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

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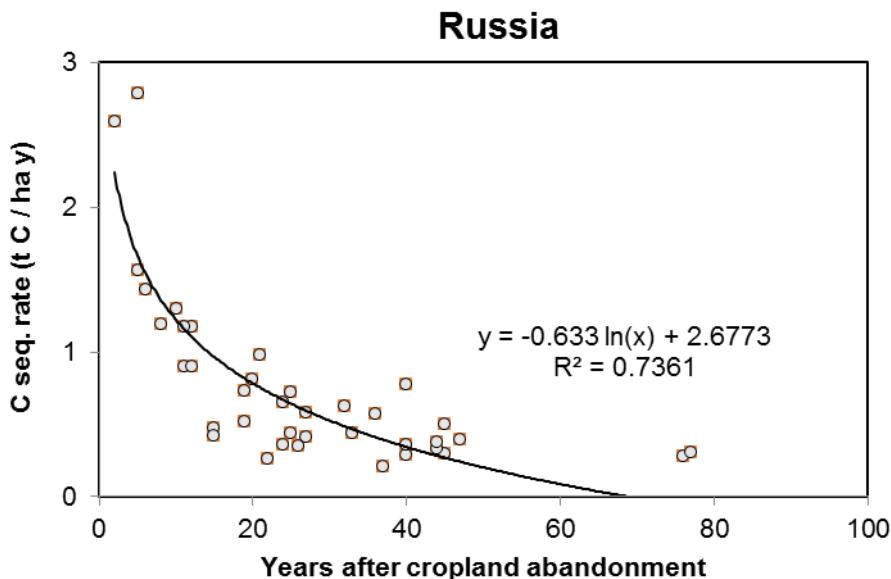
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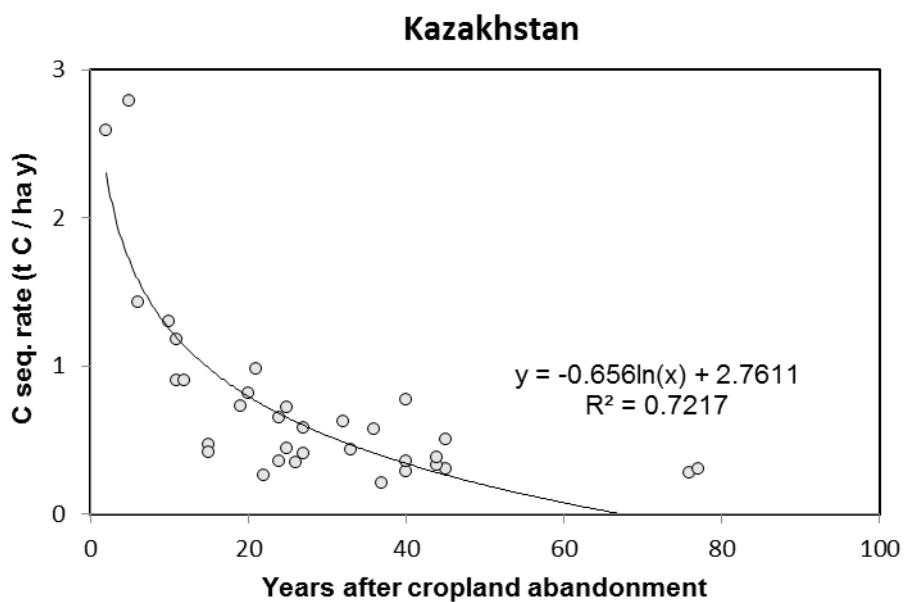
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610 Supplementary information
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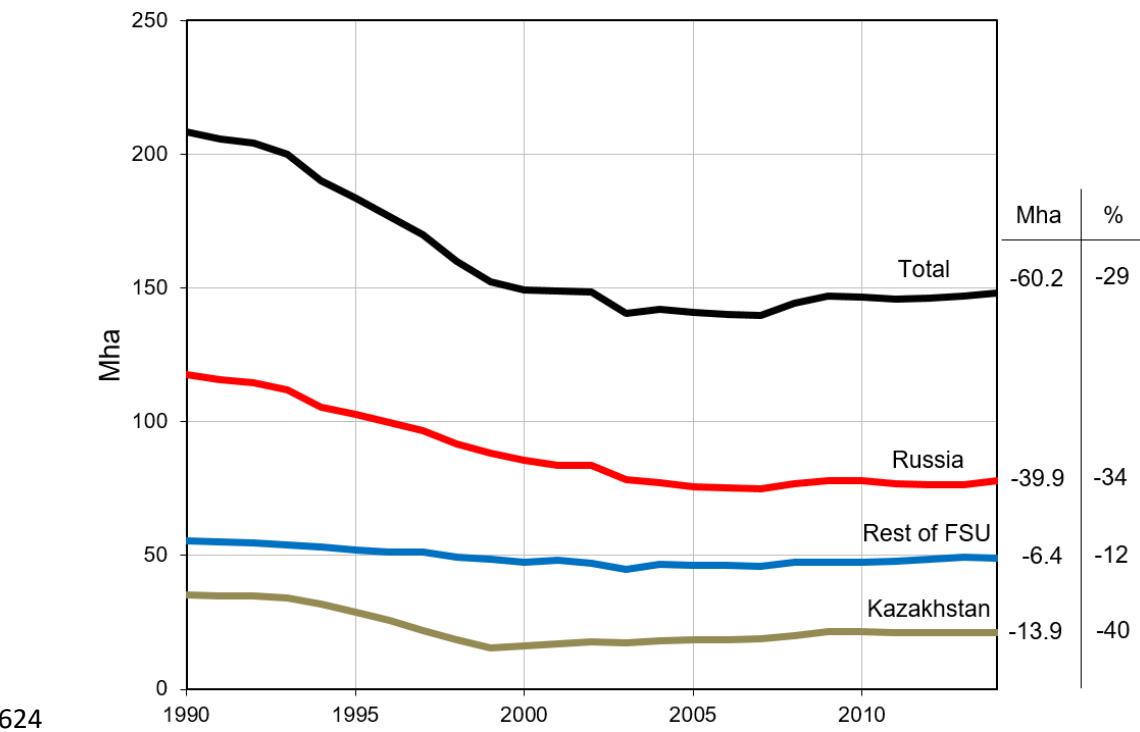
612
613 Fig. S1. Relationship between mean carbon sequestration rate and years after cropland abandonment in
614 Russia. Source: Own calculation; To estimate SOC dynamics on abandoned croplands in the FSU, we
615 used estimates of SOC sequestration rates from field experiments (unit: t C/ha/year) that are available
616 for various soil types in the FSU (Kurganova et al., 2014; Kurganova et al., 2015).

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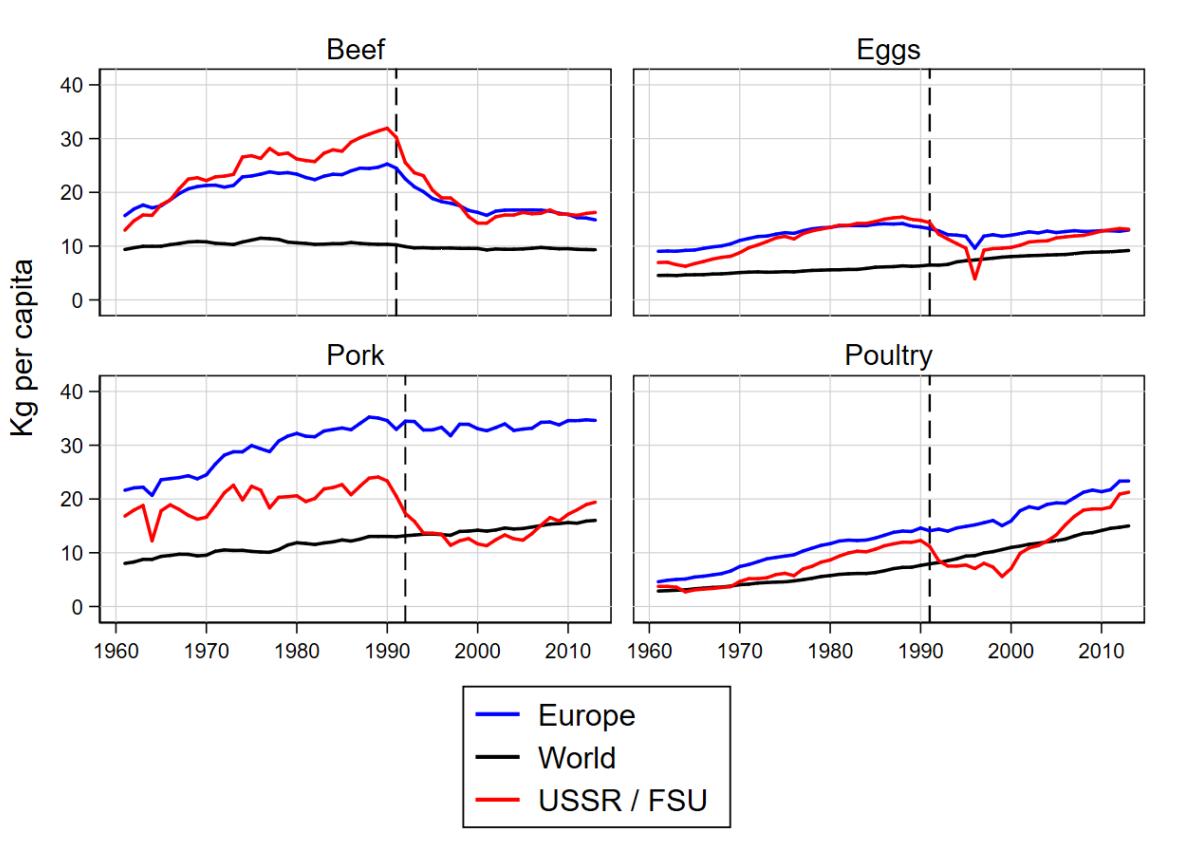
618
619 Fig. S2. Relationship between mean carbon sequestration rate and years after cropland abandonment in
620 Kazakhstan. Source: Own calculation; To estimate SOC dynamics on abandoned croplands in the FSU,
621 we used estimates of SOC sequestration rates from field experiments (unit: t C/ha/year) that are available
622 for various soil types in the FSU (Kurganova et al., 2014; Kurganova et al., 2015).

623



624
625 Fig. S3. Sowing area (million hectares, Mha) in Russia, Kazakhstan, and rest of the former Soviet Union
626 (FSU; Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kyrgyzstan, Latvia, Lithuania, Moldova,
627 Tajikistan, Turkmenistan, Ukraine, and Uzbekistan). Percent and absolute change between 1990 and
628 2014 on the right. All data sources are listed at the end of the SI.

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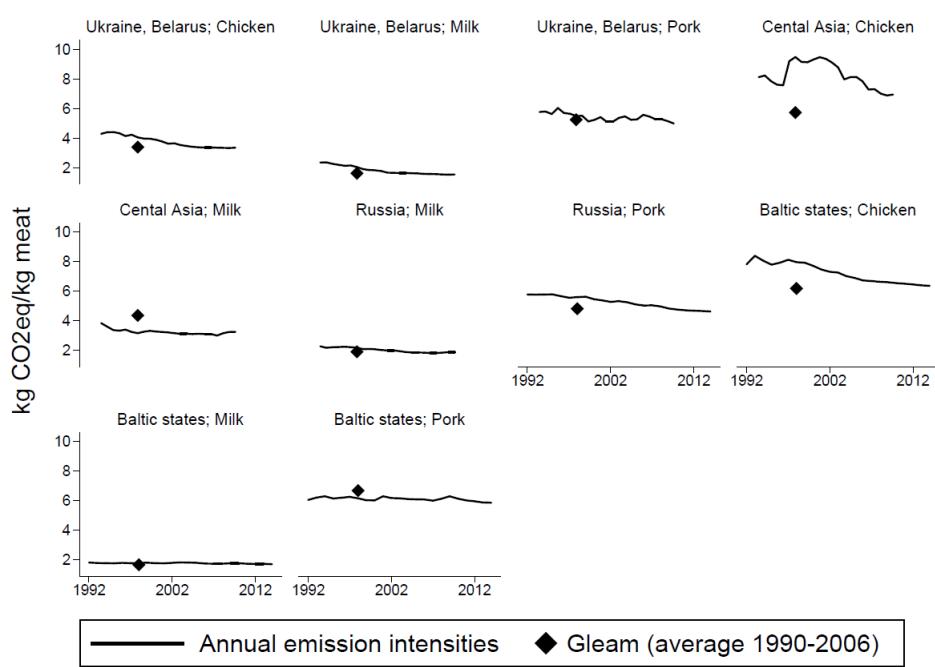


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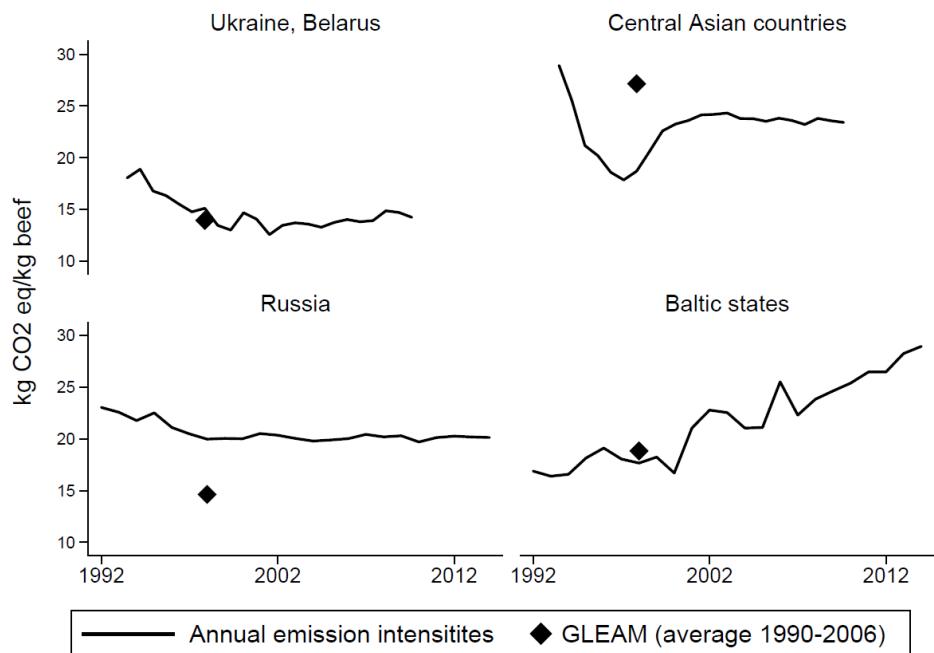
631 Fig. S4. Per capita consumption of livestock products in the Soviet Union (SU), former Soviet Union
 632 (FSU), Europe, and globally. Dashed vertical lines mark the beginning of the FSU in 1992. Data source:
 633 FAOSTAT.

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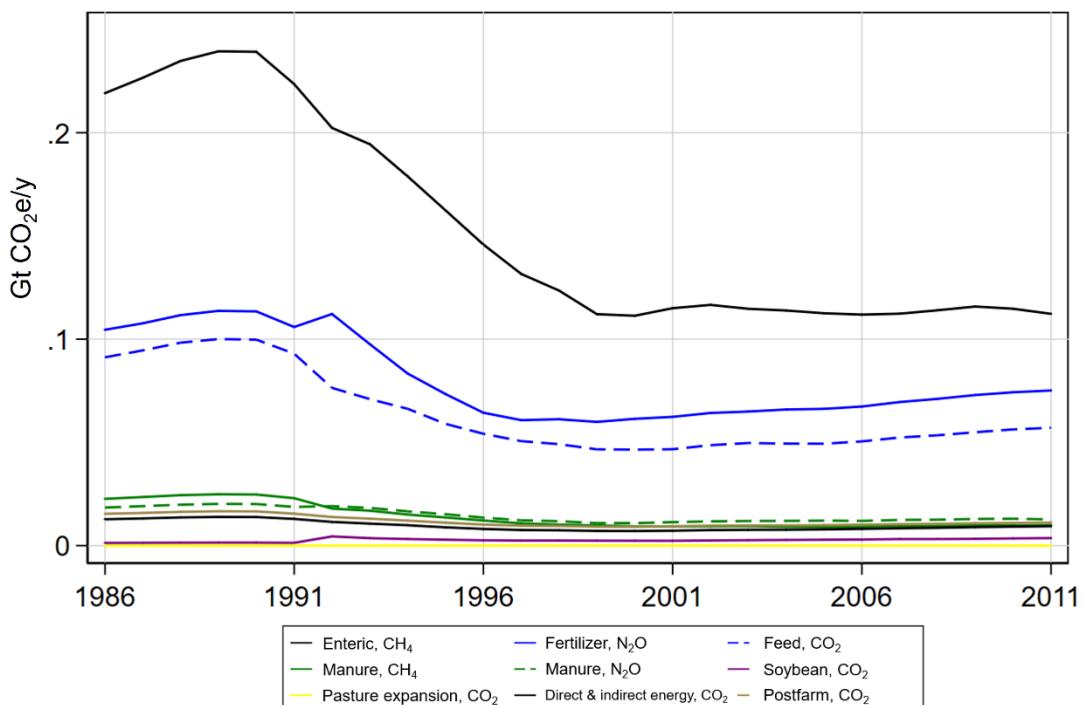


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638 Fig. S5. Emission intensity (kg CO₂e/kg) of meat and milk produced in the FSU. The upper figure shows
 639 emission intensities of milk, pork, chicken; the lower figure for beef. Lines represent the estimated
 640 annual emission intensities, as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



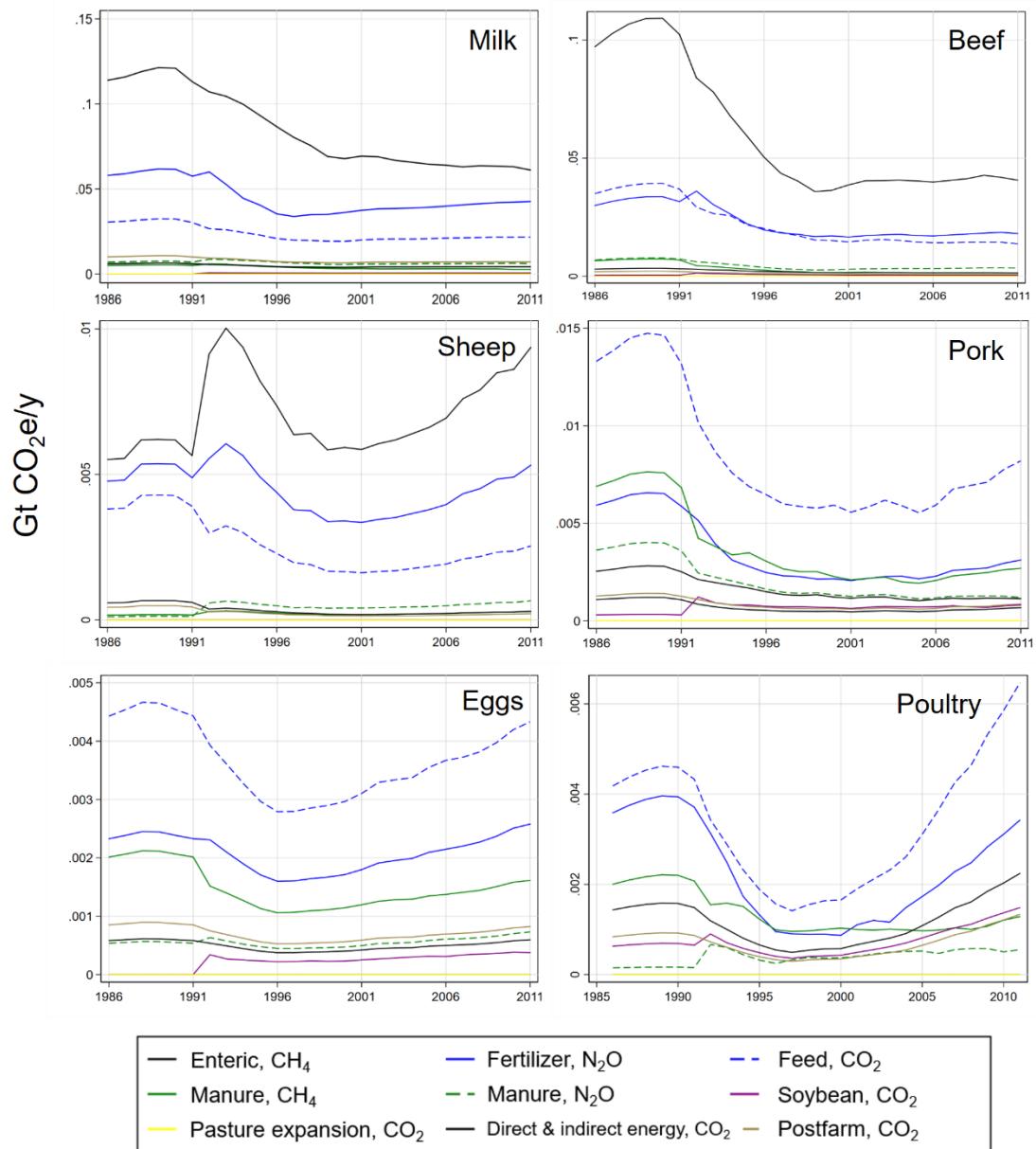
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642 Fig. S6. Contribution of different processes to total GHG emissions embodied in livestock production
 643 in the FSU. Source: Own calculation.

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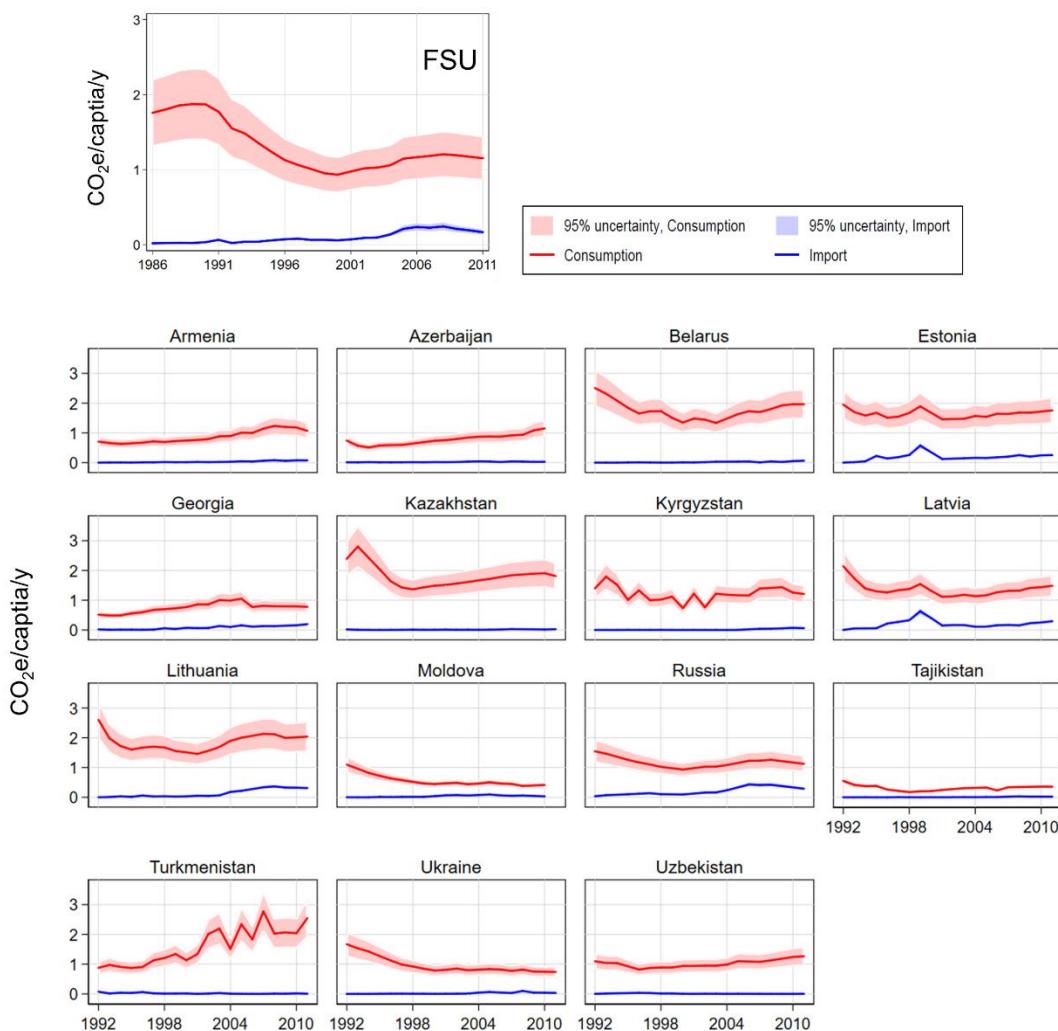
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648 Fig. S7. Contribution of different processes to total GHG emissions embodied in the production of
 649 different livestock products in the FSU. Note the different y-axis scales. Source: Own calculation.

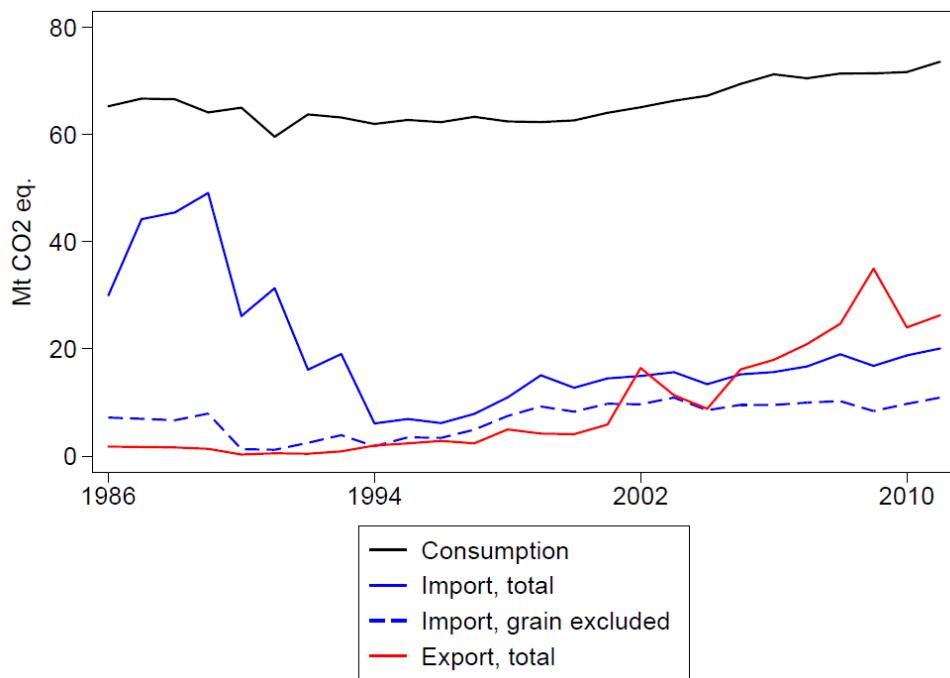
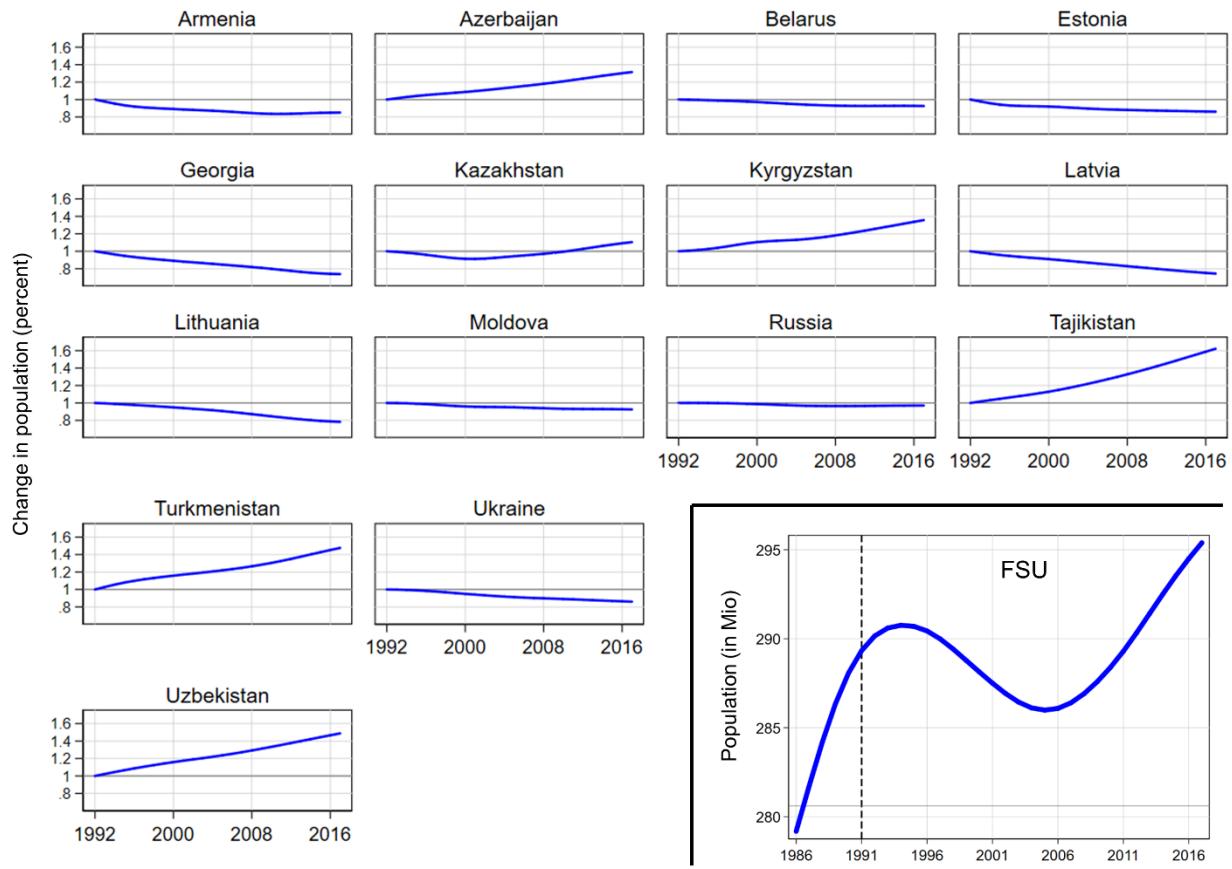
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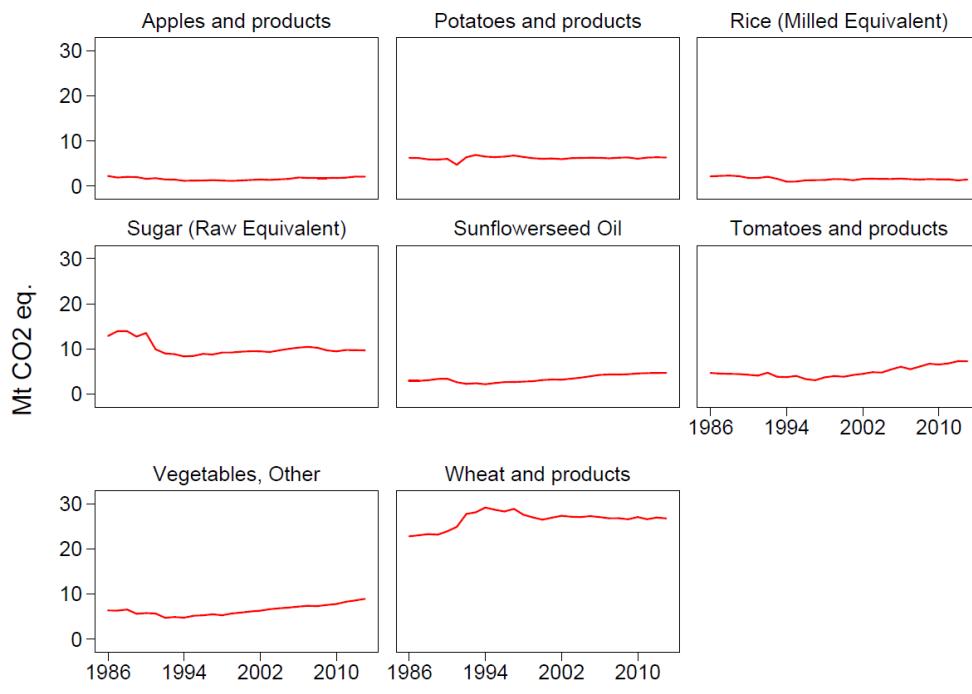
652 Fig. S 8. Per-capita GHG emissions embodied in domestic livestock consumption and imports of
 653 livestock products to the FSU. Note: Emissions from consumption include emissions from imports.
 654 Colored shades represent the 95% uncertainty intervals.

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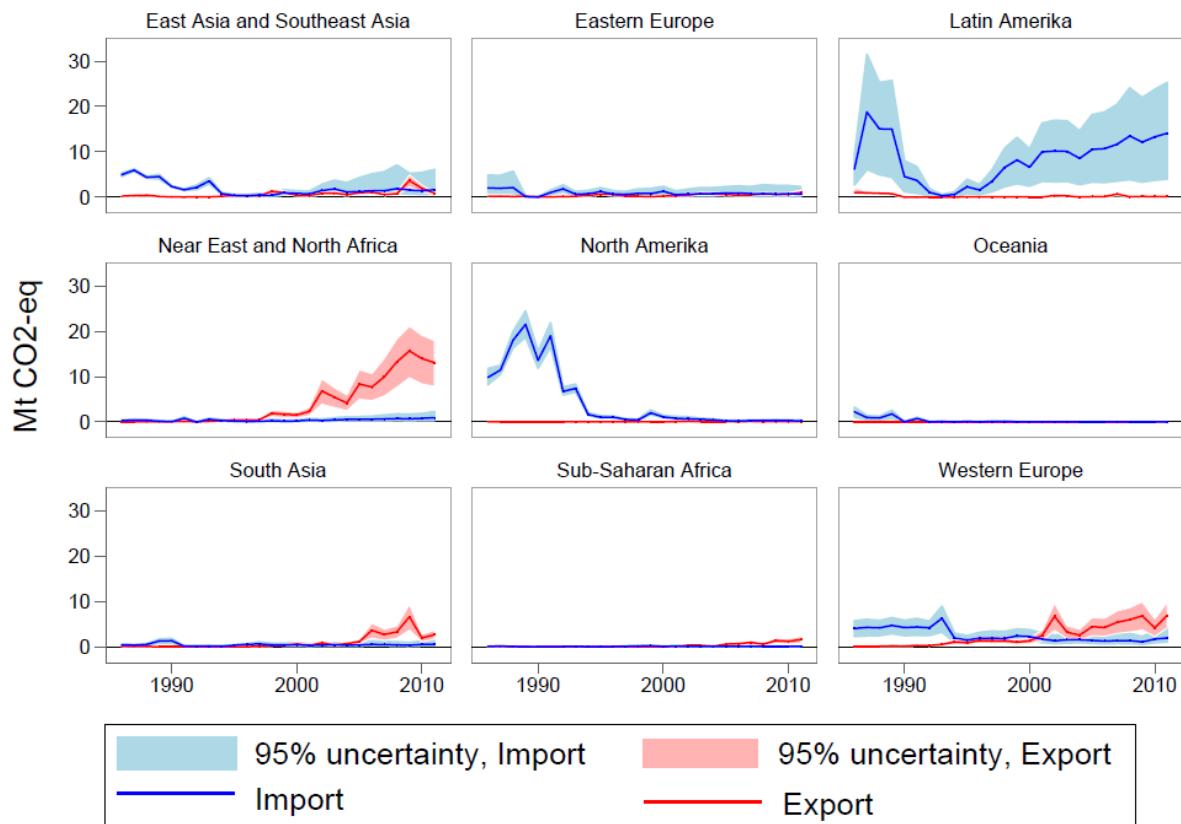
659 Fig. S10. GHG emissions embodied in consumption, imports, and exports of crops by the FSU. Source:
660 Own calculation.

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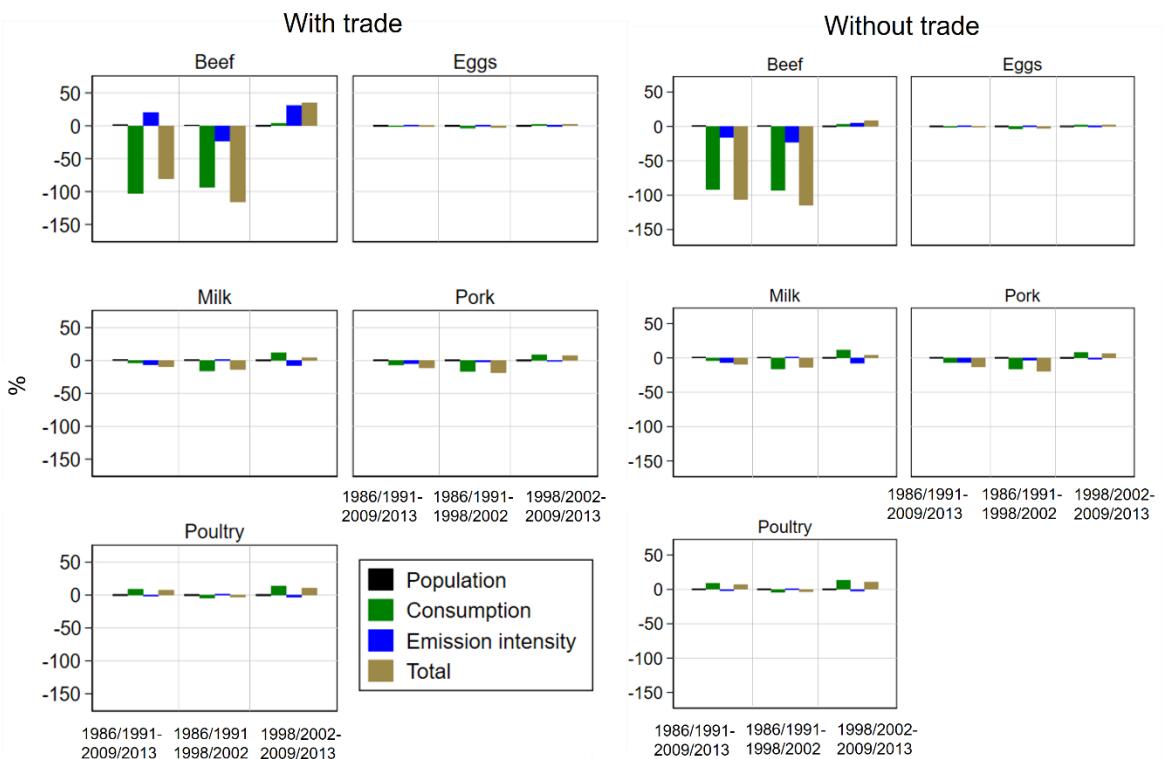
663 Fig. S11. GHG emissions embodied in consumption of the most important crops in the FSU. Source:
664 Own calculation.



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

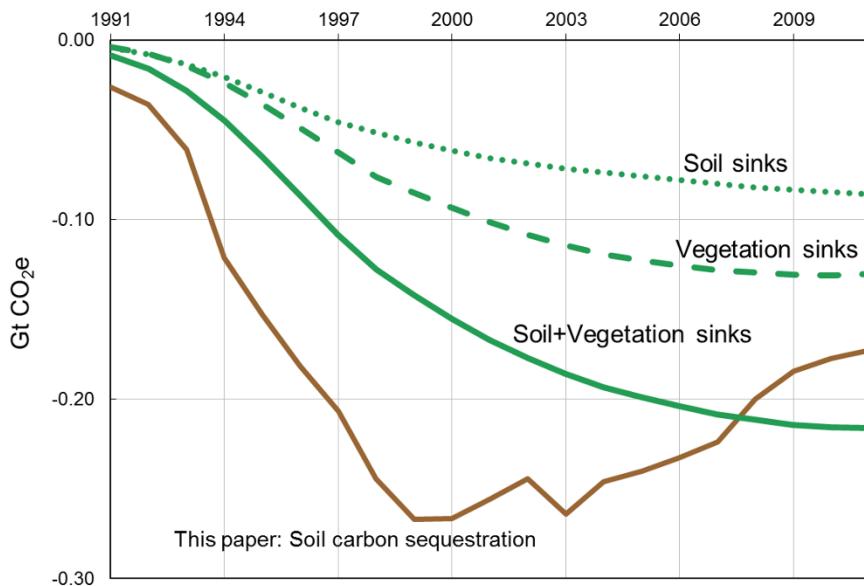
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670 Fig. S13. Contribution of changes in population, per-capita consumption, and emission intensity to
671 changes in emissions from the consumption of livestock products. Source: Own calculation.

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

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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
<hr/>					
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
<hr/>					
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

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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
<hr/>					
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
<hr/>					
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 <i>et al.</i> , 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

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

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