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Information technology for spatial greenhouse gas emission inventory ready to use for any part of Poland, and any time period

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

Deliverable 1.3. Information technology for spatial greenhouse gas emission inventory ready to use for any part of Poland, and any time period

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Work package 1. Spatially resolved greenhouse gas inventory for Poland

Deliverable 1.3.Information technology for spatial greenhouse gas emission inventory ready to use for any part of Poland, and any time period

Content

List of figures

List of tables

5. Geoinformation technology for spatial GHG inventory: agriculture sector

Agriculture contributes significantly to the emissions of greenhouse gases in the EU. It has long been overshadowed by energy-related issues in the policy and scientific debatesurrounding climate change. In many respects though, agriculture plays a key-role in this issue: (1) agriculturalactivities contribute significantly to global emissions of greenhouse gases (GHG); (2) agricultureis the major emitting sector for methane (CH_4), and nitrous oxide (N_2O) – the two main non-CO_2GHGs included in the "Kyoto basket"; (3) the impacts of climate change as predicted by climatemodels are expected to be stronger on agriculture,than on other sectors.

Emissions from agriculture involve both crop and livestock production activities. The GHG emissions from agriculture result from enteric fermentation in livestock production (CH_4), manure management (CH_4 and N_2O), nitrogen application to agricultural soils (N_2O), rice cultivation (CH_4), burning of savannas (CH_4), and burning of agricultural residues in fields (CH_4 and N_2O). Because of the lack of rice cultivation and burning of savannas in Poland, these categories of agricultural activity didn't included in the GHG emissions inventory.

The emissions of methane are disaggregated into thirteen sub-sources (enteric fermentation, that,is disaggregated into six animal categories (dairy cattle, non-dairy cattle, sheep, goats, horses, and pigs), manure management – seven animal categories, including six categories mentioned above, and poultry). The emissions of nitrous oxide are divided into nine sub-sources (five for agricultural soil direct emissions, two for indirect agricultural soil indirect emissions, one for emissions from grazing animals, and one for manure management). The agricultural soils direct emissions emitted in the result of mineral and organic fertilization are divided into five sub-sources: synthetic fertilizers, animal manure applied to soils, N-fixing crops, crops residues, and sewage sludge; on the other hand, agricultural soils indirect emissions came from volatilization, leaching, and run-off of nitrogen (N) from applied synthetic fertilizers and animal manure to soils.

The emissions in agriculture account for about 9% of the total net emissions (National Inventory Submissions). For many categories the data on agricultural activity is available on the level of three administrative-territorial units (municipality, district, region). For example, the statistical data on animal livestock (cattle, horses, pigs) is available on the municipality level separately for different types of the ownership (in individual households and agricultural enterprises), that is very important for the carrying out the spatial GHG emissions inventory from these sources. Data on livestock of sheep and goats is available on the region (in Polish – voivodeship), that is why additional disaggregation steps are used.

Carrying out the spatial GHG inventory at the level of every elementary object in agriculture consists of three main steps (*Figure5.1*):

- Import of the statistical data;
- Disaggregation of the statistical data on agricultural activity;
- Greenhouse gas emission estimation.

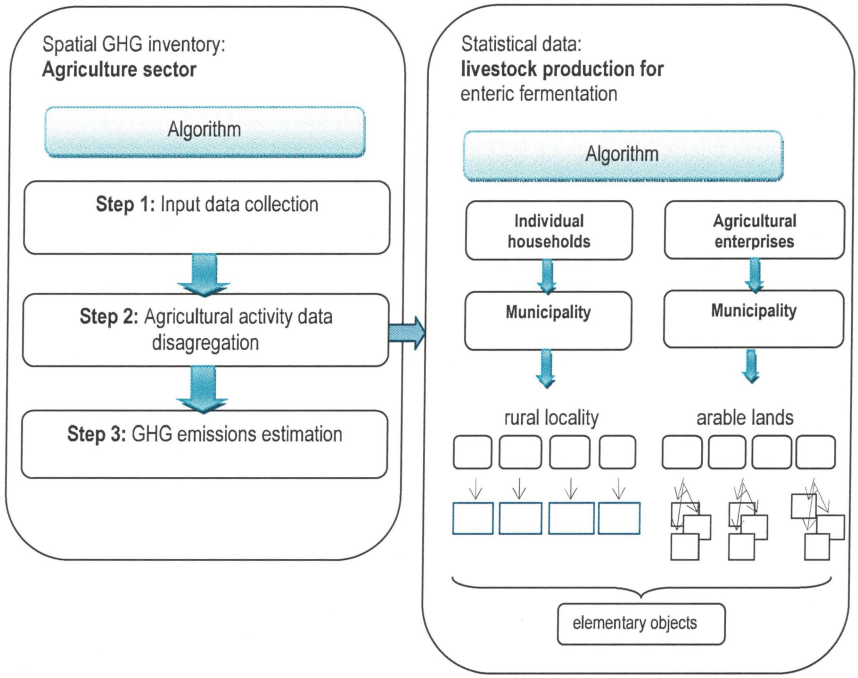

Figure 5.1. The algorithm of the spatial greenhouse gas emissions inventory in agriculture (on the left) and thealgorithm of disaggregation of livestock production (on the right).

The information technology was created for the realization of the developed methodology. The logical structure of the software is presented in *Figure5.2*. Each step of this methodology was implemented as a program module using a geographic information system. Thus, the created information technology consists of three program modules: Agr1collection, Agr2disaggregation and Agr3estimation:

(1) **Agr1collection**. All statistical information about agricultural activity (crops and livestock production) from GUS is given as Excel tables. Animals and agricultural soils are area-type GHG emissions sources. Agricultural soils include arable lands, pastures, and other territories, where farm activity may lead. We also used population density map to form the georeferenced database of input

data. The population map was created using raster data of population density disaggregated according to the Corine land cover 2000 (Gallego, 2010). The map was updated with the data for 2010. The data on population in rural localities within municipalitieswere also updated for 2010 and used for disaggregation of the statistical data of animal livestock owned by individual households (rural population) according to the algorithm givenin *Figure5.1,* on the right.

In **Agr1collection** module the statistical data was imported from given Excel tables and was linked to the digital map of municipalities. The importance of tables is very high, because they contain the statistical information about different activities in agriculture and are essential for greenhouse gas emission inventory. In particular:

- Production of animal livestock for individual municipalities (*Table 5.1*);
- Coefficients, such as fraction of nitrogen excreted from animal manure per year per head of livestock, etc;
- Greenhouse gas emission factors, for example, for methane emission factors from enteric fermentation and manure management for each animal category.

(2) **Agr2disaggregation.**In agriculture sector alot of assumptions was used for disaggregation of available statistical data. Animal livestock owned by individual households is disaggregated from municipality level to the level of elementary objectsproportionally to the share of the rural population within municipality in the elementary object. Territorially, farms are located on agricultural lands, thus animal livestock owned by agricultural enterprises is distributed in proportion to the area of all agricultural lands (arable lands, pastures, and others).

The statistical data on sown areas under main cereals and roots for 2010 are available on the level of municipalities, but without the division for different types of cereals, only total. The required information is available for 2002 for different types of cereals (wheat, oats, barley, maize etc.). The data on sown areas is calculated for 2010 for regions from publication "Production of agricultural and horticultural crops in 2011" and presented in *Table 5.2*. Information about the yield of main crops is also calculated from this publication and presented in *Table 5.3*. Data on sown areas in 2010 in the municipalities are obtained after having disaggregated data from *Table 5.2* proportionally to the statistical data in 2002, and are showed in *Table 5.4*.

Usually, arable lands are used for growing of agricultural crops (cereals, tuber and roots), and permanent crops areas are used for fruits and berries. The statistical data from *Table 5.4*formunicipalities are disaggregated proportionally to the areas of arable lands within municipalities. Maps of agricultural areas including arable lands, pastures and others are taken from the Corine Land Cover 2000.

Mineral and organic fertilizers are applied to soils to improve the crop yield. Due to the lack of information about the accurate localization of sown areas under different crops, we consider that nitrogen consumption for agricultural purposes in one municipality is disaggregated proportionally

to the areas of arable lands within it. Emissions from grazing animals occur from pastures, when animal manure directly grazes on them.

(3) **Agr3stimation**. Using specialized geoinformation system, the estimates of greenhouse gas emission have been obtained. The values of GHG emissions depend on disaggregated statistical data on animal and crops production, and specific GHG emission factors. In Poland, the agricultural activity is widely investigated, national values of emission factors are known and have been used for the emissions estimation.

Using the developed information technology, we carried out numerical experiments from the GHG emissions estimation for 2010, on the base of respective statistical information on agricultural activity in this year. This way we obtained the estimates of the greenhouse gas emissions at the level of elementary objects for 2010 for all categories of agriculture sector. Information about CH_4 and N_2Oemissions from all categories of agriculture sector are in the georeferenced database. The total greenhouse gas CO_2-equivalent emissions are also represented in the georeferenced database with inventory results.

Using the GIS-tools, the obtained GHG inventory results may be presented as thematic maps. The final georeferenced database is ready to use in further research.

As an example, we displayed the spatial GHG inventory results for elementary objects of one of the municipalities of Lesser Silesian region. The location of the Węgliniec municipality on the map of the regions is shown in *Figure5.3*. For the purpose of illustrating the inventory results at elementary objects, the map of the municipalities of Lesser Silesian region was split by grid 2 km x 2 km. The georefferenced database for geographic elementary objects of the Węgliniec municipality (*Figure 5.4*) with GHG emissions from manure managementis presented in *Table 5.5*.

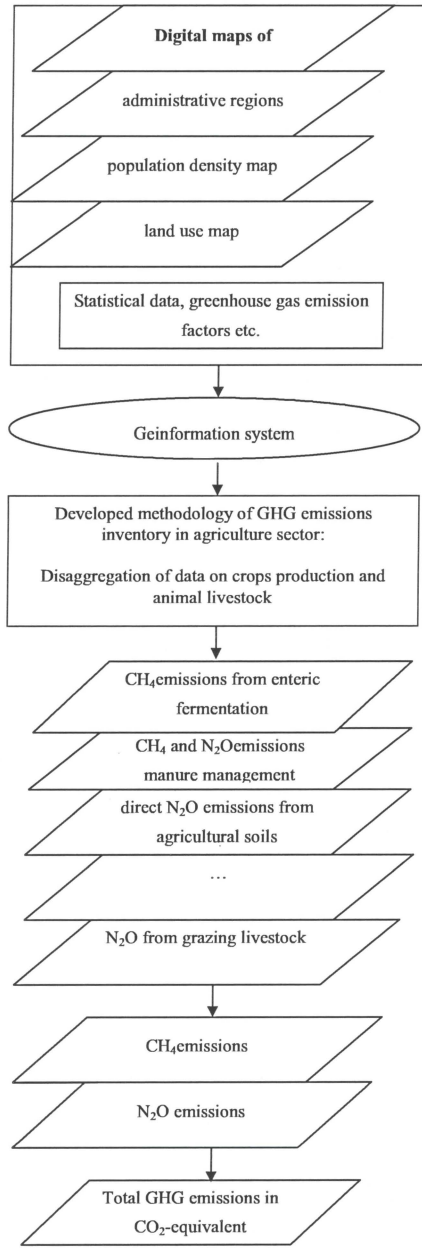

Figure 5.2. The logical structure of the software.

Figure 5.3. Location of Węgliniec municipality on the map of administrative regions of Poland.

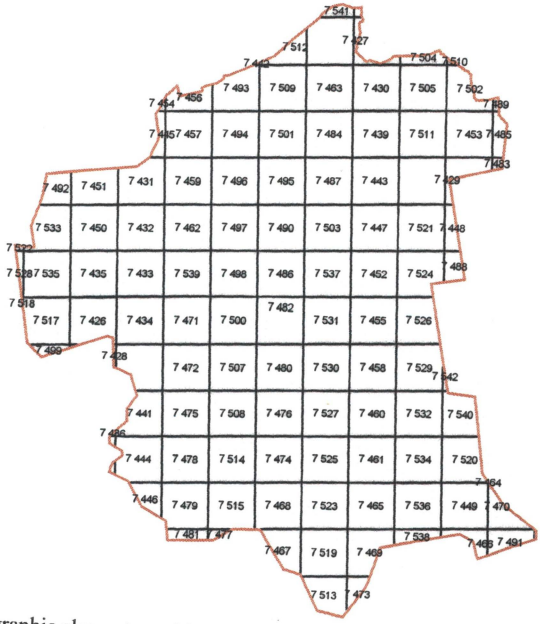

Figure 5.4. Geographic elementary objects completely or partly in Węgliniec municipality of Zgorzelecki district in Dolnośląskie region.

Table 5.1. The number of livestock (cattle, pigs, horses, and poultry) in the municipalities of Poland.

		agricultural holdings total					private farms				
		livestock					livestock				
		cattle total	cattle, cows	pigs total	horses	poultry, total	cattle total	cattle, cows	pigs total	horses	poultry, total
		2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
Code	Territorial unit	[head]	[head]	[head]	[head]	[head]	[head]	[head]	[head]	[head]	[head]
0201011	Bolesławiec (1)	0	0	54	3	844	0	0	54	3	844
0202011	Bielawa (1)	157	53	40	27	960	157	53	40	27	960
0202021	Dzierżoniów (1)	20	12	221	0	1116	20	12	221	0	1116
0202031	Pieszyce (1)	258	120	254	86	2499	258	120	254	86	2499
0202041	Piława Górna (1)	192	94	129	0	1571	70	36	129	0	1571
0203011	Głogów (1)	24	13	143	6	2158	24	13	143	6	2158
0205011	Jawor (1)	346	218	264	0	475	22	14	63	0	475
0206011	Karpacz (1)	0	0	0	0	0	0	0	0	0	0
0206021	Kowary (1)	0	0	0	126	17415	0	0	0	126	17415
0206031	Piechowice (1)	61	32	81	0	156	61	32	81	0	156
0206041	Szklarska Poręba (1)	0	0	0	23	78	0	0	0	23	78
0207011	Kamienna Góra (1)	56	27	42	0	378	56	27	42	0	378
0208011	Duszniki-Zdrój (1)	16	5	0	19	576	16	5	0	19	576
0208021	Kłodzko (1)	73	42	40	0	1402	73	42	40	0	1402
0208031	Kudowa-Zdrój (1)	171	72	95	21	1226	171	72	95	21	1226
0208041	Nowa Ruda (1)	263	149	29	77	2465	263	149	29	77	2465
0208051	Polanica-Zdrój (1)	31	19	0	0	788	24	15	0	0	788
0209011	Chojnów (1)	0	0	0	0	292	0	0	0	0	292
0210011	Lubań (1)	48	18	53	0	638	48	18	53	0	638
0210021	Świeradów-Zdrój (1)	19	10	3	0	873	19	10	3	0	873
0211011	Lubin (1)	0	0	0	5	16530	0	0	0	5	16530

0214011	Oleśnica (1)	21	5	0	38	399302	21	5	0	38	399302
0215011	Oława (1)	40	26	67	14	1192	40	26	67	14	1192
0219011	Świdnica (1)	0	0	0	0	0	0	0	0	0	0
0219021	Świebodzice (1)	0	0	0	16	14561	0	0	0	16	14561
0221011	Boguszów-Gorce (1)	275	123	0	34	12410	275	123	0	34	12410
0221021	Jedlina-Zdrój (1)	258	121	0	0	0	258	121	0	0	0

Table 5.2. Sown area of the main crops on the level of Polish regions (ha, 2010).

Woj	Region	wheat	rye	barley	oats	triticale	cerealmixed	buckwheatandmillet	maize	ediblepulses	Potatoes
0200000	DOLNOŚLĄSKIE	258373	37823	61030	23064	33057	13471	21733	70922	2568	23791
0400000	KUJAWSKO-POMORSKIE	190759,06	62689	106015	15828	122244	66236	1320	77503	2621	19023
0600000	LUBELSKIE	261866,26	63831	125814	72961	117706	120922	18798	40205	16427	30971
0800000	LUBUSKIE	56533,333	42442	26468	13788	38048	10201	9111	17107	836	5698
1000000	ŁÓDZKIE	90642,797	133962	54407	46762	132198	109788	3628	39575	1817	43386
1200000	MAŁOPOLSKIE *	86662,931	8147	37423	18432	17051	27681	474	16575	2007	37570
1400000	MAZOWIECKIE	127143,37	199035	58556	110213	200557	185632	9357	95611	1990	55179
1600000	OPOLSKIE	148580,92	12731	62381	8088	25898	22092	1285	52685	565	9084
1800000	PODKARPACKIE *	93463,993	15559	19073	29662	18180	33711	4384	15185	908	36719

2000000	PODLASKIE	37625,899	77557	21844	52191	77371	184070	3590	73447	612	18158
2200000	POMORSKIE	135903,59	56238	43347	36676	70566	49732	8711	18285	2577	21017
2400000	ŚLĄSKIE *	66268,756	30106	31797	14276	33097	22637	3176	22693	564	12423
2600000	ŚWIĘTOKRZYSKIE	68991,071	23062	50771	16968	43684	32074	4880	9293	4345	20716
2800000	WARMIŃSKO-MAZURSKIE	143718,32	39601	44739	29957	89586	64460	8397	29302	2765	11122
3000000	WIELKOPOLSKIE	207932,22	190775	170171	48978	252830	142787	4749	137426	2240	40436
3200000	ZACHODNIOPOMORSKIE	166964,02	69481	60570	39544	58072	14819	11677	14002	881	15399

Table 5.3. Yield of the main crops on the level of Polish regions (dt/ha, 2010).

Woj	Region	wheat	rye	barley	Oats	triticale	cerealmixed	buckwheatandmillet	maize	ediblepulses	potatoes
0200000	DOLNOŚLĄSKIE	51,3	31,8	39,1	29,7	36,6	30,1	34,1	465,6	25,9	207
0400000	KUJAWSKO-POMORSKIE	44,7	24,9	32,9	26,8	37,9	30,0	57,3	490,4	25,1	229,0
0600000	LUBELSKIE	37,2	23,6	30,5	24,1	26,5	33,7	46,9	552,3	19,2	265,9
0800000	LUBUSKIE	45,5	27,2	35,0	27,2	37,1	27,2	59,6	331,1	7,8	202,0
1000000	ŁÓDZKIE	38,5	23,0	31,9	28,5	34,6	30,0	38,7	548,9	16,9	210,0
1200000	MAŁOPOLSKIE *	32,0	26,0	30,6	23,9	26,3	27,1	55,6	369,4	18,1	146,0
1400000	MAZOWIECKIE	34,6	22,8	29,0	23,4	29,3	26,8	55,6	476,0	15,0	219,1
1600000	OPOLSKIE	54,8	37,7	44,0	32,9	44,7	35,8	61,2	493,1	24,2	251,0
1800000	PODKARPACKIE *	37,7	25,0	31,8	22,0	21,8	26,5	31,5	394,9	21,7	188,0
2000000	PODLASKIE	33,4	23,9	33,5	27,2	31,7	29,2	9,4	525,4	18,4	203,0
2200000	POMORSKIE	47,5	28,9	36,6	28,3	35,2	29,3	20,8	449,7	19,6	246,0
2400000	ŚLĄSKIE *	35,7	23,5	28,4	26,3	31,1	27,1	48,2	507,9	23,6	172,0
260000	ŚWIĘTOKRZYSKIE	28,0	21,9	24,7	21,3	27,7	24,7	41,5	431,6	18,1	163,9

0											
2800000	WARMIŃSKO-MAZURSKIE	49,0	34,8	44,8	26,1	36,6	41,7	11,6	485,5	22,8	232,9
3000000	WIELKOPOLSKIE	45,8	31,4	37,2	27,2	40,0	31,6	38,9	480,0	25,2	231,1
3200000	ZACHODNIOPOMORSKIE	54,4	33,6	42,6	33,8	41,1	32,8	56,5	447,7	20,2	232,0

Table 5.4. Sown area of the main crops on the municipality level of Poland.

Code	Territorial unit	wheat	rye	barley	oats	triticale	cerealmixed	buckwheatandmillet	maize	ediblepulses	potatoes
0223032	Jordanów Śląski (2)	2005	16	216	61	33	13	0	846	0	135
0223043	Kąty Wrocławskie (3)	5705	143	1018	150	129	5	15	1585	40	368
0223052	Kobierzyce (2)	5253	83	240	43	6	4	0	1724	359	689
0223062	Mietków (2)	2391	8	542	51	114	1	0	550	1	93
0225043	Pieńsk (3)	532	663	113	282	117	57	442	3	0	90
0225052	Sulików (2)	1371	820	320	410	148	101	537	120	0	77
0225063	Węgliniec (3)	18	72	5	71	37	6	54	0	0	36
0225072	Zgorzelec (2)	1722	776	320	395	132	39	200	0	0	181
0226011	Wojcieszów (1)	128	90	52	74	0	3	150	0	0	5
0226021	Złotoryja (1)	187	0	9	4	0	0	0	0	0	11
0226032	Pielgrzymka (2)	2966	32	742	164	157	28	315	611	27	139
0226043	Świerzawa (3)	1544	79	620	428	257	89	128	143	5	180
0226052	Zagrodno (2)	4585	207	479	172	136	68	32	459	23	255
0226062	Złotoryja (2)	3791	8	483	82	78	19	15	539	173	164
0261011	Jelenia Góra (1)	311	55	122	199	56	2	982	14	1	33
0262011	Legnica (1)	919	12	122	15	75	17	0	193	244	22
0264011	Wrocław (1)	2400	97	444	43	103	15	12	1541	34	145

Table 5.5. Part of the georeferenced database with the results of the spatial inventory of greenhouse gas emissions from manure management in agriculture sector (Lesser Silesian region, Zgorzelecki district, and Węgliniec municipality).

id	Gmina	Wojewodztwo	Powiat	cows_2010_ind	other_cattle_2010_ind	sheep_2010_ind	goats_2010_ind	id
7427	Węgliniec	Dolnośląskie	zgorzelecki	0.108381	0.179813	0.0418743	0.0665063	7427
7428	Węgliniec	Dolnośląskie	zgorzelecki	0.0193685	0.0321341	0.00748329	0.0118852	7428
7429	Węgliniec	Dolnośląskie	zgorzelecki	0.229289	0.380411	0.0885888	0.1407	7429
7430	Węgliniec	Dolnośląskie	zgorzelecki	0.514776	0.85406	0.198891	0.315885	7430
7431	Węgliniec	Dolnośląskie	zgorzelecki	0.462317	0.767025	0.178622	0.283694	7431
7432	Węgliniec	Dolnośląskie	zgorzelecki	0.514715	0.853959	0.198867	0.315848	7432
7433	Węgliniec	Dolnośląskie	zgorzelecki	0.514717	0.853963	0.198868	0.315849	7433
7434	Węgliniec	Dolnośląskie	zgorzelecki	0.514719	0.853966	0.198869	0.315851	7434
7435	Węgliniec	Dolnośląskie	zgorzelecki	0.514704	0.85394	0.198863	0.315841	7435
7436	Węgliniec	Dolnośląskie	zgorzelecki	0.00432883	0.00718191	0.0016725	0.00265632	7436
7437	Węgliniec	Dolnośląskie	zgorzelecki	0.0242406	0.0402174	0.0093657	0.0148749	7437
7438	Węgliniec	Dolnośląskie	zgorzelecki	0.435939	0.723262	0.168431	0.267508	7438
7439	Węgliniec	Dolnośląskie	zgorzelecki	0.514778	0.854064	0.198892	0.315887	7439
7440	Węgliniec	Dolnośląskie	zgorzelecki	0.499114	0.828075	0.192839	0.306274	7440
7441	Węgliniec	Dolnośląskie	zgorzelecki	0.393979	0.653647	0.152219	0.24176	7441
7442	Węgliniec	Dolnośląskie	zgorzelecki	0.00203107	0.00336973	0.000784731	0.00124634	7442
7443	Węgliniec	Dolnośląskie	zgorzelecki	0.514778	0.854063	0.198891	0.315886	7443
7444	Węgliniec	Dolnośląskie	zgorzelecki	0.48558	0.805622	0.187611	0.29797	7444
7445	Węgliniec	Dolnośląskie	zgorzelecki	0.102966	0.17083	0.0397823	0.0631837	7445
7446	Węgliniec	Dolnośląskie	zgorzelecki	0.177508	0.294502	0.0685826	0.108925	7446
7447	Węgliniec	Dolnośląskie	zgorzelecki	0.514782	0.854071	0.198893	0.315889	7447
7448	Węgliniec	Dolnośląskie	zgorzelecki	0.131424	0.218044	0.0507773	0.0806462	7448
7449	Węgliniec	Dolnośląskie	zgorzelecki	0.514821	0.854135	0.198908	0.315913	7449
7450	Węgliniec	Dolnośląskie	zgorzelecki	0.514701	0.853936	0.198862	0.31584	7450
7451	Węgliniec	Dolnośląskie	zgorzelecki	0.386964	0.642009	0.149509	0.237455	7451
7452	Węgliniec	Dolnośląskie	zgorzelecki	0.514784	0.854074	0.198894	0.31589	7452
7453	Węgliniec	Dolnośląskie	zgorzelecki	0.514804	0.854107	0.198902	0.315903	7453

Table 5.5 (Continuation 1).Part of the georeferenced database with the results of the spatial inventory of greenhouse gas emissions from manure management in agriculture sector (Lesser Silesian region, Zgorzelecki district, and Węgliniec municipality).

id	horses_2010_ind	pigs_2010_ind	poultry_2010_ind	CH4_kg_cows_ind	CH4_kg_other_catlle_ind	CH4_kg_sheep_ind	id
7427	0.147792	0	24.127	1.49132	0.460322	0.00711864	7427
7428	0.0264116	0	4.31169	0.266511	0.0822633	0.00127216	7428
7429	0.312666	0	51.0428	3.15501	0.973852	0.0150601	7429
7430	0.701967	0	114.596	7.08332	2.18639	0.0338114	7430
7431	0.630432	0	102.918	6.36148	1.96358	0.0303658	7431
7432	0.701884	0	114.583	7.08248	2.18614	0.0338074	7432
7433	0.701887	0	114.583	7.08251	2.18614	0.0338076	7433
7434	0.70189	0	114.584	7.08254	2.18615	0.0338077	7434
7435	0.701868	0	114.58	7.08232	2.18609	0.0338067	7435
7436	0.00590294	0	0.963656	0.0595646	0.0183857	0.000284325	7436
7437	0.0330554	0	5.39629	0.333551	0.102957	0.00159217	7437
7438	0.594462	0	97.0459	5.99852	1.85155	0.0286332	7438
7439	0.70197	0	114.597	7.08335	2.1864	0.0338116	7439
7440	0.68061	0	111.11	6.86781	2.11987	0.0327827	7440
7441	0.537244	0	87.7052	5.42116	1.67334	0.0258773	7441
7442	0.00276964	0	0.452144	0.0279475	0.0086265	0.000133404	7442
7443	0.70197	0	114.597	7.08334	2.1864	0.0338115	7443
7444	0.662155	0	108.097	6.68159	2.06239	0.0318938	7444
7445	0.140408	0	22.9216	1.41681	0.437325	0.006763	7445
7446	0.242056	0	39.5157	2.44251	0.753925	0.011659	7446
7447	0.701976	0	114.598	7.08341	2.18642	0.0338118	7447
7448	0.179214	0	29.2567	1.80839	0.558192	0.00863214	7448
7449	0.702029	0	114.606	7.08394	2.18659	0.0338144	7449
7450	0.701866	0	114.58	7.08229	2.18608	0.0338065	7450
7451	0.527678	0	86.1435	5.32463	1.64354	0.0254165	7451
7452	0.701979	0	114.598	7.08343	2.18643	0.033812	7452
7453	0.702006	0	114.602	7.08371	2.18651	0.0338133	7453

Table 5.5 (Continuation 2).Part of the georeferenced database with the results of the spatial inventory of greenhouse gas emissions from manure management in agriculture sector (Lesser Silesian region, Zgorzelecki district, and Węgliniec municipality).

id	CH4_kg_goats_in	CH4_kg_horses_in	CH4_kg_pigs_in	CH4_kg_poultry_in	N2O_kg_liquid_system	N2O_kg_solid_system	id
7427	0.00798075	0.205431	0	1.93016	0.00201832	0.373188	7427
7428	0.00142623	0.0367121	0	0.344936	0.00036069	0.0666917	7428
7429	0.016884	0.434606	0	4.08342	0.00426993	0.789511	7429
7430	0.0379062	0.975735	0	9.16769	0.00958643	1.77253	7430
7431	0.0340433	0.8763	0	8.23344	0.0086095	1.5919	7431
7432	0.0379018	0.975619	0	9.16661	0.00958529	1.77232	7432
7433	0.0379019	0.975623	0	9.16665	0.00958533	1.77233	7433
7434	0.0379021	0.975627	0	9.16668	0.00958537	1.77234	7434
7435	0.0379009	0.975597	0	9.1664	0.00958507	1.77228	7435
7436	0.000318759	0.00820509	0	0.0770924	8.06136e-005	0.0149055	7436
7437	0.00178499	0.045947	0	0.431704	0.000451422	0.0834679	7437
7438	0.0321009	0.826302	0	7.76367	0.00811828	1.50107	7438
7439	0.0379064	0.975739	0	9.16773	0.00958647	1.77254	7439
7440	0.0367529	0.946048	0	8.88877	0.00929476	1.7186	7440
7441	0.0290112	0.74677	0	7.01641	0.00733689	1.35659	7441
7442	0.000149561	0.0038498	0	0.0361715	3.78236e-005	0.00699359	7442
7443	0.0379064	0.975738	0	9.16772	0.00958646	1.77254	7443
7444	0.0357564	0.920396	0	8.64775	0.00904273	1.672	7444
7445	0.00758204	0.195167	0	1.83373	0.00191749	0.354543	7445
7446	0.013071	0.336458	0	3.16126	0.00330565	0.611214	7446
7447	0.0379067	0.975747	0	9.16781	0.00958654	1.77255	7447
7448	0.00967755	0.249107	0	2.34053	0.00244744	0.452531	7448
7449	0.0379096	0.97582	0	9.1685	0.00958727	1.77269	7449
7450	0.0379007	0.975593	0	9.16636	0.00958504	1.77227	7450
7451	0.0284946	0.733473	0	6.89148	0.00720625	1.33244	7451
7452	0.0379069	0.975751	0	9.16784	0.00958658	1.77256	7452
7453	0.0379083	0.975788	0	9.1682	0.00958695	1.77263	7453

Table 5.5 (Continuation 3).Part of the georeferenced database with the results of the spatial inventory of greenhouse gas emissions from manure management in agriculture sector (Lesser Silesian region, Zgorzelecki district, and Węgliniec municipality).

id	CH4_kg_total	N2O_kg_total	CO2-eqv_kg	id
7427	4,10233	0,3752063	214,3697	7427
7428	0,73312	0,0670524	38,30962	7428
7429	8,67884	0,7937809	453,5177	7429
7430	19,4849	1,7821164	1018,193	7430
7431	17,4992	1,5986095	913,8656	7431
7432	19,4826	1,7819053	1018,073	7432
7433	19,4826	1,7819153	1018,076	7433
7434	19,4827	1,7819254	1018,081	7434
7435	19,4821	1,7818651	1018,048	7435
7436	0,163851	0,0149861	8,562133	7436
7437	0,917535	0,0839193	47,94633	7437
7438	16,5008	1,5091883	862,2581	7438
7439	19,4849	1,7821265	1018,196	7439
7440	18,892	1,7192948	984,6499	7440
7441	14,9126	1,3639269	779,2652	7441
7442	0,076878	0,0070314	4,017315	7442
7443	19,4849	1,7821265	1018,196	7443
7444	18,3798	1,6810427	960,4457	7444
7445	3,89738	0,3564605	203,6597	7445
7446	6,71888	0,6145197	351,0989	7446
7447	19,4851	1,7821365	1018,204	7447
7448	4,97453	0,4549784	259,9468	7448
7449	19,4866	1,7822773	1018,284	7449
7450	19,482	1,7818550	1018,043	7450
7451	14,647	1,3396463	765,3896	7451
7452	19,4852	1,7821466	1018,21	7452
7453	19,4859	1,7822170	1018,248	7453

Table 5.6. Explanation of columns of the attribute table.

Column name	Explanation
id	elementary object ID
Gmina	name of the municipality
Powiat	name of the district
Wojewodztwo	name of the region
cows_2010_ind	number of cows in the ownership of individual households (head)
other_cattle_2010_ind	number of other non-dairy cattle in the ownership of individual households (head)
sheep_2010_ind	number of sheep in the ownership of individual households (head)
goats_2010_ind	number of goats in the ownership of individual households (head)
horses_2010_ind	number of horses in the ownership of individual households (head)
pigs_2010_ind	number of pigs in the ownership of individual households (head)
poultry_2010_ind	number of poultry in the ownership of individual households (head)
CH4_kg_cows_ind	CH_4 emissions from enteric fermentation of cows (kg)
CH4_kg_other_cattle_ind	CH_4 emissions from enteric fermentation of other non-dairy cattle (kg)
CH4_kg_sheep_ind	CH_4 emissions from enteric fermentation of sheep (kg)
CH4_kg_goats_ind	CH_4 emissions from enteric fermentation of goats (kg)
CH4_kg_horses_ind	CH_4 emissions from enteric fermentation of horses (kg)
CH4_kg_pigs_ind	CH_4 emissions from enteric fermentation of pigs (kg)
CH4_kg_poultry_ind	CH_4 emissions from enteric fermentation of poultry (kg)
N2O_kg_liquid_system	N_2O emissions from collection, storage and usage of manure of all agricultural animals in liquid systems (kg)
N2O_kg_solid_system	N_2O emissions from collection, storage and usage of manure of all agricultural animals in solid systems (kg)
CH4_kg_total	total CH_4 emissions from enteric fermentation and manure managementof animals in the ownership of individual households in the agriculture sector (kg)
N2O_kg_total	total N_2O emissions from enteric fermentation and manure managementof animals in the ownership of individual households in the agriculture sector (kg)
CO2-eqv_kg	greenhouse gas CO_2-equivalent (kg)emissions in the agriculture sector

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