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Analysis of emissions' territorial distribution for individual subcategories and greenhouse gases. Deliverable 1.2

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Geoinformation technologies, spatio-temporal approaches, and full carbon account for improving accuracy of GHG inventories

Deliverable 1.2. Analysis of emissions' territorial distribution for individual subcategories and greenhouse gases

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Work package 1. Spatially resolved greenhouse gas inventory for Poland

Deliverable 1.2. Analysis of emissions' territorial distribution for individual subcategories and greenhouse gases

Content

List of figures

List of tables

3. Analysis of emissions' territorial distribution for individual subcategories and greenhouse gases from Industry and Agriculture

Cement Production

Territorial distribution of GHG emissions of cement production is quite disproportional because of uneven allocation of cement plants. In most cases cement plants are located not far from coal mines, which provide plants by raw materials.

Table 1 shows contributions of each plant in total GHG emissions of cement production. Heidelberg Cement group is the biggest emitter of carbon dioxide (CO_2) – 26%. The contribution of Lafarge group in total emissions is 23%; CRH – 15%; Cemex – 13%; Dyckerhoff – 8%; Polen Cement – 7%; Miebach – 4,5%; Polska Energetyka Holding SA – 1% and Mapei – 0,5%.

Table 3.1. CO_2 emissions from cement production

Group	Plants	Cement production 2010 (Gg)	Clinkier production 2010 (Gg)	K_clinkier (kg CO2/ kg of clinkier)	K_CP	CO_2 emissions (Gg)
Cemex	Cementownia Chełm	1123.42	836.08	0.529	1.02	451.13
Cemex	Cementownia Rudniki	936.18	696.73	0.529	1.02	375.94
CRH	Cementownia Ożarów	1217.04	905.75	0.529	1.02	488.73
CRH	Cementownia Rejowiec	1217.04	905.75	0.529	1.02	488.73
Dyckerhoff	Dyckerhoff Polska Sp. z o.o.	1310.65	975.42	0.529	1.02	526.32
Heidelberg Cement	Cementownia Górażdże	2808.54	3065.62	0.529	1.02	1654.15
Heidelberg Cement	EKOCEM Sp. z o.o.	1310.65	0.00	0.529	1.02	0.00
Lafarge	Cementownia Małogoszcz	1872.36	1393.46	0.529	1.02	751.89
Lafarge	Cementownia Kujawy	1872.36	1393.46	0.529	1.02	751.89
Mapei	Górka Cement Sp. z o.o.	93.62	69.67	0.529	1.02	37.59
Miebach	Cementownia Odra S.A.	702.14	522.55	0.529	1.02	281.96
Polen Cement	Cementownia Warta S.A.	1160.86	863.95	0.529	1.02	466.17
Polska Energetyka Holding SA	Cementownia Kraków - Nowa Huta Sp. z o.o.	187.24	139.35	0.529	1.02	75.19

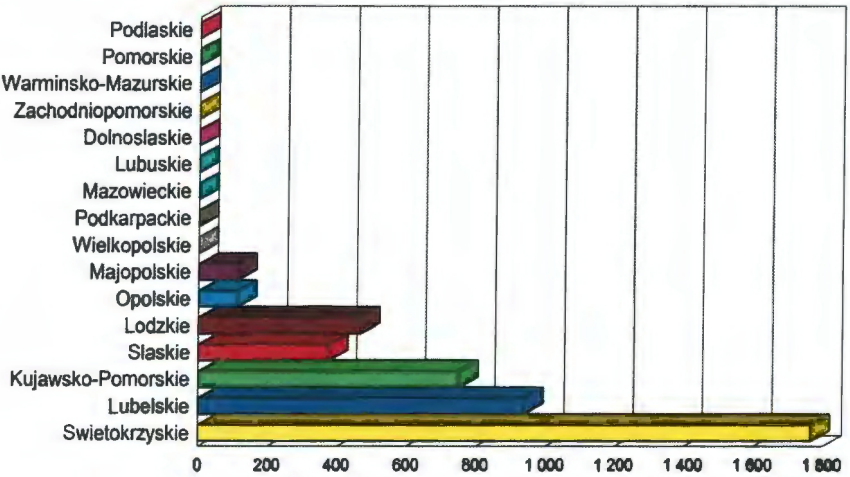

Figure 3.1. CO_2 emissions from cement production of voivodeships (sorted by the amount of emissions: from the largest to the smallest one)

Glass Production

As for the cement production, territorial distribution of GHG emissions from glass production depends on location of plants which produce limestone. **Figure 1** presents the information on CO_2 emissions for Polish voivodeships.

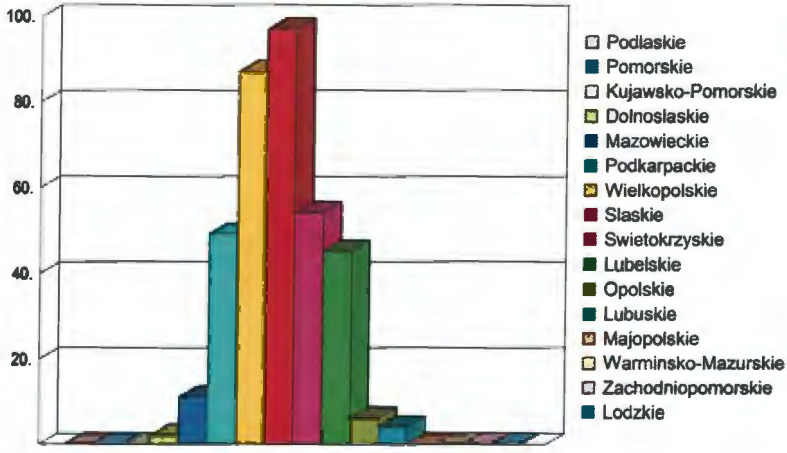

Figure 3.2. CO_2 emissions from Glass Production in voivodeships

Table 3.2. CO_2 emissions of the main glass factories

Plants	Glass production (Gg)	K_emission (kg of CO_2/ kg of glass)	Part of cullet (%)	CO_2 emissions (Gg)
Ardagh Glass Gostyń S.A.	183.59	0.21	0.45	21.20
Ardagh Glass Ujście S.A.	124.78	0.21	0.45	14.41
Ardagh Glass Wyszków S.A.	53.07	0.21	0.45	6.13
Euroglas Polska Sp. z.o.o	272.1	0.21	0.2	45.71
Guardian Industries Poland Sp. z o.o.	272.1	0.21	0.25	42.86
HUTA SZKŁA "CZECHY" S.A.	37.29	0.21	0.45	4.31
HUTA SZKŁA "GLOSS"	15	0.1	0.4	0.90
Huta Szkła „Jedlice" S.A.	53.07	0.21	0.45	6.13
Huta Szkła Gospodarczego Irena S.A.	15	0.1	0.4	0.90
Huta Szkła Kryształowego „Beata"	15	0.1	0.4	0.90
Huta Szkła Kryształowego „Julia"	15	0.1	0.4	0.90
Huta Szkła Kryształowego Violetta S.A.	15	0.1	0.4	0.90
Huta Szkła SŁAWA S.P.	53.07	0.21	0.45	6.13
Huta Szkła Warta S.A.	91.8	0.21	0.45	10.60
Huta Szkła WYMIARKI S.A.	38.73	0.21	0.45	4.47
Huta Szkła Zawiercie Sp. z o.o.	15	0.1	0.4	0.90
Huta Szkła Arystycznego i Gospodarczego "Fistek Glass"	15	0.1	0.4	0.90
KROSGLASS S.A.	79.58	0.19	0.075	13.99
MAKORA Krośnieńska Huta Szkła S.A.	15	0.1	0.4	0.90
Owens-Illinois Polska S.A.	288.29	0.21	0.45	33.30
Owens-Illinois Polska S.A.	288.29	0.21	0.45	33.30
Part-Glass Krosno Sp. z o.o.	15	0.1	0.4	0.90
Philips Lighting Poland S.A.	5.81	0.2	0.55	0.52
Pilkington Polska Sp. z o.o.	272.1	0.21	0.15	48.57
Saint-Gobain Glass Polska Sp. Z o.o.	272.1	0.21	0.25	42.86
SCHOTT Poland Sp. z o. o.	5.81	0.1	0.4	0.35
Stolzle Częstochowa S.A.	91.8	0.21	0.45	10.60
Sudety Crystal Works Sp. z o.o.	15	0.1	0.4	0.90
Thomson Multimedia Polska Sp. z o.o.	5.81	0.13	0.45	0.42
Vitrosilicon S.A.	53.07	0.21	0.45	6.13
Total				360.98

Agriculture

The assessment of greenhouse gas emissions in the sector of "Agriculture" is conducted for the following sources: domestic livestock (enteric fermentation and manure management), rice cultivation (flooded rice fields), savanna burning, field burning of agricultural residues and agricultural soil management. The categories of "Rice cultivation" and "Savanna burning" are not investigated for Poland due to the absence of these agricultural activities in the country.

Major agricultural enterprises and farms in Poland are considered to be point-type sources of GHG emissions. In this case, the data on the livestock referees to spatially located point-objects (enterprises). In order to construct the geo-distributed cadastres digital maps of administrative divisions and populated areas were used.

Livestock owned by smaller agricultural enterprises referees to the territories classified as farmlands – area type sources.

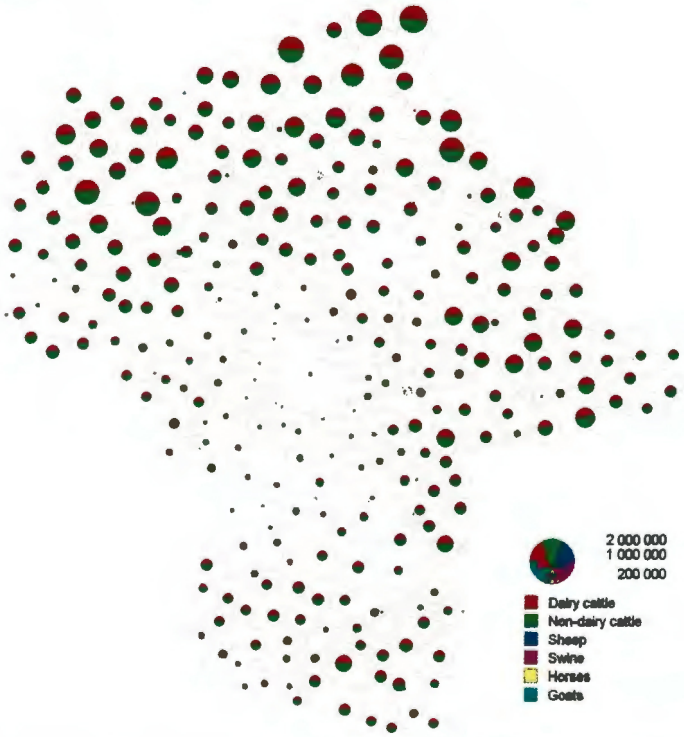

Figure 3.3. Structure of methane emissions from enteric fermentation of livestock animals bred for individual farms (Mazowieckie voivodeship, 2010)

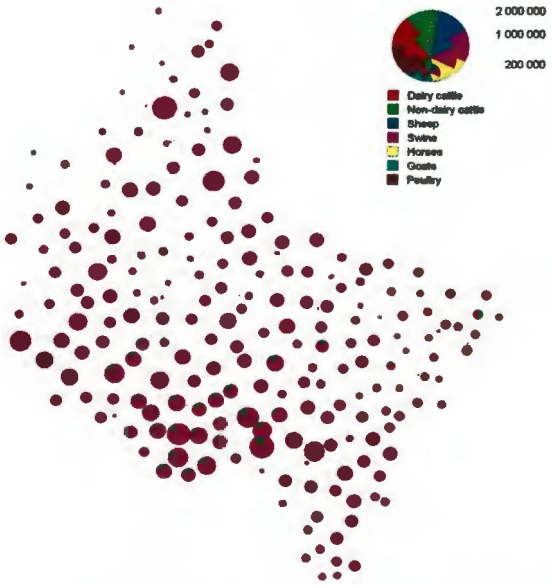

Figure 3.4. Structure of methane emissions from manure management of livestock animals bred at individual farms (Wielkopolskie voivodeship, 2010)

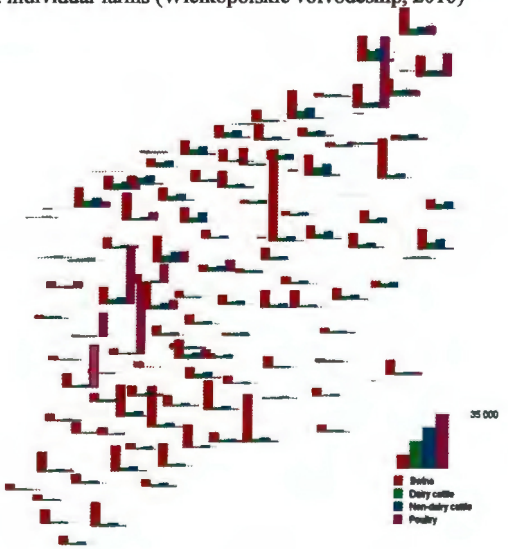

Figure 3.5. Structure of methane emissions from manure management of dairy and non-dairy cattle, swine, and poultry bred at individual farms (Zachodniopomorskie voivodeship, 2010)

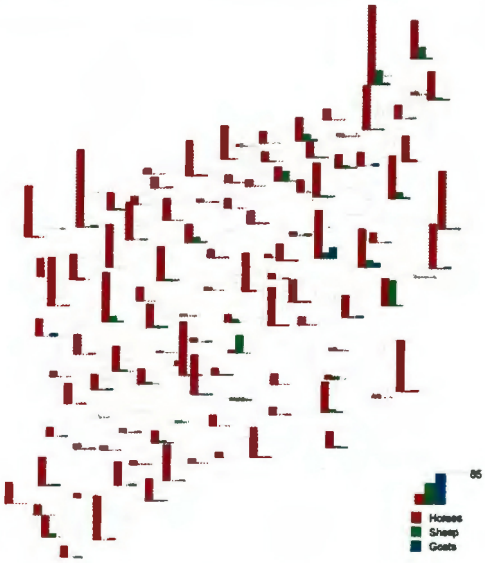

Figure 3.6. Structure of methane emissions from manure management of horses, sheep, and goats bred at individual farms (Zachodniopomorskie voivodeship, 2010)

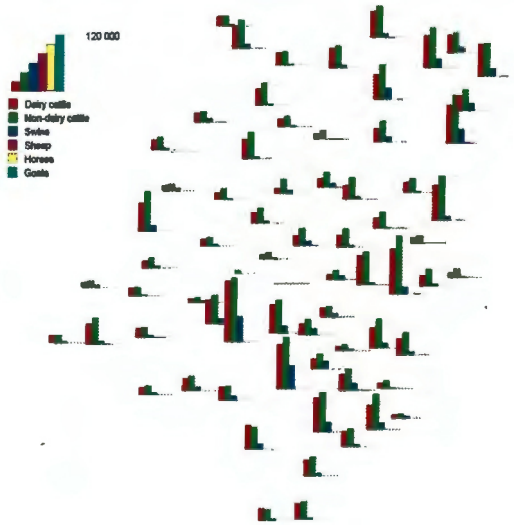

Figure 3.7. Structure of methane emissions from enteric fermentation of livestock animals bred at individual farms (Opolskie voivodeship, 2010)

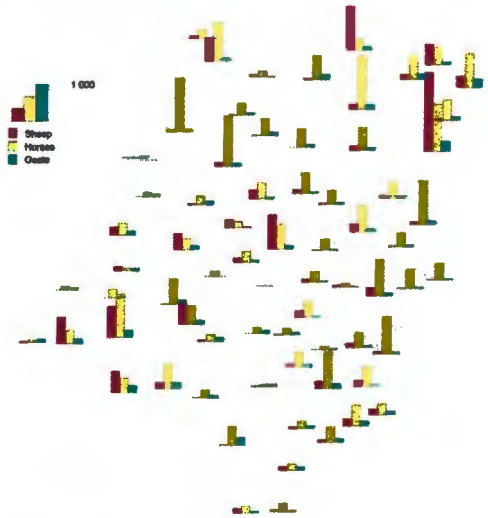

Figure 3.8. Structure of methane emissions from enteric fermentation of horses, sheep, and goats bred at individual farms (Opolskie voivodeship, 2010)

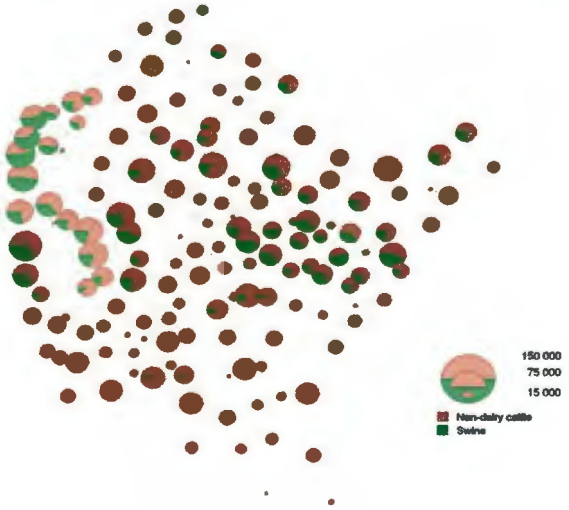

Figure 3.9 Structure of methane emissions from enteric fermentation of non-dairy cattle and from manure management of swine bred at individual farms (Podkarpackie voivodeship, 2010)

Gmina	Województwo	Powiat	Id_teryt_	Dairy_cattle_indiv_2010	Nondairy_cattle_indiv_2010	Sheep_indiv_2010	Swine_indiv_2010	Horses_indiv_2010	Goats_indiv_2010	Poultry_indiv_2010
Bolesławiec	Dolnośląskie	bolesławiecki	0201011	0	10	5	55	8	9	319
Bolesławiec	Dolnośląskie	bolesławiecki	0201022	223	565	21	1 540	81	72	105 666
Gromadka	Dolnośląskie	bolesławiecki	0201032	75	202	16	2 259	39	28	25 711
Nowogrodziec	Dolnośląskie	bolesławiecki	0201043	288	766	0	2 220	53	110	21 108
Osiecznica	Dolnośląskie	bolesławiecki	0201052	24	57	45	234	24	19	10 436
Warta Bolesławiecka	Dolnośląskie	bolesławiecki	0201062	109	297	10	1 116	14	34	25 933
Bielawa	Dolnośląskie	dzierżoniowski	0202011	53	126	0	63	21	12	464
Dzierżoniów	Dolnośląskie	dzierżoniowski	0202021	18	30	16	287	7	21	5 386
Pieszyce	Dolnośląskie	dzierżoniowski	0202031	91	180	62	956	94	46	1 032
Pieszyce G_ma	Dolnośląskie	dzierżoniowski	0202041	59	151	3	145	10	10	1 043
Dzierżoniów	Dolnośląskie	dzierżoniowski	0202052	313	819	61	1 993	66	79	50 436
_ęgiawki	Dolnośląskie	dzierżoniowski	0202062	342	913	20	1 883	14	30	4 941
Niemcza	Dolnośląskie	dzierżoniowski	0202073	54	132	0	331	32	62	1 483
G_ęg_w	Dolnośląskie	ząbkowicki	0203011	12	36	0	363	15	5	218
G_ęg_w	Dolnośląskie	ząbkowicki	0203022	98	273	0	1 635	52	34	5 502
Jordanowice	Dolnośląskie	ząbkowicki	0203032	43	109	5	929	15	6	11 659
Kotla	Dolnośląskie	ząbkowicki	0203042	40	129	0	2 470	66	27	2 627
P_c_ew	Dolnośląskie	ząbkowicki	0203052	60	160	5	1 103	10	14	884
_ąbkowice	Dolnośląskie	ząbkowicki	0203062	34	107	0	2 572	36	22	4 342
G_ra	Dolnośląskie	ząbkowicki	0204013	442	1 145	24	7 100	64	137	5 295
Jaroliny	Dolnośląskie	ząbkowicki	0204022	165	421	2	3 215	63	32	3 377
Niechl_w	Dolnośląskie	ząbkowicki	0204032	285	651	9	2 468	27	22	4 877
W_sosz	Dolnośląskie	ząbkowicki	0204043	585	1 578	5	4 609	91	80	134 711
Jawor	Dolnośląskie	jaworski	0205011	6	17	0	115	0	0	171
Bolk_w	Dolnośląskie	jaworski	0205023	280	664	764	957	150	92	5 377
M_chka	Dolnośląskie	jaworski	0205032	166	443	199	1 662	42	63	5 385
M_ciwój_w	Dolnośląskie	jaworski	0205042	106	307	4	1 336	29	22	2 985
Paszowice	Dolnośląskie	jaworski	0205052	153	389	29	1 092	84	37	1 819
W_dro_e Wielkie	Dolnośląskie	jaworski	0205062	175	464	6	1 781	7	19	2 474
Kargacz	Dolnośląskie	jeleniogórski	0206011	6	10	3	29	6	7	34
Kowary	Dolnośląskie	jeleniogórski	0206021	22	66	5	8	36	0	8 570
Piechowice	Dolnośląskie	jeleniogórski	0206031	32	87	0	20	42	33	199
Szklarska Por_ba	Dolnośląskie	jeleniogórski	0206041	3	13	6	29	29	24	141
Janowice Wielkie	Dolnośląskie	jeleniogórski	0206052	94	226	14	208	95	19	708
Je__w Sudecki	Dolnośląskie	jeleniogórski	0206062	218	616	36	600	109	47	2 973
Mys_akowice	Dolnośląskie	jeleniogórski	0206072	231	579	23	114	104	21	1 309
Podg_zyn	Dolnośląskie	jeleniogórski	0206082	164	421	556	61	167	38	3 161
Stara Kamienica	Dolnośląskie	jeleniogórski	0206092	149	372	33	171	97	62	3 216
Kamienna G_ra	Dolnośląskie	kamiennogórski	0207011	17	37	14	16	11	5	270
Kamienna G_ra	Dolnośląskie	kamiennogórski	0207022	520	1 249	72	635	264	84	2 680
Lubawka	Dolnośląskie	kamiennogórski	0207033	330	808	158	396	186	77	1 849
Marciszów	Dolnośląskie	kamiennogórski	0207042	269	603	144	94	132	80	1 413

Figure 3.10. Fragment of geodatabase: methane emissions from enteric fermentation of livestock owned by individual farms (kg, 2010)

Gmina	Województwo	Powiat	Id_Soyt_	M_Dairy_cattle_Indiv_2010	M_Nondairy_cattle_Indiv_2010	M_Sheep_Indiv_2010	M_Swine_Indiv_2010	M_Horses_Indiv_2010	M_Goats_Indiv_2010	M_Poultry_Indiv_2010
Bolesławiec	Dolnośląskie	bolesławiecki	0201011	0,000	49,300	0,880	389,700	11,120	1,680	25,520
Bolesławiec	Dolnośląskie	bolesławiecki	0201022	2 340,190	2 768,450	3,570	10 671,600	112,000	9,640	8 453,280
Gromadka	Dolnośląskie	bolesławiecki	0201032	789,750	995,880	2,720	14 773,880	54,210	3,120	2 056,880
Nowogrodziec	Dolnośląskie	bolesławiecki	0201043	2 822,040	3 771,450	1,530	14 518,008	73,670	13,200	1 686,480
Osiecznica	Dolnośląskie	bolesławiecki	0201052	252,720	291,610	7,080	1 539,360	33,360	2,280	834,080
Warta Bolesławiecka	Dolnośląskie	bolesławiecki	0201062	1 147,770	1 454,210	1,700	7 311,720	19,480	4,680	2 074,640
Bielawa	Dolnośląskie	dzierżoniowski	0202011	558,090	621,180	0,000	412,020	20,190	1,440	37,120
Dzierżoniów	Dolnośląskie	dzierżoniowski	0202021	188,540	187,340	2,720	1 876,980	9,730	2,520	430,880
Pieszyce	Dolnośląskie	dzierżoniowski	0202031	542,330	867,400	10,540	3 638,240	130,860	5,480	82,560
Pieszyce G_ma	Dolnośląskie	dzierżoniowski	0202041	621,270	744,430	0,510	948,300	13,900	1,200	83,440
Dzierżoniów	Dolnośląskie	dzierżoniowski	0202052	3 295,890	4 037,670	13,770	13 034,220	91,740	9,480	4 034,880
Łagiewniki	Dolnośląskie	dzierżoniowski	0202062	2 548,260	3 022,090	3,400	12 184,020	19,460	3,600	395,280
Niemcza	Dolnośląskie	dzierżoniowski	0202073	569,620	650,760	0,000	2 164,740	44,460	7,440	117,040
Głogów	Dolnośląskie	głogowski	0203011	126,360	177,480	0,000	2 374,020	20,880	0,600	17,440
Głogów	Dolnośląskie	głogowski	0203022	1 031,940	1 345,890	0,000	10 692,900	72,260	4,080	440,160
Jerzmanowa	Dolnośląskie	głogowski	0203032	452,790	537,370	0,850	5 421,660	20,660	0,720	932,720
Kotla	Dolnośląskie	głogowski	0203042	421,200	535,970	0,000	16 153,800	122,320	3,240	202,160
Pęcław	Dolnośląskie	głogowski	0203052	631,800	798,800	0,850	7 213,620	13,900	1,680	69,120
Żukowice	Dolnośląskie	głogowski	0203062	358,020	527,510	0,000	16 820,880	50,040	2,640	347,360
Głogówek	Dolnośląskie	głogowski	0204013	4 654,260	5 644,650	4,080	46 434,000	88,960	16,440	423,600
Jemielno	Dolnośląskie	głogowski	0204022	1 737,450	2 075,530	0,340	21 026,100	116,370	3,840	262,160
Niechlów	Dolnośląskie	głogowski	0204032	2 685,150	3 209,430	0,000	18 140,720	37,530	2,640	368,160
Wąsosz	Dolnośląskie	głogowski	0204043	6 285,350	7 779,540	0,850	32 104,680	126,490	9,600	10 776,880
Jawor	Dolnośląskie	jaworski	0205011	63,180	83,810	0,000	782,100	0,000	0,000	13,680
Bolków	Dolnośląskie	jaworski	0205023	3 685,500	4 703,220	129,880	8 258,700	208,900	11,040	430,160
Mściwojów	Dolnośląskie	jaworski	0205032	1 747,900	2 153,990	33,320	12 031,480	59,360	7,560	430,800
Męcinka	Dolnośląskie	jaworski	0205042	1 116,180	1 513,510	0,680	8 737,440	38,020	2,640	238,800
Paszowice	Dolnośląskie	jaworski	0205052	1 611,090	1 819,170	4,930	7 141,660	116,780	4,440	146,520
Wądroże Wielkie	Dolnośląskie	jaworski	0205062	1 842,750	2 369,120	0,000	11 647,740	9,730	2,280	197,920
Karpacz	Dolnośląskie	jeleniogórski	0206011	0,000	49,300	0,510	189,660	11,120	0,840	2,480
Kowary	Dolnośląskie	jeleniogórski	0206021	231,660	325,360	0,850	92,328	92,020	0,000	685,600
Piechowice	Dolnośląskie	jeleniogórski	0206031	231,660	281,010	0,000	130,560	58,380	2,760	15,200
Szklarska Poręba	Dolnośląskie	jeleniogórski	0206041	31,590	64,090	0,000	109,650	30,920	2,880	11,280
Janowice Wielkie	Dolnośląskie	jeleniogórski	0206052	969,820	1 114,180	2,380	1 380,320	76,450	2,280	56,400
Jeżów Sudecki	Dolnośląskie	jeleniogórski	0206062	2 295,540	3 036,880	6,120	3 270,000	151,510	5,640	165,840
Mysłakowice	Dolnośląskie	jeleniogórski	0206072	2 432,430	2 854,470	3,910	745,560	144,560	2,520	109,800
Podgórzyn	Dolnośląskie	jeleniogórski	0206082	1 726,920	2 075,530	94,520	398,940	232,130	4,560	254,480
Stara Kamienica	Dolnośląskie	jeleniogórski	0206092	1 568,970	1 833,960	5,610	1 118,340	134,630	7,440	257,200
Kamienna Góra	Dolnośląskie	kamiennogórski	0207011	179,010	182,410	2,380	104,640	15,280	0,600	21,600
Kamienna Góra	Dolnośląskie	kamiennogórski	0207022	5 475,600	6 157,570	12,240	4 152,900	353,060	19,080	214,400
Lubawka	Dolnośląskie	kamiennogórski	0207033	3 559,140	4 367,980	28,560	2 602,920	258,540	9,240	147,920

Figure 3.11. Fragment of geodatabase: methane emissions from manure management of livestock owned by individual farms (kg, 2010)