

Schierhorn, Florian et al.

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Large greenhouse gas savings due to changes in the post-Soviet food systems

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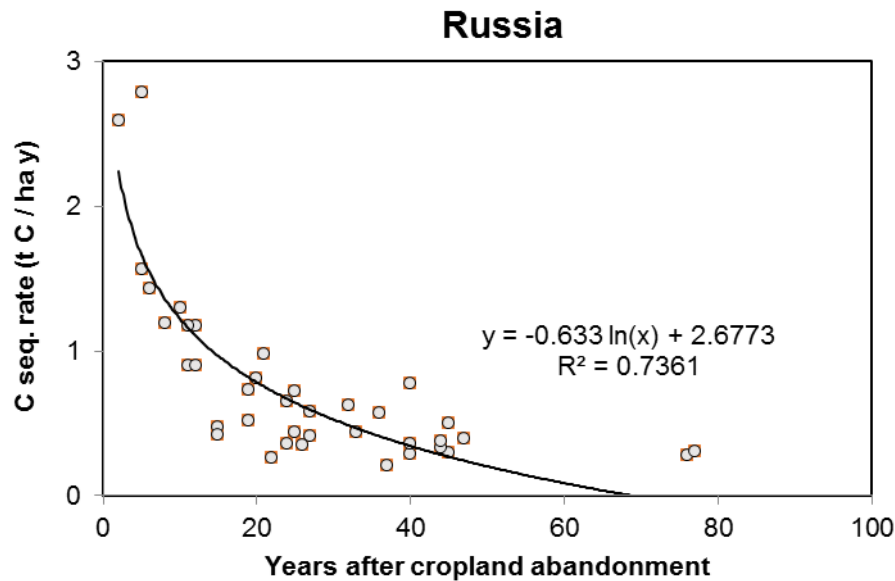


Fig. S1. Relationship between mean carbon sequestration rate and years after cropland abandonment in Russia. Source: Own calculation; To estimate SOC dynamics on abandoned croplands in the FSU, we used estimates of SOC sequestration rates from field experiments (unit: t C/ha/year) that are available for various soil types in the FSU (Kurganova et al., 2014; Kurganova et al., 2015).

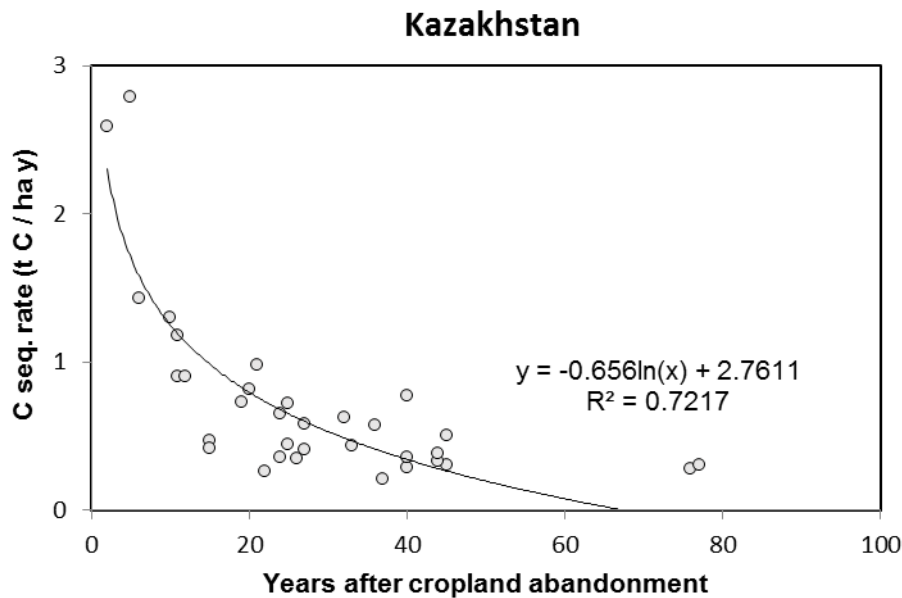


Fig. S2. Relationship between mean carbon sequestration rate and years after cropland abandonment in Kazakhstan. Source: Own calculation; To estimate SOC dynamics on abandoned croplands in the FSU, we used estimates of SOC sequestration rates from field experiments (unit: t C/ha/year) that are available for various soil types in the FSU (Kurganova et al., 2014; Kurganova et al., 2015).

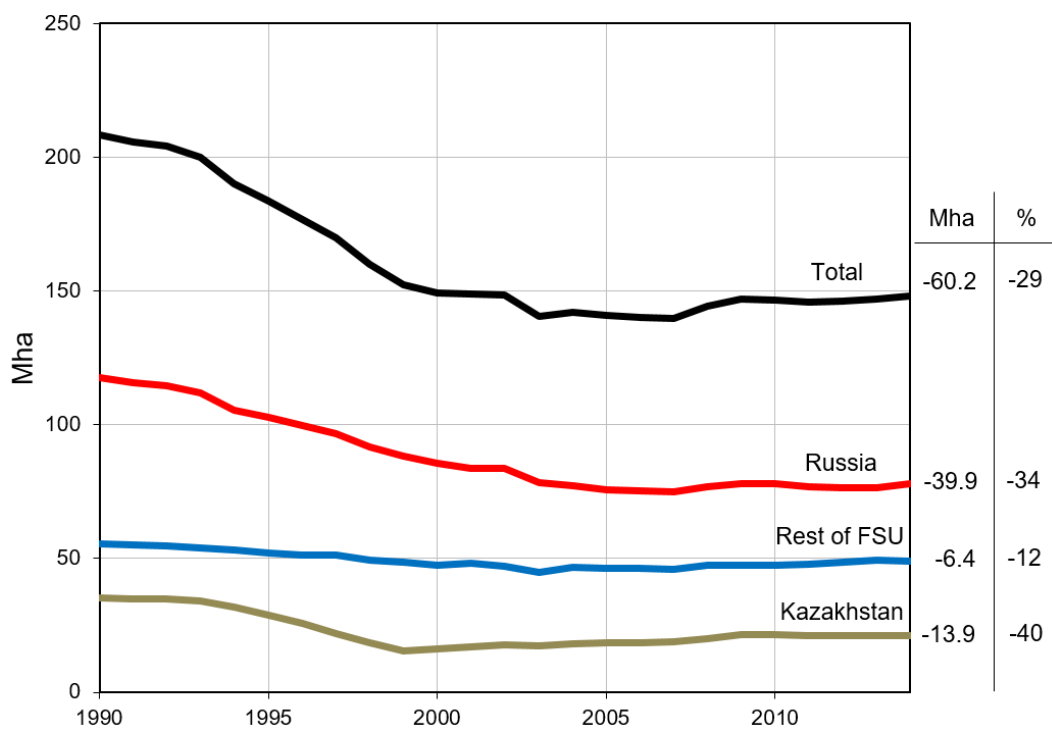


Fig. S3. Sowing area (million hectares, Mha) in Russia, Kazakhstan, and rest of the former Soviet Union (FSU; Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kyrgyzstan, Latvia, Lithuania, Moldova, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan). Percent and absolute change between 1990 and 2014 on the right. All data sources are listed at the end of the SI.

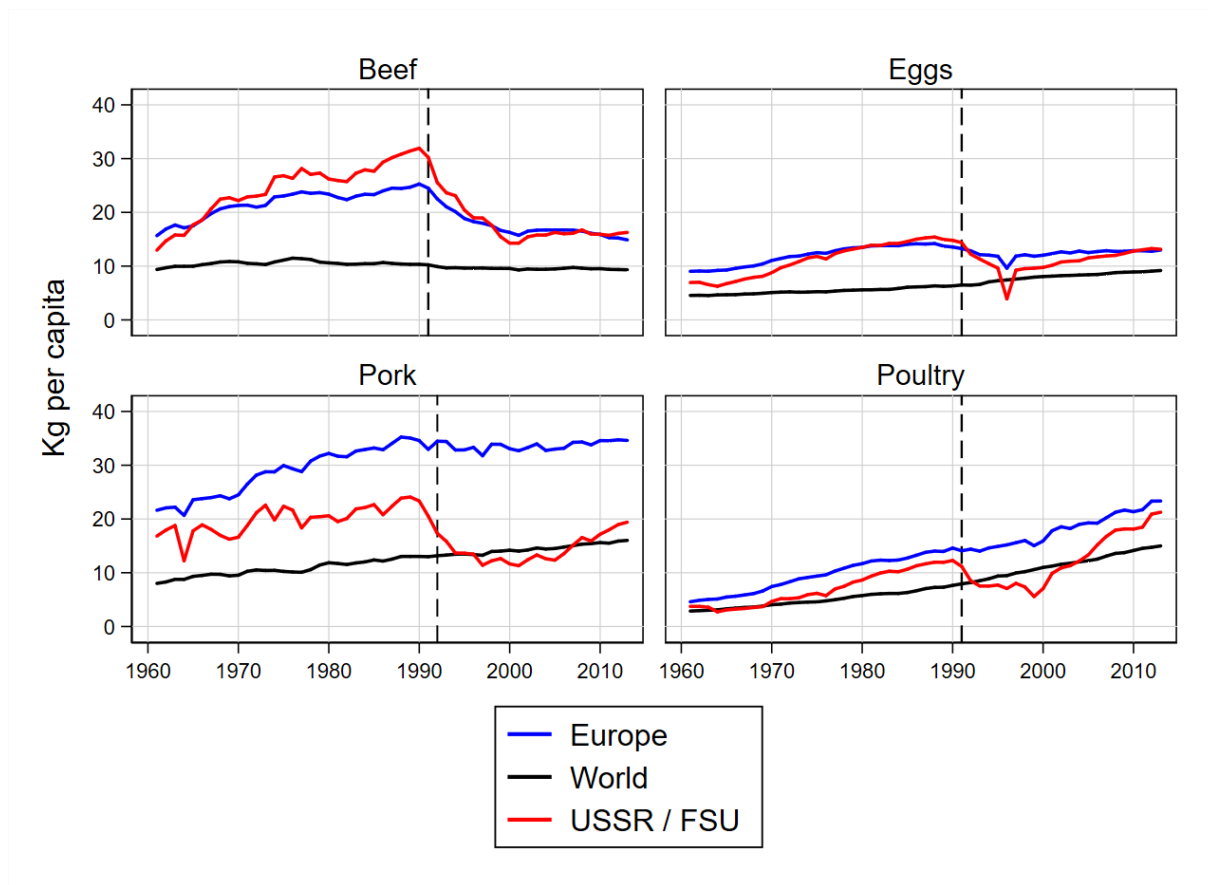
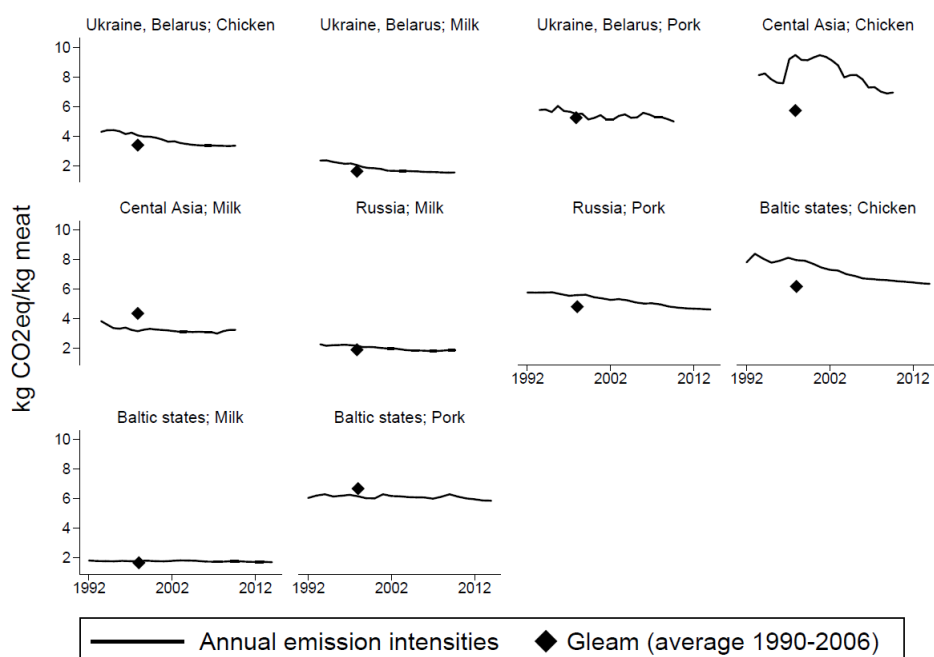


Fig. S4. Per capita consumption of livestock products in the Soviet Union (SU), former Soviet Union (FSU), Europe, and globally. Dashed vertical lines mark the beginning of the FSU in 1992. Data source: FAOSTAT.



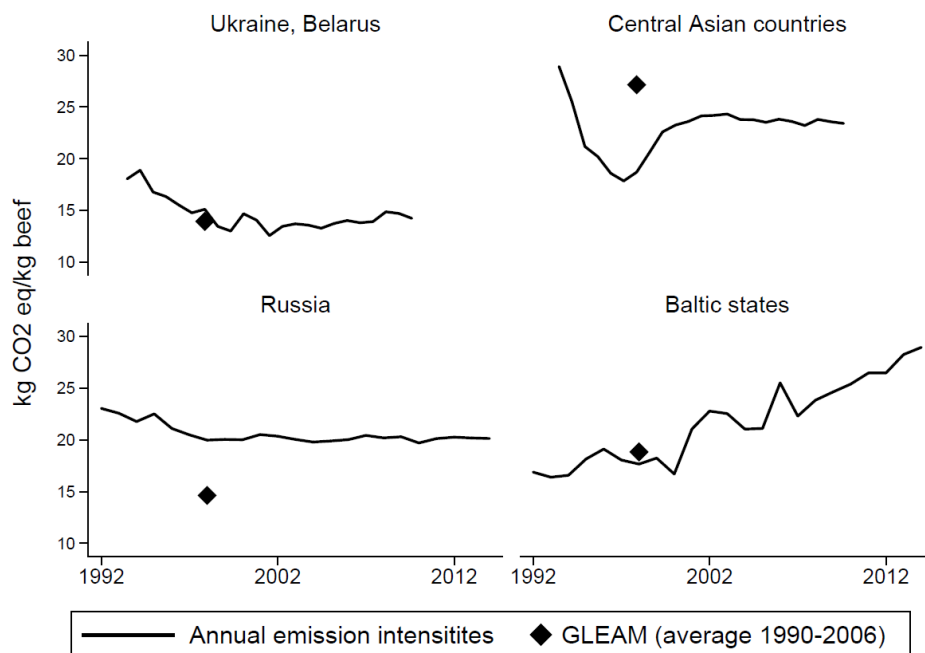


Fig. S5. Emission intensity (kg CO₂e/kg) of meat and milk produced in the FSU. The upper figure shows emission intensities of milk, pork, chicken; the lower figure for beef. Lines represent the estimated annual emission intensities, as explained in the Methods section. Source: Own calculation.

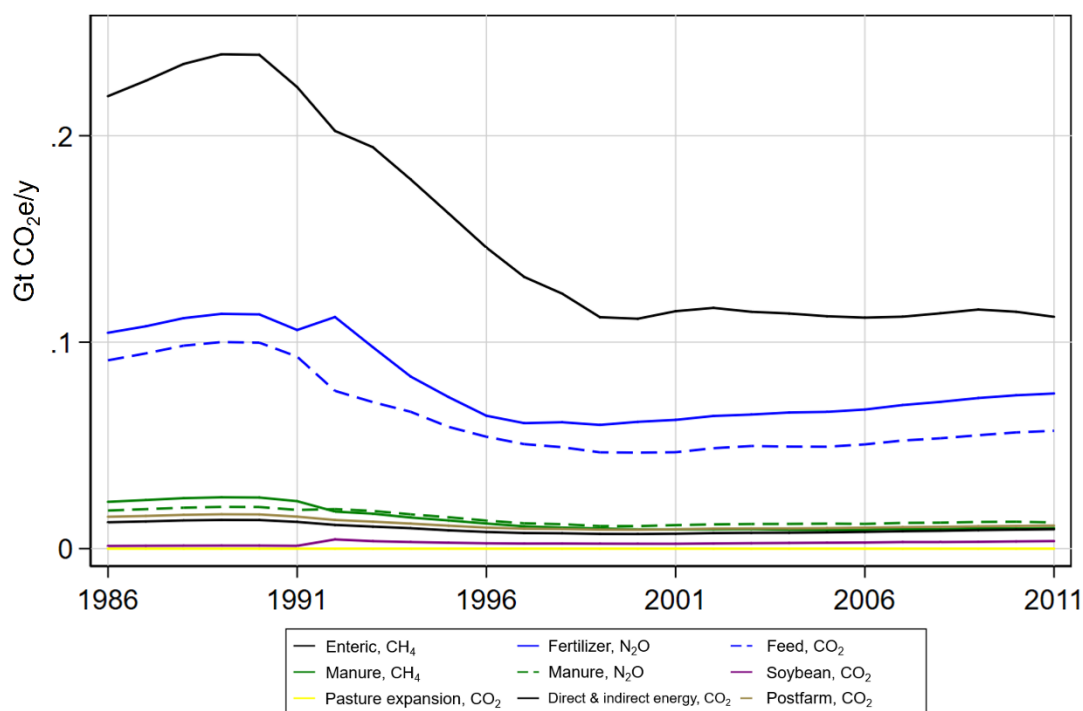


Fig. S6. Contribution of different processes to total GHG emissions embodied in livestock production in the FSU. Source: Own calculation.

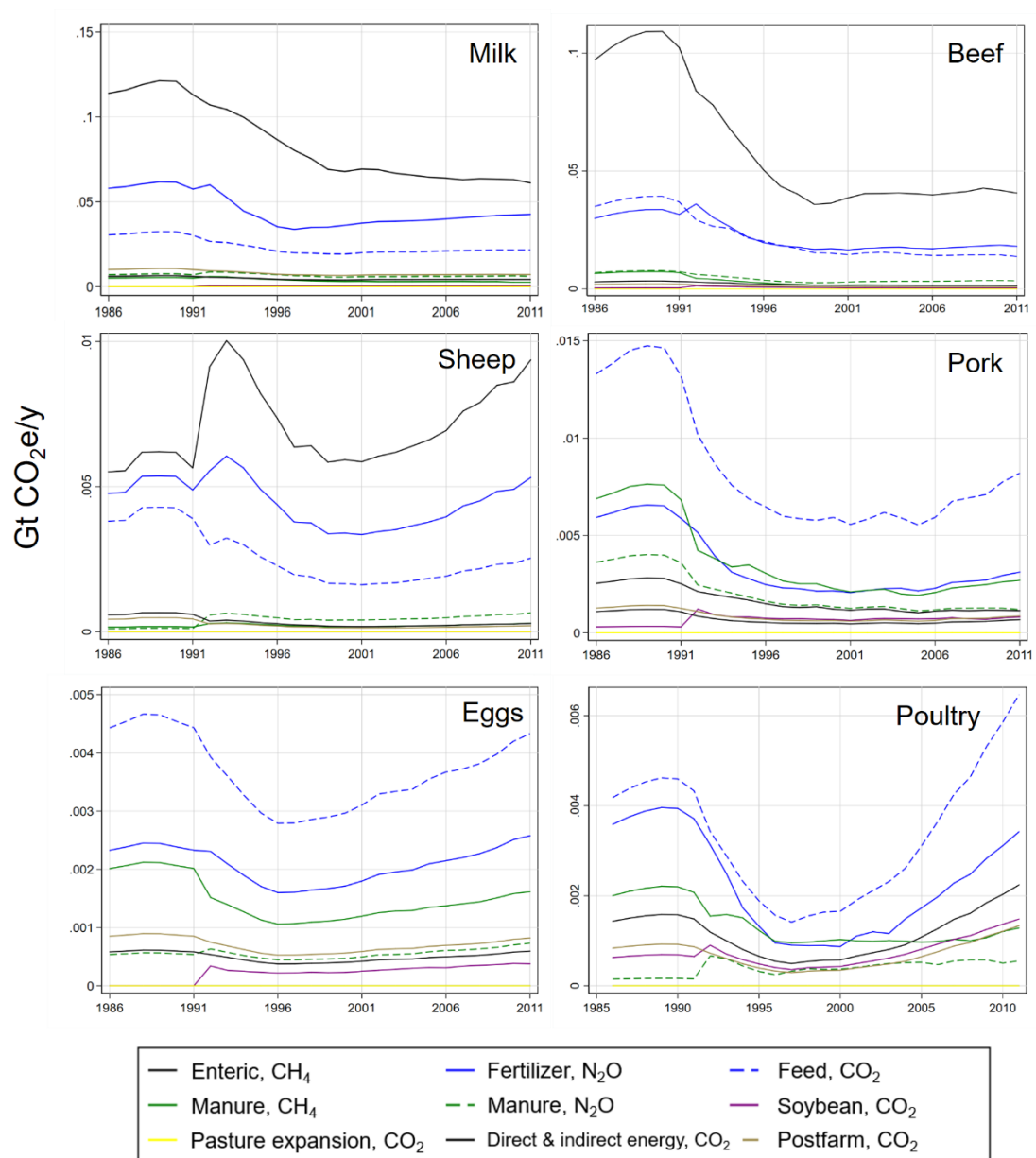


Fig. S7. Contribution of different processes to total GHG emissions embodied in the production of different livestock products in the FSU. Note the different y-axis scales. Source: Own calculation.

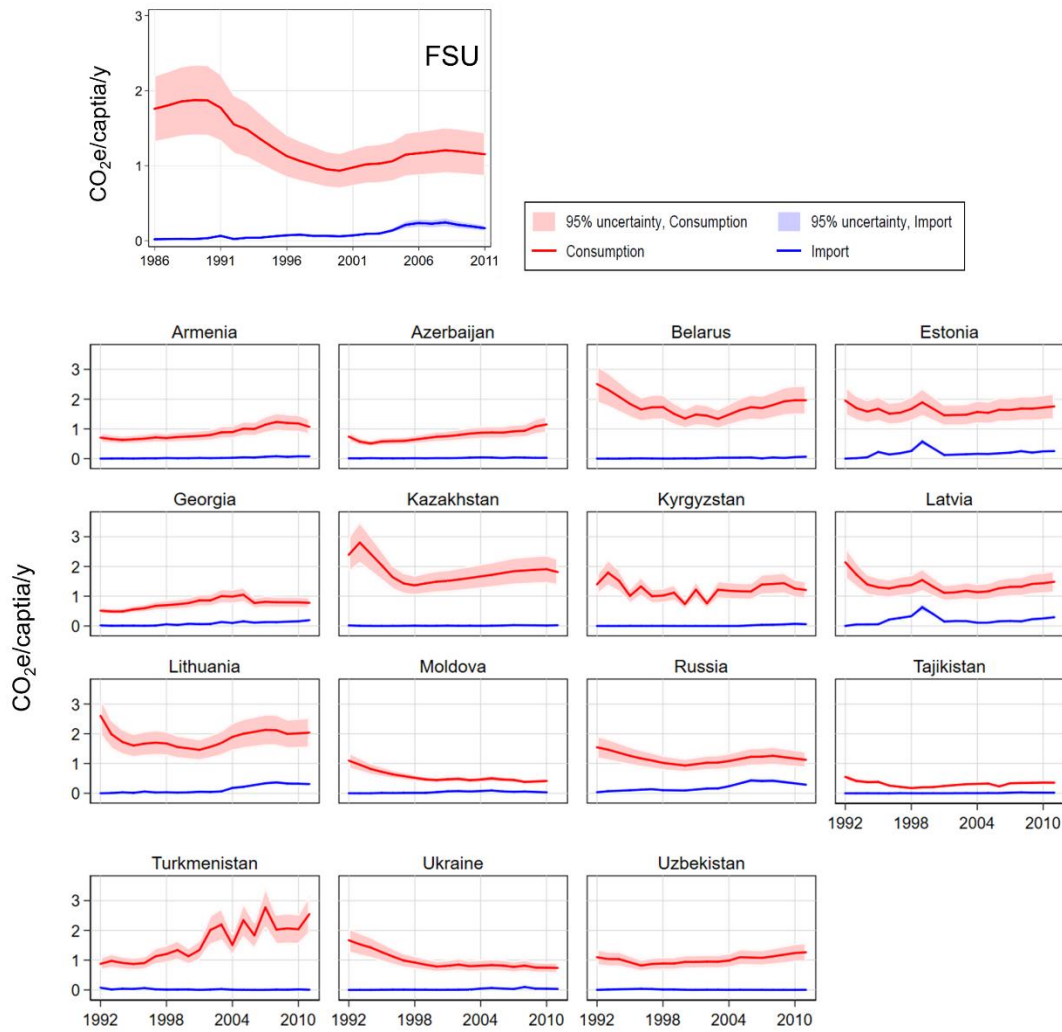


Fig. S 8. Per-capita GHG emissions embodied in domestic livestock consumption and imports of livestock products to the FSU. Note: Emissions from consumption include emissions from imports. Colored shades represent the 95% uncertainty intervals.

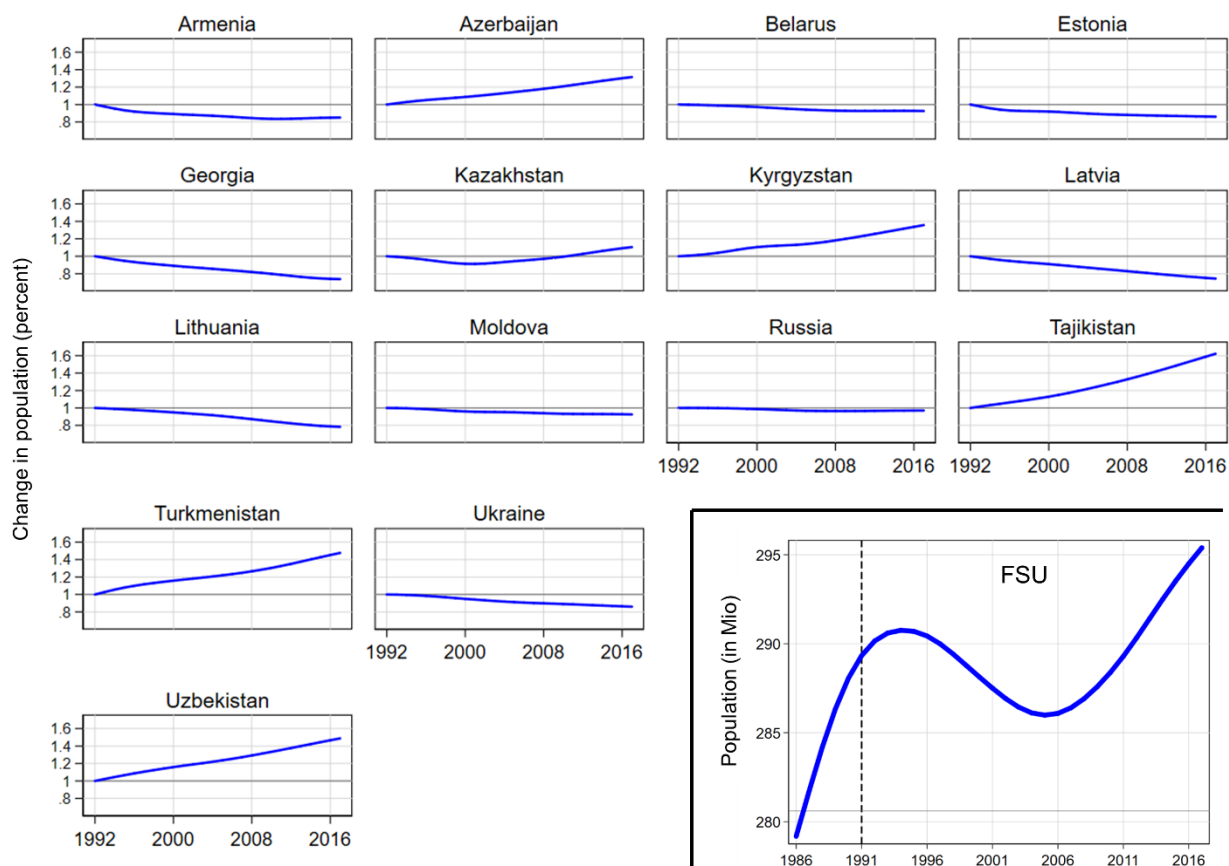


Fig. S 9. Population change in the SU and FSU (% change since 1992). Data source: FAOSTAT.

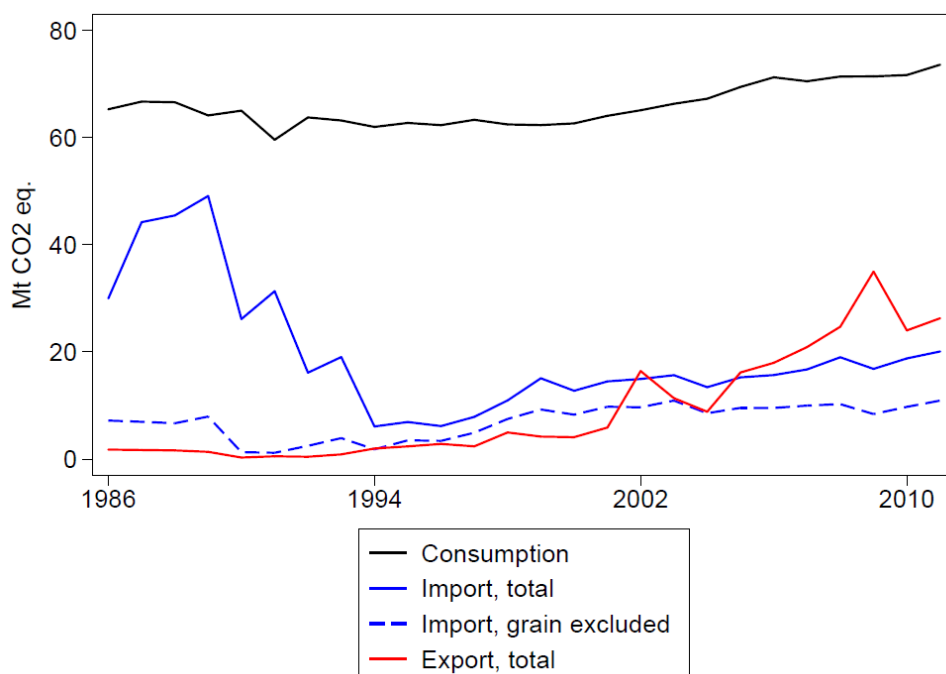


Fig. S10. GHG emissions embodied in consumption, imports, and exports of crops by the FSU. Source: Own calculation.

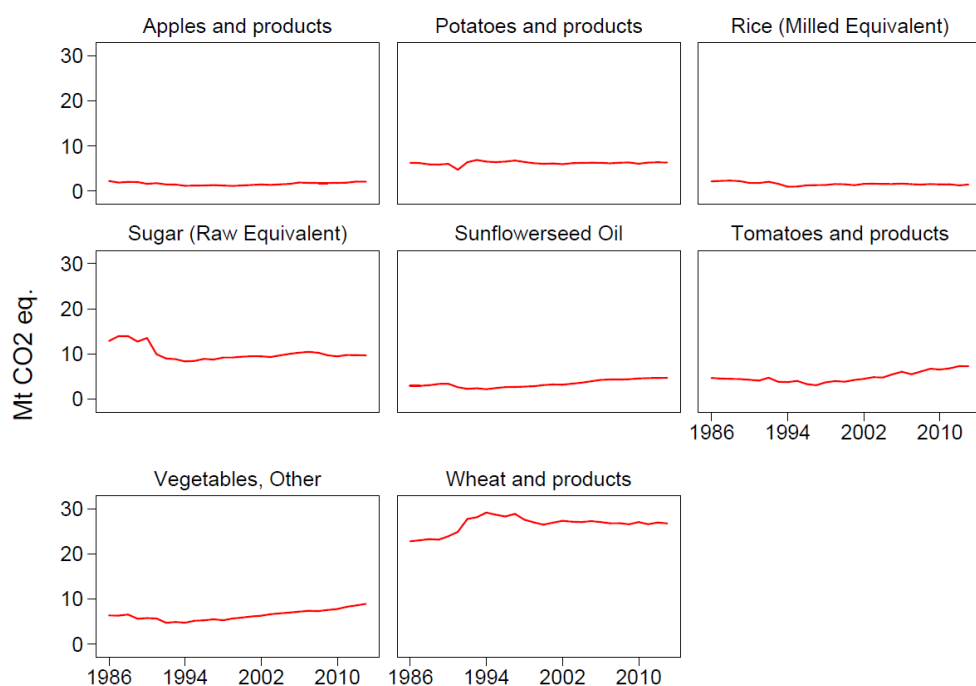


Fig. S11. GHG emissions embodied in consumption of the most important crops in the FSU. Source: Own calculation.

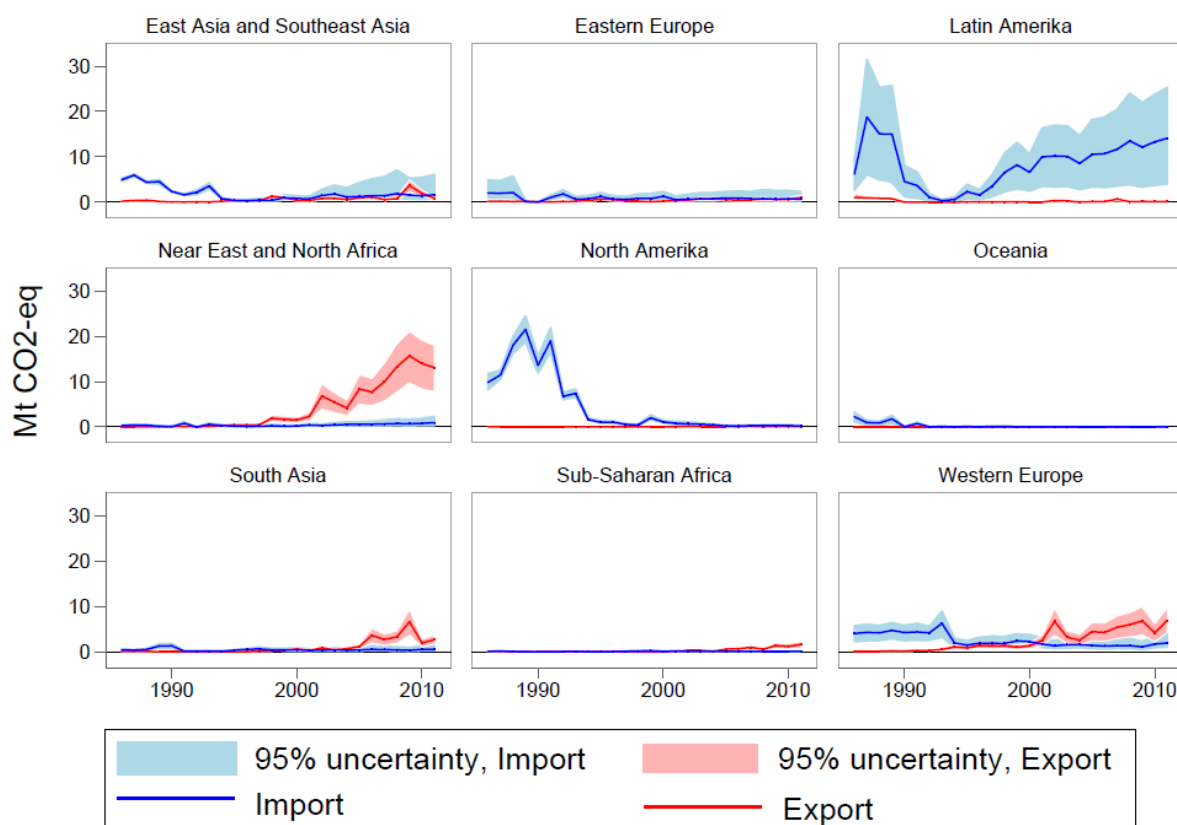


Fig. S12. GHG emissions embodied in crop exports from and imports to the FSU. Source: own calculation.

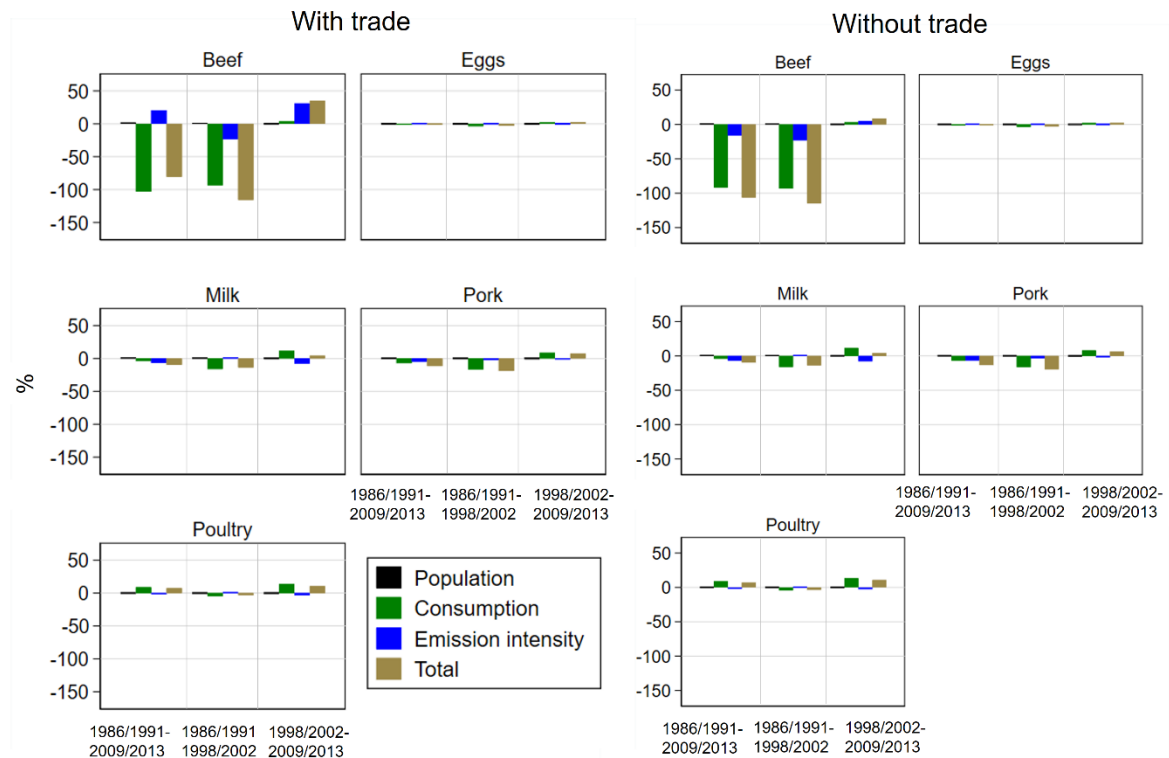


Fig. S13. Contribution of changes in population, per-capita consumption, and emission intensity to changes in emissions from the consumption of livestock products. Source: Own calculation.

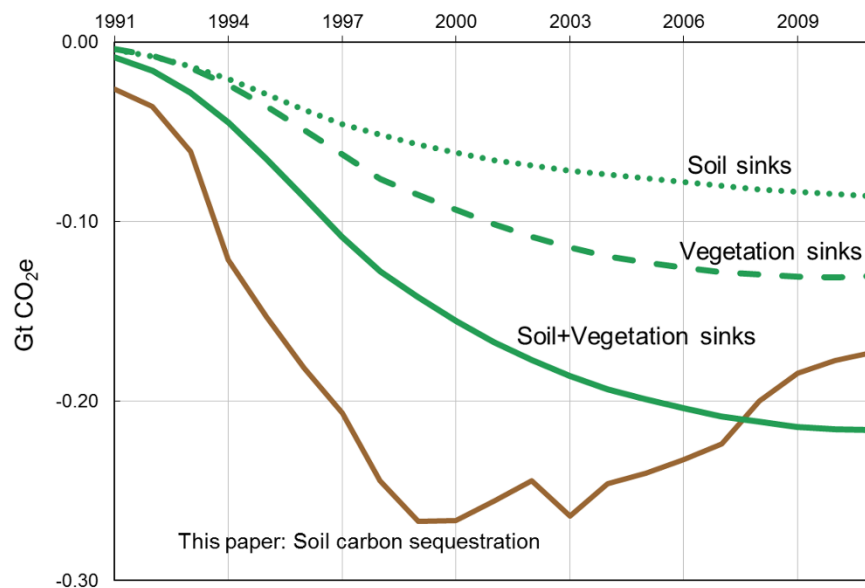


Fig. S14. Annual net GHG emissions from land-use changes (mainly cropland abandonment) after 1991 in the FSU. Comparison of the estimates by Houghton and Nassikas (2017) with the estimates presented in this paper.

680

681 Table S1. Contribution of changes in population, per-capita consumption, and emission intensity to
 682 changes in emissions from the consumption of livestock products. Trade is excluded in B.

683 **A: With trade**

Item	Period	Population	Consumption	Emission intensity	Total
Milk	1986/1991-2009/2013	1.30	-4.06	-6.86	-9.63
Beef	1986/1991-2009/2013	1.90	-103.07	20.51	-80.65
Pork	1986/1991-2009/2013	0.37	-7.11	-4.79	-11.52
Eggs	1986/1991-2009/2013	0.12	-1.45	0.67	-0.67
Poultry	1986/1991-2009/2013	0.21	8.95	-1.61	7.55
Milk	1986/1991-1998/2002	1.01	-16.10	1.32	-13.77
Beef	1986/1991-1998/2002	1.30	-93.52	-23.48	-115.70
Pork	1986/1991-1998/2002	0.25	-16.58	-2.55	-18.87
Eggs	1986/1991-1998/2002	0.08	-3.52	0.46	-2.98
Poultry	1986/1991-1998/2002	0.12	-4.60	1.41	-3.06
Milk	1998/2002-2009/2013	0.25	11.58	-7.69	4.14
Beef	1998/2002-2009/2013	0.25	3.74	31.07	35.06
Pork	1998/2002-2009/2013	0.05	8.56	-1.27	7.34
Eggs	1998/2002-2009/2013	0.02	2.17	0.12	2.31
Poultry	1998/2002-2009/2013	0.04	13.78	-3.22	10.60

684

685 **B: Without trade**

Item	Period	Population	Consumption	Emission intensity	Total
Milk	1986/1991-2009/2013	1.30	-4.07	-6.88	-9.65
Beef	1986/1991-2009/2013	1.70	-92.03	-15.99	-106.32
Pork	1986/1991-2009/2013	0.36	-6.89	-6.69	-13.22
Eggs	1986/1991-2009/2013	0.12	-1.45	0.65	-0.69
Poultry	1986/1991-2009/2013	0.21	8.86	-2.02	7.05
Milk	1986/1991-1998/2002	1.01	-16.12	1.34	-13.76
Beef	1986/1991-1998/2002	1.30	-93.16	-23.04	-114.90
Pork	1986/1991-1998/2002	0.25	-16.35	-3.36	-19.46
Eggs	1986/1991-1998/2002	0.08	-3.52	0.46	-2.98
Poultry	1986/1991-1998/2002	0.12	-4.47	0.68	-3.68
Milk	1998/2002-2009/2013	0.25	11.59	-7.73	4.11
Beef	1998/2002-2009/2013	0.22	3.29	5.14	8.65
Pork	1998/2002-2009/2013	0.05	8.13	-1.95	6.23
Eggs	1998/2002-2009/2013	0.02	2.17	0.10	2.29
Poultry	1998/2002-2009/2013	0.04	13.26	-2.60	10.70

686

687 Table S2. Estimates of average soil carbon sequestration rates due to cropland abandonment in the FSU
 688 and globally.

Reference	Period	Average soil carbon sequestration (g C m ⁻² y ⁻¹)	Study Area	Method
(Wertebach et al., 2017)	first 20y	66	Western Siberia	Field sampling, 470 plots
(Heikkinen et al., 2014)	first 5 y	140-150	Puschino (Moscow)	Field data and model
(Heikkinen et al., 2014)	6-40y	100-25	Puschino (Moscow)	Field data and model
(Vuichard et al., 2008)	first 10y	47	European Russia	Model
(Kurganova et al., 2014)	first 20y	96	Russia	Meta-study
(Kurganova et al., 2015)	first 20y	90-122	Russia+Kaz	Meta-study
(Schierhorn et al., 2013)	first 20y	70	Europ Russia + Ukraine	Model
(Kalinina et al., 2011)	first 59y	52-103	Kursk	Field data, 6 plots
IPCC	first 50y	50	Global	
(Soussana et al., 2004)	first 20y	49	Global	Meta-study
(Kämpf et al., 2016)	first 14y	72	Global, temperate soils	Meta-study
(Poeplau et al., 2011)	first 40y	60-80	Global	Meta-study

689

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691

692 **Text S1: Sources of the sown area statistics for the former Soviet Union countries**

693 CISSTAT (1990-2014). Statistics of the Countries of the Commonwealth of Independent States. CIS
694 database. CIS Interstate Statistical Committee (Moscow). Statistics for Armenia, Azerbaijan, Belarus,
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699 <http://pub.stat.ee/px-web.2001/dialog/statfile1.asp> (accessed September 9th, 2017)

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730 (accessed September 9th, 2017)

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