Cambisol	1.09 (0.94)	-0.05 (0.09)	-0.01 (0.03)	3,691.97** (1,817.92)	-76.30 (222.06)	-138.32 (116.55)
Share of Luvisol	-2.04 (1.43)	0.05 (0.14)	-0.004 (0.04)	-2,770.03 (2,752.83)	-347.88 (336.26)	94.57 (176.49)
Average Slope	-0.01 (0.02)	-0.002 (0.002)	-0.001 (0.001)	6.75 (46.72)	6.38 (5.71)	-6.09** (3.00)
Year 2014	-0.77 (1.03)	0.05 (0.10)	0.07** (0.03)	-2,828.05 (1,981.22)	-216.89 (242.01)	265.60** (127.02)
Year 2015	-0.97 (0.72)	0.03 (0.07)	0.08*** (0.02)	-2,393.36* (1,391.73)	-123.96 (170.00)	334.65*** (89.23)
Rainfall	-0.001 (0.001)	-0.0001 (0.0001)	0.0000 (0.0000)	-5.66*** (2.11)	-0.35 (0.26)	-0.17 (0.14)
Temperature	0.70*** (0.20)	-0.01 (0.02)	0.001 (0.01)	1,437.10*** (387.33)	49.36 (47.31)	-16.25 (24.83)
Constant	-7.57 (8.45)	-0.53 (0.81)	0.81*** (0.25)	-1,108.96 (16,274.23)	-43.49 (1,987.90)	2,579.30** (1,043.36)
Observations	95	95	95	95	95	95

R ²	0.67	0.35	0.82	0.58	0.94	0.86
Adjusted R ²	0.53	0.09	0.75	0.41	0.91	0.80

Note: *** p < 0.001, ** p < 0.01, * p < 0.05

SM 11. Interaction effects

	Net Environmental performance per L (1)	Gross Environmental performance per L (2)	Economic performance per L (3)	Net Environmental performance per Ha (4)	Gross Environmental performance per Ha (5)	Economic performance per Ha (6)
Electricity per cow	-0.001 (0.001)	-0.001 (0.001)	-0.0003 (0.0002)	-2.68 (3.87)	-1.43 (1.81)	0.04 (0.92)
Share hay in the diet	-0.01 (0.01)	-0.01 (0.01)	-0.003 (0.003)	-16.56 (43.77)	-2.59 (20.43)	-11.93 (10.42)
Fuel per ha	0.001 (0.01)	-0.001 (0.004)	0.002 (0.001)	6.15 (23.13)	-0.96 (10.80)	-0.05 (5.51)
Share grass in the diet	0.06 (0.05)	-0.04 (0.03)	0.001 (0.01)	394.16** (179.97)	151.98* (84.02)	-63.65 (42.85)
Concentrates	0.0001 (0.001)	-0.0003 (0.0004)	-0.0001 (0.0001)	1.43 (1.94)	0.43 (0.91)	-0.48 (0.46)
Labor Use per cow	-4.43 (3.64)	-2.12 (2.33)	-6.43*** (0.72)	1,415.10 (12,341.19)	5,683.35 (5,761.38)	-17,635.98*** (2,938.55)
Share protein in the diet	3.25 (4.18)	-1.10 (2.68)	-2.74*** (0.82)	2,826.73 (14,191.77)	-3,911.25 (6,625.30)	-7,089.72** (3,379.19)
Age first calving	-0.02 (0.01)	0.01 (0.01)	0.004 (0.003)	-58.13 (46.25)	-10.62 (21.59)	16.61 (11.01)
Herd's Renewal Rate	-0.20 (0.38)	-0.22 (0.24)	0.02 (0.07)	388.22 (1,286.06)	-302.58 (600.39)	75.16 (306.22)
Ecological Focus Area	-0.0002 (0.0002)	-0.0001 (0.0001)	-0.0001 (0.0000)	0.30 (0.78)	-0.17 (0.36)	-0.32* (0.19)
Farm's size	-0.0005 (0.001)	-0.0004 (0.001)	0.0000 (0.0002)	0.18 (3.27)	1.09 (1.52)	-0.13 (0.78)
Mineral N spread on pasture	0.001 (0.01)	0.01* (0.01)	0.01** (0.002)	8.16 (36.23)	5.72 (16.92)	29.66*** (8.63)
Mineral N spread on cereals	-0.001 (0.001)	-0.0001 (0.0005)	-0.0001 (0.0001)	-1.95 (2.55)	-0.25 (1.19)	-0.32 (0.61)
Organic N on pasture	-0.005** (0.002)	0.001 (0.001)	0.0003 (0.0004)	-40.09*** (6.51)	-31.26*** (3.04)	9.50*** (1.55)
Organic N spread on cereals	-0.0002 (0.01)	0.001 (0.005)	0.002 (0.002)	16.44 (25.97)	22.11* (12.12)	1.87 (6.18)
Mineral P spread on pasture	-0.002 (0.005)	0.003 (0.003)	0.0002 (0.001)	-11.86 (16.66)	1.54 (7.78)	1.81 (3.97)
Mineral K spread	-0.002	-0.001	-0.001	-11.29	-3.93	-3.78

on pasture	(0.004)	(0.003)	(0.001)	(13.46)	(6.29)	(3.21)
Mineral K spread	0.001	0.001	0.0005	3.21	0.77	2.95**
on cereals	(0.001)	(0.001)	(0.0003)	(5.07)	(2.36)	(1.21)
Share manure in	-0.67	0.05	0.05	-3,877.95**	-342.16	329.02
organic fertilizers	(0.52)	(0.33)	(0.10)	(1,747.42)	(815.77)	(416.08)
Manure	-0.17**	-0.09**	-0.02	-390.50	-109.48	-79.66
Composting	(0.07)	(0.05)	(0.01)	(249.88)	(116.66)	(59.50)
Share of Cambisol	-0.26*	-0.04	-0.02	-758.66	-71.84	-151.14
	(0.15)	(0.09)	(0.03)	(501.37)	(234.06)	(119.38)
Share of Luvisol	0.27	0.11	0.02	-227.83	-280.80	213.23
	(0.22)	(0.14)	(0.04)	(737.92)	(344.49)	(175.71)
Average Slope	-0.002	-0.002	-0.001	-1.24	5.94	-5.43*
	(0.004)	(0.002)	(0.001)	(12.37)	(5.78)	(2.95)
Year dummy 2015	0.26	-0.003	0.04	385.26	-349.35	167.88
	(0.16)	(0.10)	(0.03)	(551.91)	(257.65)	(131.41)
Year dummy 2014	0.24**	0.05	0.08***	336.80	-173.07	342.95***
	(0.11)	(0.07)	(0.02)	(381.09)	(177.91)	(90.74)
Rainfall	0.0001	-0.0001	0.0000	0.93	-0.30	-0.14
	(0.0002)	(0.0001)	(0.0000)	(0.58)	(0.27)	(0.14)
Temperature	-0.13***	-0.02	-0.001	-267.05**	45.59	-31.96
	(0.03)	(0.02)	(0.01)	(103.69)	(48.41)	(24.69)
Electricity: Share	0.0000	0.0000	0.0000	0.05	0.02	0.003
hay in the diet	(0.0000)	(0.0000)	(0.0000)	(0.07)	(0.03)	(0.02)
Fuel: Share grass	-0.0001	-0.0000	-0.0000	-0.21	-0.10	-0.003
in the diet	(0.0001)	(0.0001)	(0.0000)	(0.48)	(0.22)	(0.11)
Share grass diet:	-0.0000	0.0000	0.0000	-0.03	-0.02	0.01
Concentrates	(0.0000)	(0.0000)	(0.0000)	(0.04)	(0.02)	(0.01)
Mineral N pasture:	0.0000	-0.0001*	-0.0001**	-0.30	-0.29	-0.25***
Organic N pasture	(0.0001)	(0.0001)	(0.0000)	(0.39)	(0.18)	(0.09)
Share grass diet ²	-0.001	0.0003	0.0000	-3.68**	-1.21	0.49
	(0.0005)	(0.0003)	(0.0001)	(1.65)	(0.77)	(0.39)
Constant	0.13	0.58	0.80**	-4,699.65	-3,326.82	3,823.52**
	(1.93)	(1.24)	(0.38)	(6,558.34)	(3,061.71)	(1,561.60)
Observation	95	95	95	95	95	95
R ²	0.76	0.41	0.85	0.88	0.94	0.88
Adjusted R ²	0.63	0.11	0.77	0.82	0.91	0.81

Note: *** p < 0.001, ** p < 0.01, * p < 0.05

SM 12. Variables Selection via LASSO

	Net Environmental performance per L (1)	Gross Environmental performance per L (2)	Economic performance per L (3)	Net Environmental performance per Ha (4)	Gross Environmental performance per Ha (5)	Economic performance per Ha (6)
Labor Use per cow	-0.002** (0.001)	-0.001** (0.001)		-13.87 (16.82)	-4.08*** (1.47)	
Fuel per Ha	0.0004** (0.0002)	0.0003*** (0.0001)			-0.49* (0.25)	0.21 (0.14)
Electricity per cow					-0.41*** (0.15)	
Concentrate per cow			-6.05*** (0.56)		4,109.13 (3,951.77)	-14,379.54*** (2,436.57)
Share protein in the diet	-0.004 (0.004)		0.0001 (0.001)		8.99 (5.84)	
Share grass in the diet			-0.001 (0.001)			
Share hay in the diet		-1.64 (1.88)	-2.65*** (0.61)			-7,963.99*** (2,786.09)
Age first calving		0.003 (0.01)	0.003 (0.002)			
Herd's Renewal Rate	-0.19 (0.33)	-0.30 (0.19)				
Biodiversity	-0.001 (0.001)					
Farm's size	-0.0003 (0.001)			-12.49 (9.84)		
Mineral N spread on pasture					-20.33*** (3.36)	7.81*** (1.80)
Mineral N spread on cereals	-0.002 (0.001)			-64.08*** (23.42)	-33.05*** (2.21)	7.45*** (1.15)
Organic N on pasture	-0.003 (0.01)			-163.28* (94.57)		1.08 (4.05)
Organic N spread	-0.58			-5,952.18		260.84

on cereals	(0.43)			(6,297.74)		(337.23)
Mineral P spread on pasture		-0.0001 (0.0001)	-0.0001** (0.0000)			-0.29** (0.11)
Mineral K spread on pasture		0.003 (0.002)		-81.24 (59.05)		
Mineral K spread on cereals		0.0005 (0.001)				1.36 (0.99)
Share manure in organic fertilizers	-0.15** (0.06)	-0.08** (0.04)		-1,687.80 (1,025.86)		-56.43 (49.84)
Manure Composting	-0.32*** (0.11)			-4,475.44*** (1,683.44)		
Share of Cambisol			-0.0005 (0.001)			
Share of Luvisol	0.15 (0.13)		0.07** (0.03)			203.80* (108.74)
Average Slope	0.17** (0.08)		0.08*** (0.02)			282.21*** (62.01)
Year 2014	-0.10*** (0.02)		0.001 (0.005)	-1,119.65*** (287.85)		
Year 2015		0.11 (0.08)	0.02 (0.03)			248.34** (118.40)
Rainfall		-0.0001 (0.0001)		5.14** (2.22)	-0.29 (0.20)	-0.16 (0.12)
Temperature			-0.001 (0.001)		6.42* (3.55)	-2.33 (2.27)
Constant	0.62* (0.35)	-0.85** (0.36)	0.77*** (0.18)	13,482.89*** (4,177.03)	-319.73 (486.53)	1,679.41*** (448.22)
Observations	95	95	95	95	95	95
R ²	0.70	0.33	0.81	0.68	0.93	0.84
Adjusted R ²	0.65	0.24	0.79	0.64	0.92	0.81

Note: *** p < 0.001, ** p < 0.01, * p < 0.05