Proiect: BiG>East

(EIE/07/214)

Assessment of the agricultural structure for biogas production in Eastern Europe

WP2 - Task 2.4

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Content

1 Introduction and report description

For each target country the agricultural structure was assessed. This includes the typical sizes of farms, their productivity and the distribution of farms within the country. The agricultural structure largely influences the possibilities of biogas production. It also significantly affects different technical aspects and management issues (e.g. feedstock supply chain).

In task 2.3 the countries maximum biomass potential for production of biogas was evaluated. In this task the **main aim is to evaluate the countries specific production systems and on this basses and inputs from 2.3 to establish how much from this total potential biomass could be in reality available for biogas production.**

Base on the results from task 2.3 the most important source of biomass that could be utilized for biogas production is represented by agricultural wastes, the difference between the maximum potential and the real potential being given by the structure (mainly by organization) of the production systems (farms) in what concerns the feedstock potential, as well as the capacity to implement integrated waste management systems.

2 Methodology

The methodology used to assess the agricultural structure and potential for biogas was selected from EUROSTAT – EUROFARM as described in the next sub-chapter:

2.1 Agricultural holding and typology[1]

The basic unit underlying the Community farm structure survey is the agricultural *holding*. A holding is defined as a technical-economic unit under single management unit engaged in agricultural production.
For each activity ("*enterprise*") on a holding, or farm, (e.g. wheat, dairy cow or vineyard), a *standard gross margin (SGM*) is estimated, based on the area (or the number of heads) and a regional coefficient. The sum of all margins, for all activities of a given farm, is referred to as the *economic size* of that farm. The economic size is expressed in *European Size Units (ESU)*, 1 ESU being equal to 1200 Euro of SGM. The SGMs used for the purpose of the FSS 2003 refer to the average of the years 1999, 2000 and 2001 (SGMs "2000").
In the community typology, each holding is classified by its economic size and its *type of farming***.** The type of farming is determined on the basis of the relative importance of the individual activities carried out by a given farm. For instance, a farm is classified as *specialist pig rearing* (type 5011) if breeding accounts for more than 2/3 of the economic size. Depending on the level of aggregation, farms are grouped into 8 to 70 types.

The *utilized agricultural area* (UAA) is the total of arable land, permanent pasture and meadows, land used for permanent crops and kitchen gardens. The UAA excludes unutilized agricultural land, woodland and land occupied by buildings, farmyards, tracks,

[1] After: Eurostat, Statistical Office of the European Communities, P. MARQUER

ponds, etc. For the purpose of this report, we will in general refer to the utilized agricultural area as "*agricultural area*" (AA).
For certain purposes, one needs to aggregate various categories of livestock, e.g. piglets, breeding sows and other pigs. The coefficients used to this end, are the so-called *Livestock Units* (LSU). The LSU are related to the feed requirements of the individual animal categories. The following LSU coefficients are used in the framework of the Farm Structure Survey (FSS).

Agricultural holding: a single unit both technically and economically, which has single management and which produces agricultural products. Other supplementary (non-agricultural) products and services may also be provided by the holding. The smallest farms (less than 1% of national agricultural activity) do not have to be surveyed.

The data on individual agricultural holdings are collected by all Member States and sent to Eurostat. The aggregated results are disseminated through statistical tables.

Data for basic surveys are available in a three-level geographical breakdown of the whole country, the regions and the district; while data for intermediate surveys are only available upon the two-levels of country and regions.

The Eurofarm domain does not cover the whole territory. So the land use data without link with other farm characteristics should be downloaded by the user from the relevant data holder. Specific national data about rearing structure or agricultural labor force can be found in other domains, without link between the various productions at farm level.

2.2 Land and livestock

Based on the described methodology, the Consortium developed extensions and an application that is based on the same principles and take in account specific assumptions, described in this chapter.
Taking into consideration the EUROSTAT criteria for classification based on the number of agricultural holdings, using *ArcGis* software, Romania was included in the class 5, Greece is included in class 3, Bulgaria in class 2, Latvia and Slovenia in class 1 (for class intervals see Figure 1).

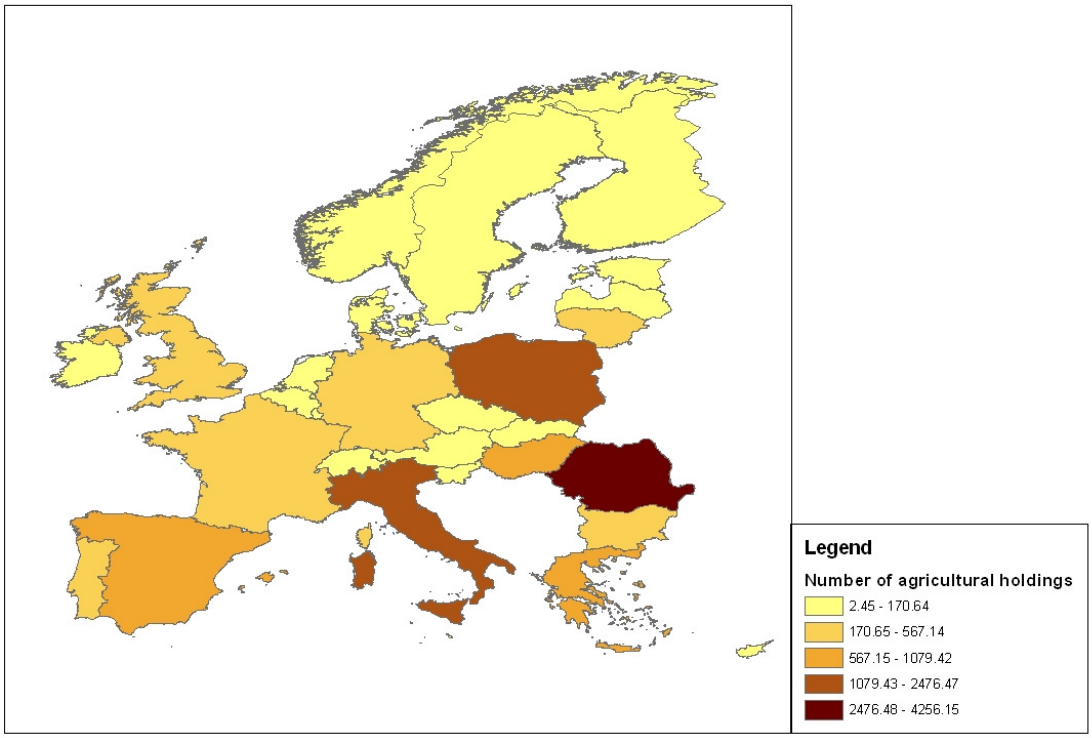


Figure 1 Total number of agricultural holdings (*1000) at the European scale (source: Eurostat)

Taking into consideration the agricultural area (AA) and the purpose of the report (identification of the agricultural structure with relevance for biomass potential) we considered the following classification with higher relevancy for the farms:

- holding with agricultural area <5 ha;
- holding with agricultural area >5<20 ha;
- holding with agricultural area >20<50 ha;
- holding with agricultural area >50 ha;

3 Organization of the farming system

Structural and functional peculiarities of the agricultural production in the European countries (those participating in the project) were described using integrated ***indicators*** for farms. Those indicators are specific measures related to feedstock, production, number of heads (for animals), related with area of agricultural land or farm, number of farms, structure of production system or ownership. By studying those relationships one could infer details about factors as: fragmentations, specific production per Ha, dominant cultures or domestic species. Fragmentation of the land could be one of the major factors that could influence the biogas projects, especially because sustainable access to feedstock needs a coordinated local management system. A series of assumptions have been used (those described in chapter 3.1). In equal measure, the assumptions stated in the Final Report WP 2, Task 2.3, elaborated under BiG>East Project, stands for the possibility to further integrate the results of both reports.

For the purpose of this report a farm is defined as an agricultural production unit with dimensions starting from individual subsistence units up to the complex farming units that assures the needs of a local community or the export to other regions.

3.1 Total number of holdings

A detailed situation of the total number of holdings in relation with the surface of agricultural area is presented in figure 2. All the target countries (except Croatia, which was not included due to the fact that necessary data are not listed in Eurostat database) have a high degree of fragmentation of the agricultural land and still we could find a lot of farms (agricultural holdings) with smaller farm size than the set described in Figure 2.

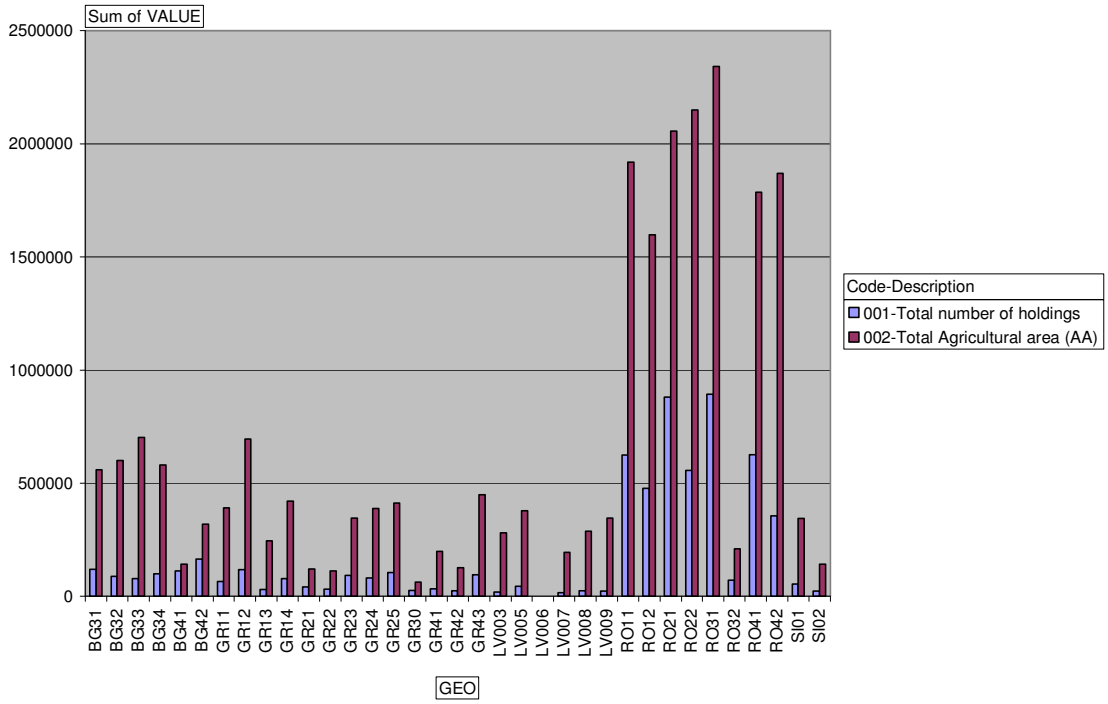


Figure 2 Total number of holdings in relation with surface of agricultural area

The fragmentation of the agricultural area in the target European countries (especially in Bulgaria, Latvia, Romania and Slovenia) is obvious when we compare the number of holdings and surface of utilized agricultural area from that region with other like Germany (figure 3).

Romania has the highest degree of fragmentation from the studied countries. Local data shows an even higher degree of fragmentation in Croatia, were farms with surfaces of around 1 Ha are numerous.

Fragmentation is an indicator of the difficulties one could face during a biogas project development, difficulties related with the fact that, higher the number of agricultural holdings and smaller the production area of the farm being, the access to feedstock will be tougher, due to logistical constrains. In the measure of the possibilities, choosing a site for a biogas plant should take in account that fragmentation of the agricultural holdings is a negative impact factor for the success of a biogas project.

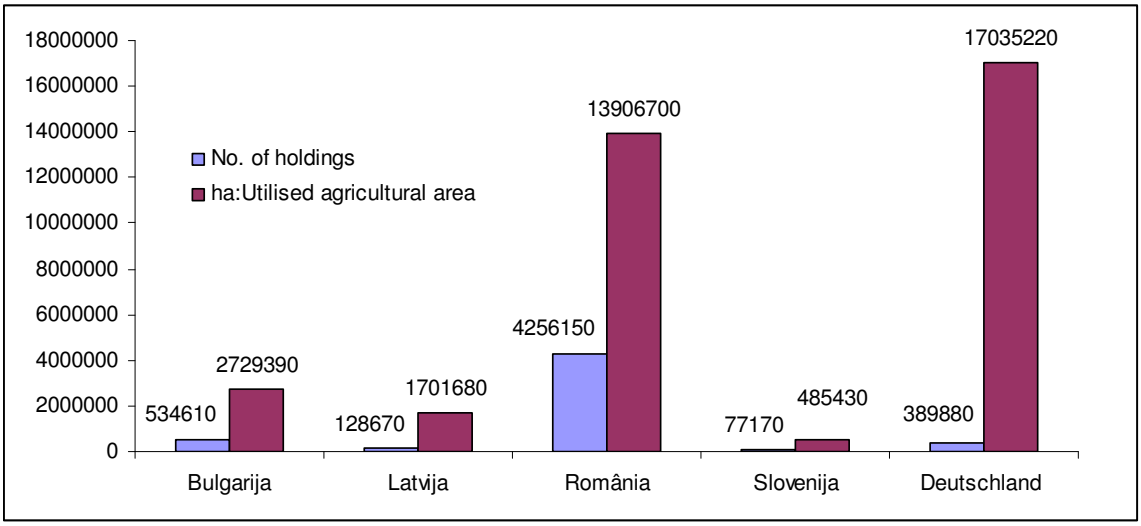


Figure 3 Total number of holdings in relation with the utilized agricultural area

The farms are much greater in Germany, with surfaces in average over 43 hectares were in the target European countries the farm area has an average of 7 hectares[2].

3.2 Total number of holdings with livestock

The variability of the animal farm counts from the target European countries, at NUTS level 2, is presented in Figure 4. Both Figure 3 and Figure 4 support the idea of a correspondence between the available agricultural surface and the capacity to develop and implement animal farms as complementary production units.

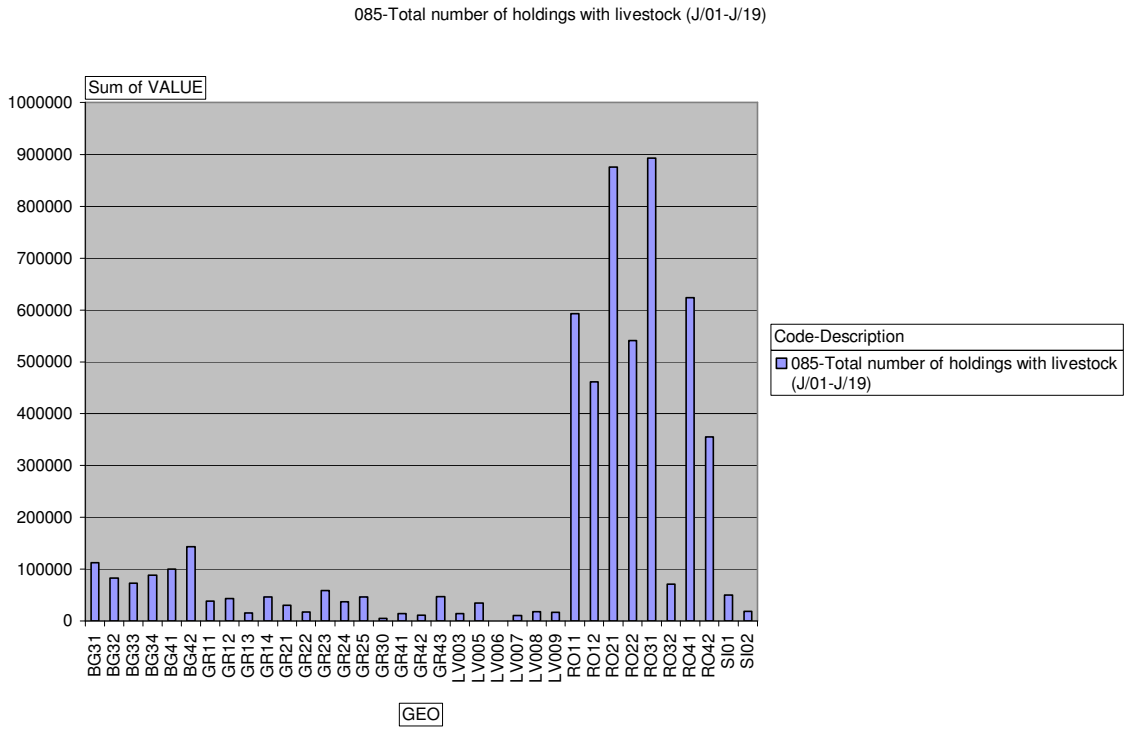


Figure 4 Total number of holdings with livestock

[2] Source: Mangus

Again, the number of holdings with livestock is far greater in South-Eastern European countries, and Romania is a special case, showing the biggest number of livestock holdings. Nevertheless the number of livestock per holding is far less in the target countries than for e.g. in Germany. This has a direct link with the possible sources of biomass for biogas production due to the increased transport distances that must be covered in order to gather the needed amount of wastes from livestock (feedstock logistics problems).
In the measure of the possibilities, biogas plant project developers will find area were high capacity livestock holdings exist.

3.3 Farm types

Farm type is another indicator that has influence in the biogas projects. Different crops have specific biogas potential; in terms of effective biogas volume produced per ton of feedstock and also in terms of specific agricultural wastes resulted from agricultural production, which could be directed to biogas production. A synthetic view is presented in Figure 5 and Figure 6, showing categories resulted from their surfaces in relation with type of crops and their share from the total agricultural area.

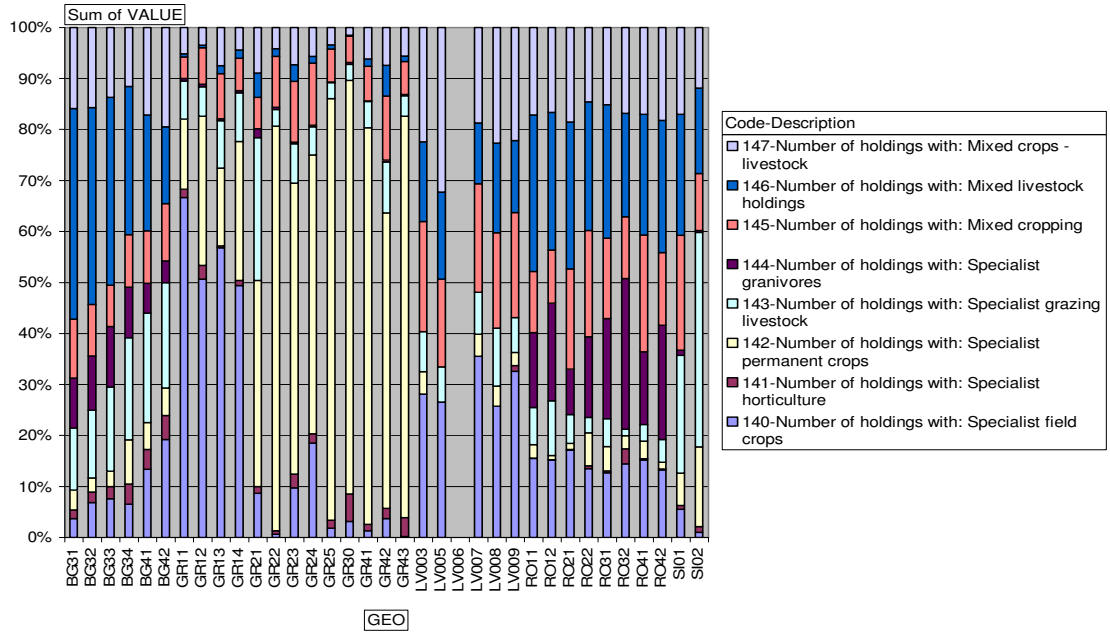


Figure 5 Farm numbers on major activity categories

Greece is different from other countries in the area, as the number of "specialist permanent crops" is increased, compared with farm number for field crops or granivores, as Romania and Bulgaria have. Relating information as number of farms, farm dimensions and type of farm, one could provide important hints about the possible production of biogas and sources of biogas. Romania and Bulgaria show an interesting characteristic, being the presence of large proportion of mixed livestock holdings. In relation to the farm fragmentation analysis, this shows a developed section of "subsistence agriculture", were small farms have diversified crops and livestock. The same comparing strategy for Latvia will give a balanced production system, were farms are not very small (small degree of

agricultural land fragmentation, and a specialization of the crops related to the farm categories). This could be an advantage in site selection, that could be oriented also on the type of crop (most appropriate for biogas), knowing that access to feedstock will have no major logistic constrains). For Greece, identification of the major specialist permanent crops could be a base for new site selection fro biogas plants, knowing that specialist permanent crops could be a stability factor for feedstock supply in a biogas plant.

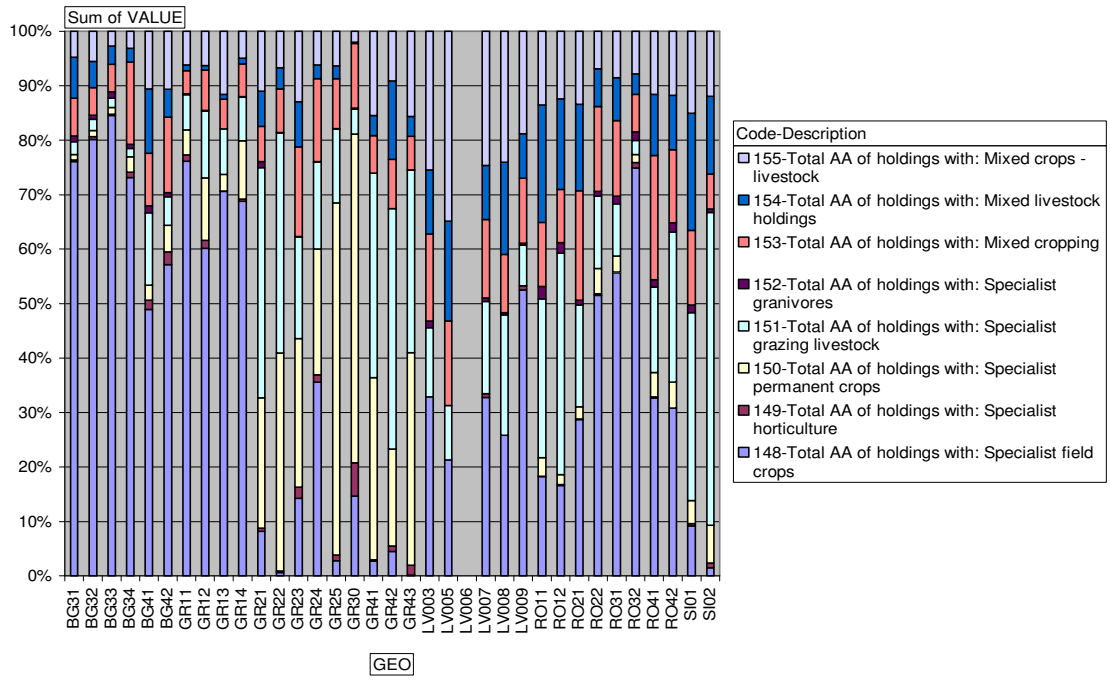


Figure 6 Agricultural surface allocated to major farm categories

3.4 Farms ownership types

Another important indicator of the farm type that could influence the biogas projects is their ownership type. Two types of ownerships over the agricultural land are encountered in countries like Slovenia (SI), Latvia (LV) and Bulgaria (BG) – direct ownership and a leased form. In Greece (GR) and Romania (RO) a third ownership form exists represented by association of individual owners with the main aim to increase farm surface and transform the existing farm units in a more efficient structures. (Figure 7). Owned and shared associations could be a positive factor for biogas projects. Especially the associations could offer an already existing complex shareholder structure for a future biogas venture.

At the other side of the scale, Bulgaria has an important percent of tenant farms. This could be a negative factor, as the actual user of the land needs owner agreement to develop a biogas project. In Bulgaria, mobilization campaigns should stress the advantages of a biogas plant, having as target the owners of the land.

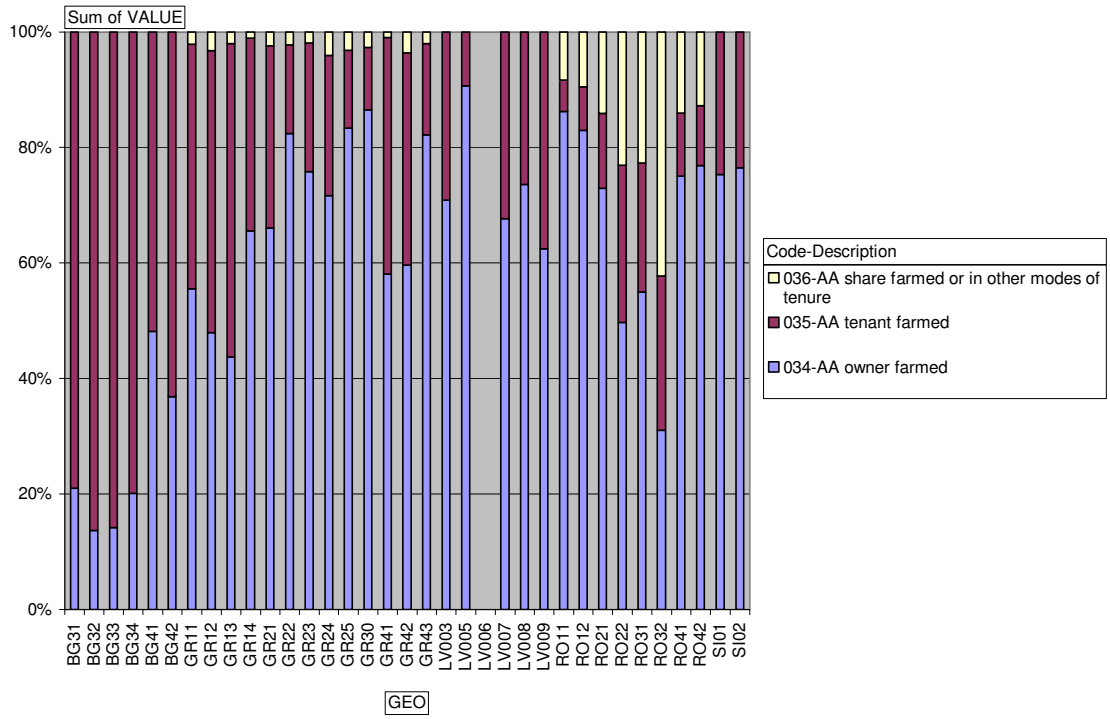


Figure 7 Ownership weight of agricultural land

3.5 Farm size

This indicator is related with the number of holdings and contribute to the general indicator of agricultural land fragmentation, but includes also the actual number of owners, tenants and different forms of associations.

The target European countries are characterized by a series of structural characteristics and a diversity of organizational structures, with farms starting with less then 5 ha, single ownership, up to farms of 500 or more ha, with different number of owners and complex association types. (figures 8-12).

In Romania and Bulgaria the weight of family farms is up to 30 % and in other target countries the weight is less but still high in comparison with other EU Member States.

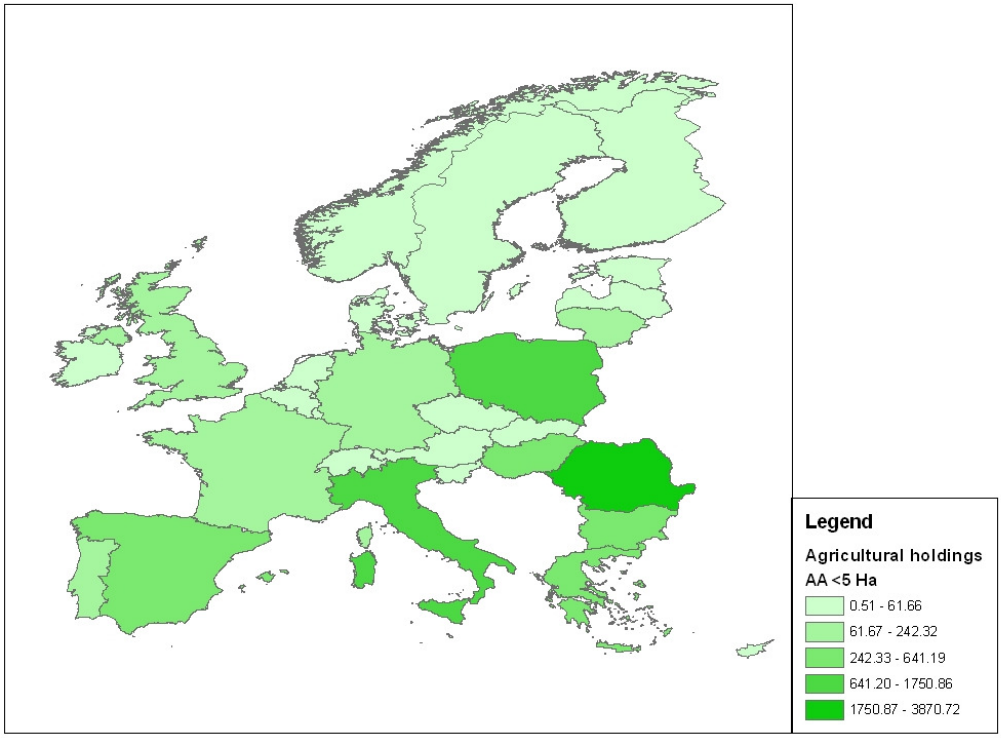


Figure 8 Number of agricultural holding with agricultural area <5ha

As already discussed the most fragmented agricultural land is to be found in Romania (between 1750 and up to 3870 units less than five hectares.

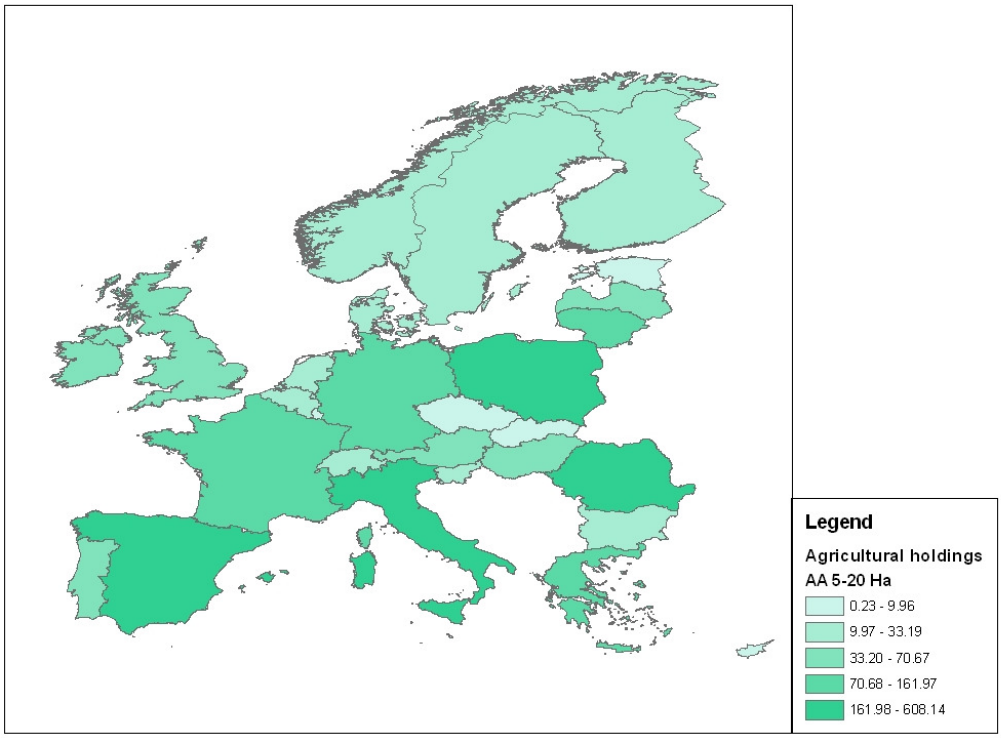


Figure 9 Number of agricultural holding with agricultural area >5<20 ha

The same is for agricultural holdings with surfaces up to 20 ha that are also characteristic to Romania as well as Bulgaria, Poland and Estonia. This is in fact to say that overall for this area the agricultural farm surface is between 3 and 20 hectares.

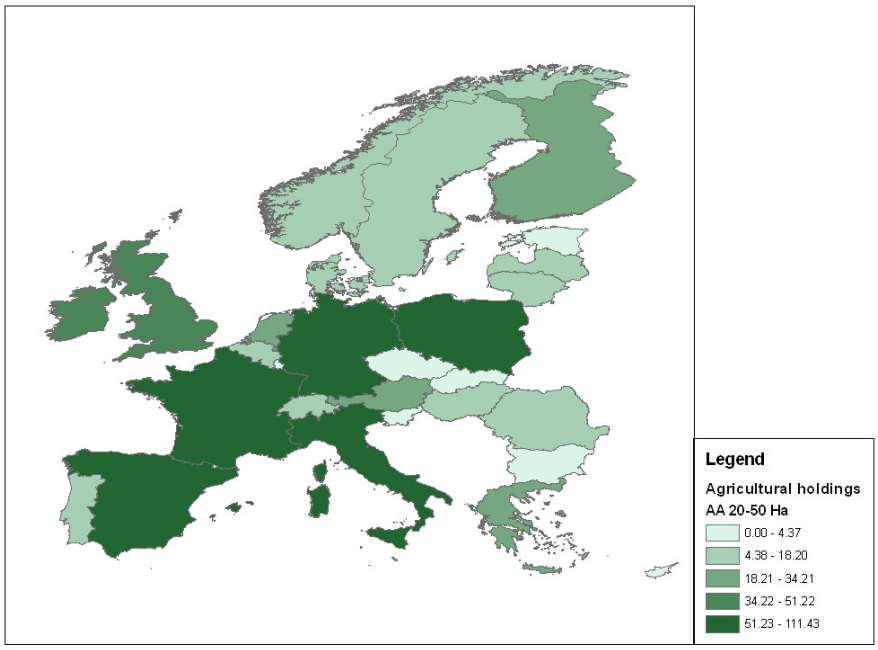


Figure 10 Number of agricultural holding with agricultural area >20<50 ha

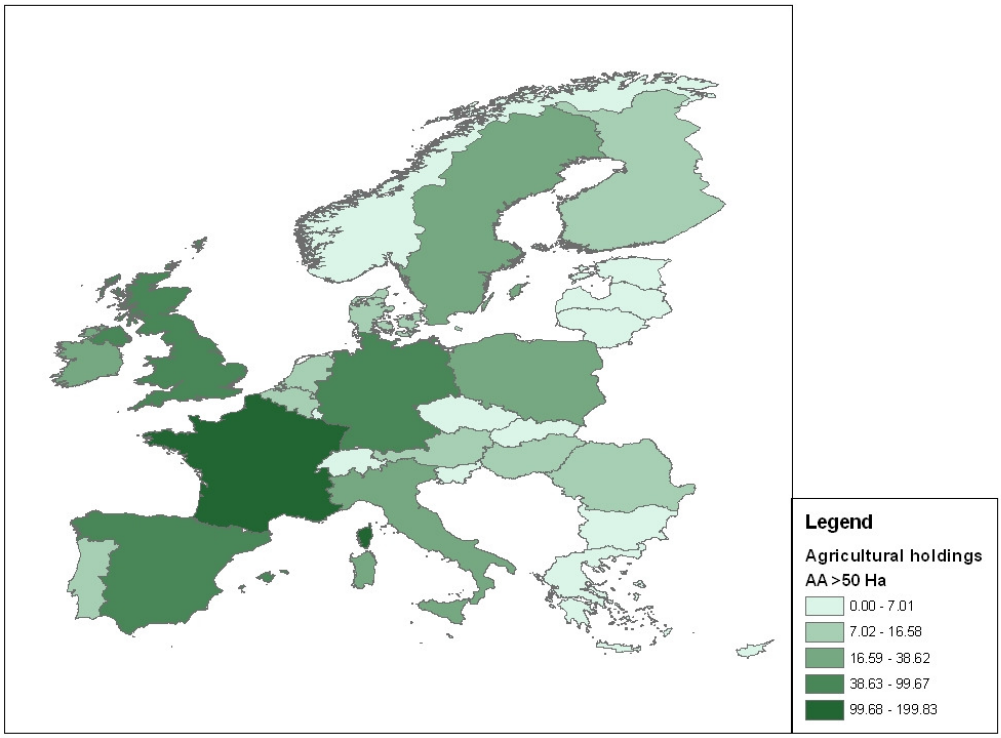


Figure 11 Number of agricultural holding with area >50 ha

3.5.1 Comparative analysis of farm size (target countries Europe)

In almost all the target countries the farming system is still not strong (well develop efficient structures) enough to support the biogas industry in the way that is foreseen in the rest of the Europe.
In order, Latvia and Greece are the countries more organized in terms of aggregated farms, than the rest of the target countries. This is a positive value of the indicator, making those countries more suitable for fast future investments in the biogas industry.

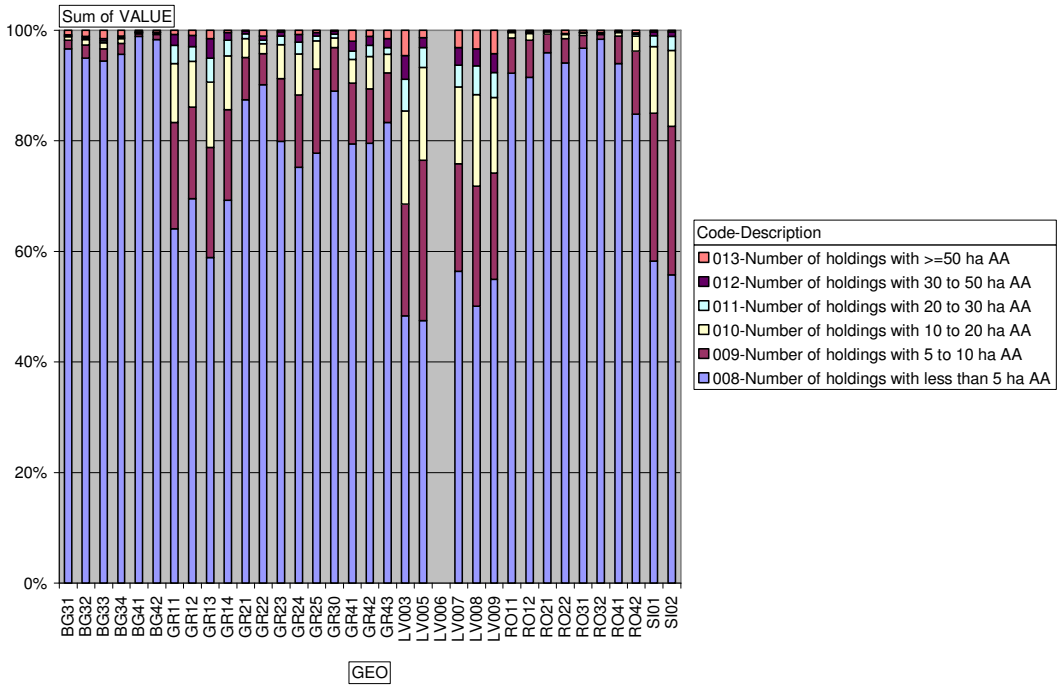


Figure 12 Total number of holdings – comparative analysis

Nevertheless the potential for biomass is very important in the region, and the considerations related with the farm structure and logistics are not the only ones to take into consideration in the development of biogas facilities.
The results of this report should be carefully integrated with the results about biogas potential in the target areas (WP 2, Task 2.3, BiG>East Report).

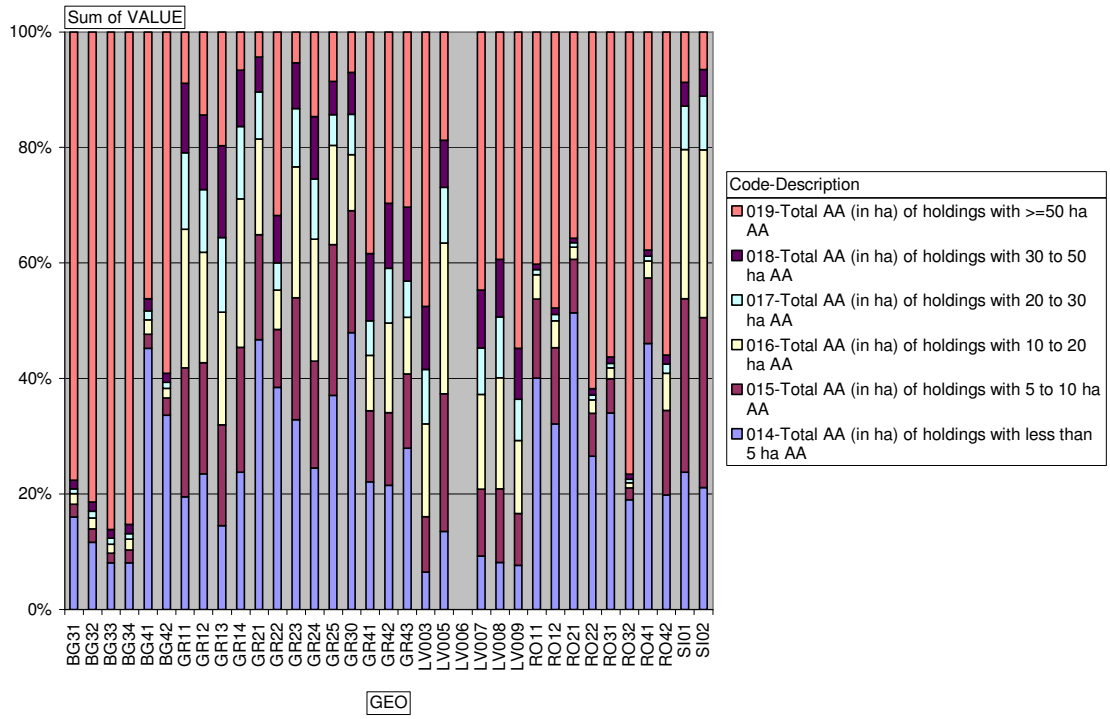


Figure 13 Total area (ha) of farms – comparative analysis

From the total countries analyzed in Bulgaria we could see an interesting aspect, being a concentration of land in holdings with surfaces around 50 hectares (over 80%). This could be either natural process of aggregation (especially due to the market drivers), but also an effect of a special phenomenon (aggregation in structures named "associations" – free tenant structures were different small land owners put together the land under the management of a specialist management company).
Nevertheless it is expected that the aggregation process to continue and more, to be accelerated in the next years in the region. The impact upon the possible biogas production is important and could increase as the surface of the agricultural holdings is increasing. A greater surface could mean in the same time a more sustainable agricultural production and as a consequence a greater availability for multifunctional utilization of the land. Based on the experiences of other countries (Germany, Norway) it is normally to consider that an area with numerous farms with surfaces of about 40 to 60 hectare, is the most appropriate for the production of biogas.
In other countries the percentage of farms with surfaces greater than 50 hectares is much lower, with Greece that has around 30%, Romania 55%, and Latvia 35%.

3.6 Farm heterogeneity based on the biomass type

An important indicator for the assessment of biomass potential is the variety of feedstock availability and the use of different feedstock (co-digestion). It is widely accepted that co-digestion is a complex process. The biogas plants needs to process various types of biomass in order to assure an optimized plant operation and energy utilization (figure 12 and 15). Permanent crops will assure better stability in feedstock, hence countries with moderate degree of variability of the feedstock would have a slightly advantage for the development of biogas plants. On the other hand, narrow niches could be identified as

supplementary feedstock for established plants in countries with higher degree of crops variability. This chapter is presenting the heterogeneity of the possible feedstock and gives an idea about the mass and the type of feedstock country by country.

3.6.1 Primary production

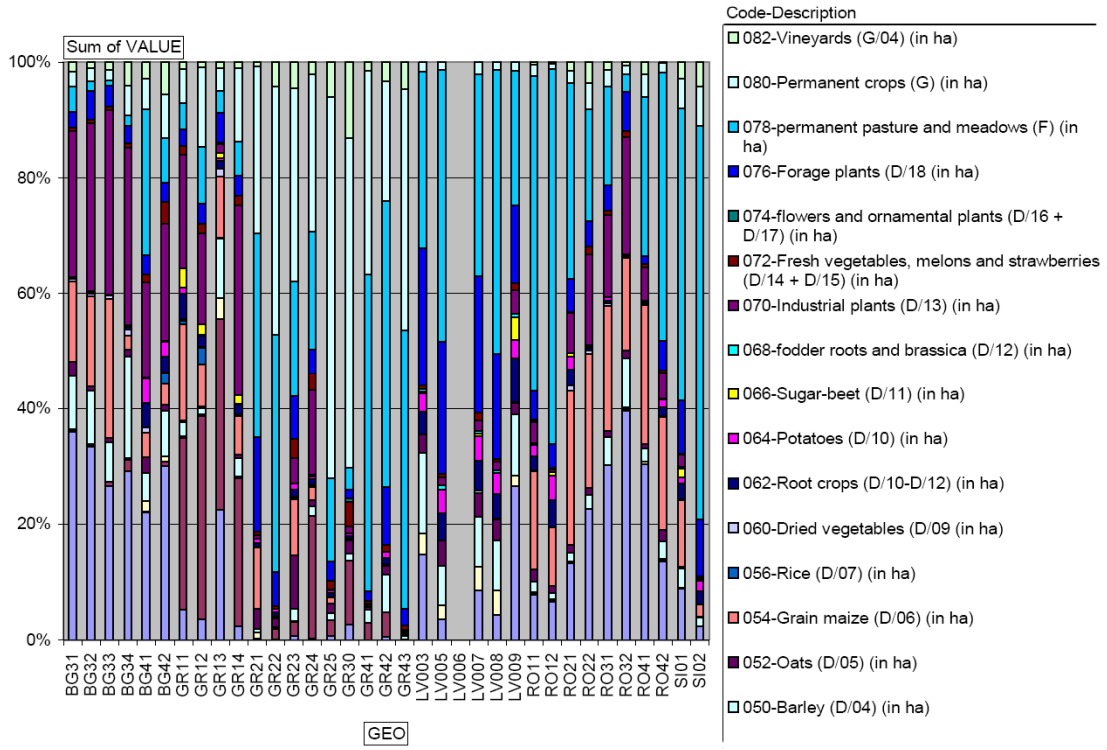


Figure 14 Primary production heterogeneity – comparative analysis

From the analyzed countries (Figure 14), only Greece has a less diverse primary production. Romania, Croatia and Bulgaria are from this point of view more heterogeneous or more fragmented. Nevertheless for a better understanding of the heterogeneity of the primary production an analysis of the dynamics (time characteristic) should be carried on. This will increase the knowledge about the long term sustainability of the biogas production and its "raw materials".

3.6.2 Secondary production

Secondary production could be very important for the biogas production. Based on the number (and not on production) of holdings, it could be concluded that in Bulgaria, a very important role could play the poultry industry (with 23 %) the pig farming (15%) and also the cow and goats farming (with 10 and 15 % respectively) see figures 16 and 17.
In Greece the poultry could be very important as well as the goat farming (20%). The importance of these farming types for biogas facilities is nevertheless low. Romania has a great potential generated by the pigs farms as well as the poultry farming, as sources for biogas production.

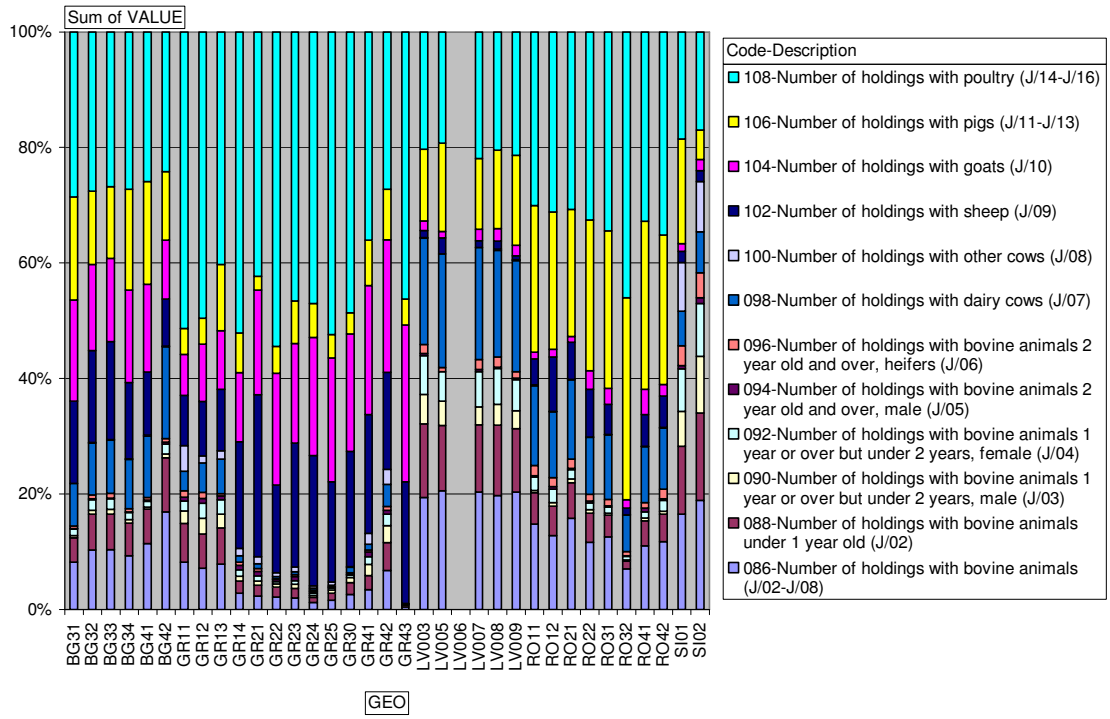


Figure 15 Number of holdings for various types of livestock – comparative analysis

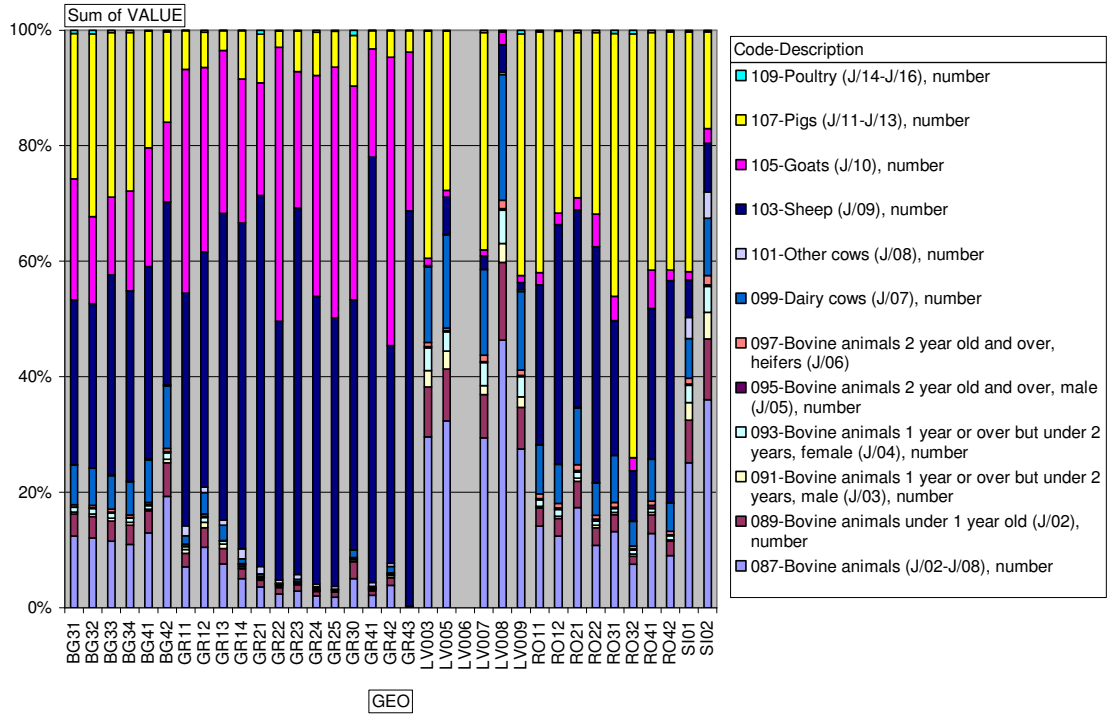


Figure 16 Number of units for various types of livestock – comparative analysis

3.6.3 Spatial structure of land use

3.6.3.1 Romania

The land cover structure spatially distributed is shown in Figure 17. The dominant PHARE CORINE cover class is class 211, which represent the agricultural area, 60% from total country surface.

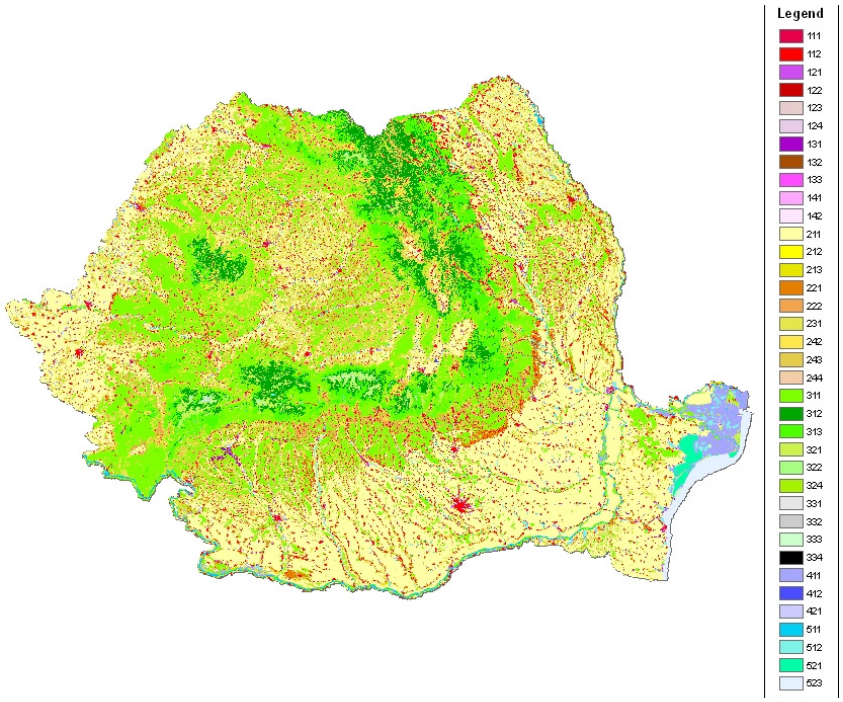


Figure 17 PHARE CORINE land covers distribution for Romania[3]

Figure 18 Typical agricultural spatial structure at the local scale in Romania

[3] See also Figure 31

The holdings with a AA<5ha are located near to rural systems and mainly used as mixed crop type farms. This type of farms has a low potential for biogas production (low level of feedstock). In the same time these types of holdings can be used in order to better control the co-digestion process by assuring the much needed heterogeneity of the feeds (see Figure 17).

The utilized agricultural area of about 13.9 million hectares is distributed to more than 4.30 million agricultural holdings. There are *individual agricultural holdings* – 4.28 million in total, accounting for 99.5% of the total number of agricultural entities. These operate 55.4% of UAA and have an average size of 1.73 ha as well as *agricultural holdings organized as legal entities* totalling 0.02 million and accounting for 0.5% of total agricultural holdings and operating 44.6% of UAA. The average size of this unit is 274 ha.

The holdings bigger then >50 ha are representing the optimum solution for energetic crop feedstock biogas investment.

Also high potential will be represented by holdings with animal breeding as main activity, and this could be also seen as a solution of waste management. The regions with big number of animal heads and small number of holding will be the best. In that respect, South-East regions of Romania shows the most promising opportunities to biogas plants development.

3.6.3.2 Croatia

Croatia is a special case as no data is reported to the Eurostat and all the data are coming from internal reports to different international institutions (FAO) or from the Statistical Yearbooks of Croatia.

Data provided are publicly available data gathered from the Croatian Bureau of Statistics. Only data on solid waste were retrieved from Strategy of Waste Management (OG 130/05). In that sense, notes on methodology for data provided are explained according to the tables in the WP 2.3.

There are no publicly available spatial data at the NUTS 3 level. Thus, data are provided for NUTS 2 level that encompasses 3 regions as explained in the table below:

Table 1 Nomenclature of Territorial Units for Statistics - Croatia

Code	Country	NUTS 1	NUTS 2	NUTS 3
HR 01			Sjeverozapadna Hrvatska	
HR 011				Grad Zagreb
HR 012				Zagrebačka county
HR 013				Krapinsko-zagorska county
HR 014				Varaždinska county
HR 015				Koprivničko-križevačka county
HR 016				Međimurska county
HR02			Središnja i Istočna (Panonska) Hrvatska	
HR 021				Bjelovarsko-bilogorska county
HR 022				Virovitičko-podravska county
HR 023				Požeško-slavonska county
HR 024				Brodsko-posavska county
HR 025				Osječko-baranjska county
HR 026				Vukovarsko-srijemska county
HR 027				Karlovačka county
HR 028				Sisačko-moslavačka county
HR 03			Jadranska Hrvatska	
HR 031				Primorsko-goranska county
HR 032				Ličko-senjska county

Code	Country	NUTS 1	NUTS 2	NUTS 3
HR 033				Zadarska county
HR 034				Šibensko-kninska county
HR 035				Splitsko-dalmatinska county
HR 036				Istarska county
HR 037				Dubrovačko-neretvanska county

Figure 19 PHARE CORINE land covers distribution for Croatia

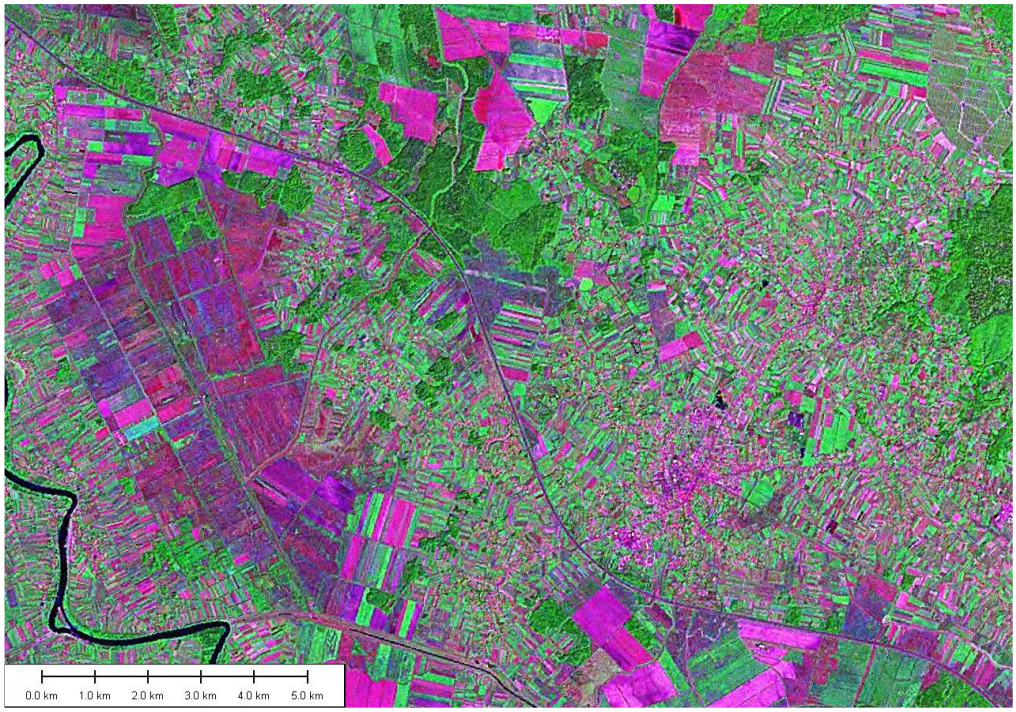


Figure 20 Typical agricultural spatial structure at the local scale in Croatia

Due to this reason Croatia was not included in the comparative analysis at European level but data is presented separately. Nevertheless Croatia performed in 2005 a Farm Structure Survey (FSS).
Based on the data reported in 2003, the farm sector is also very fragmented with farms surfaces averaging 1,9 hectares and with more then 448532 family farms. In the same time there are 1364 agricultural companies with an average surface of 159 hectares (Figure 20).

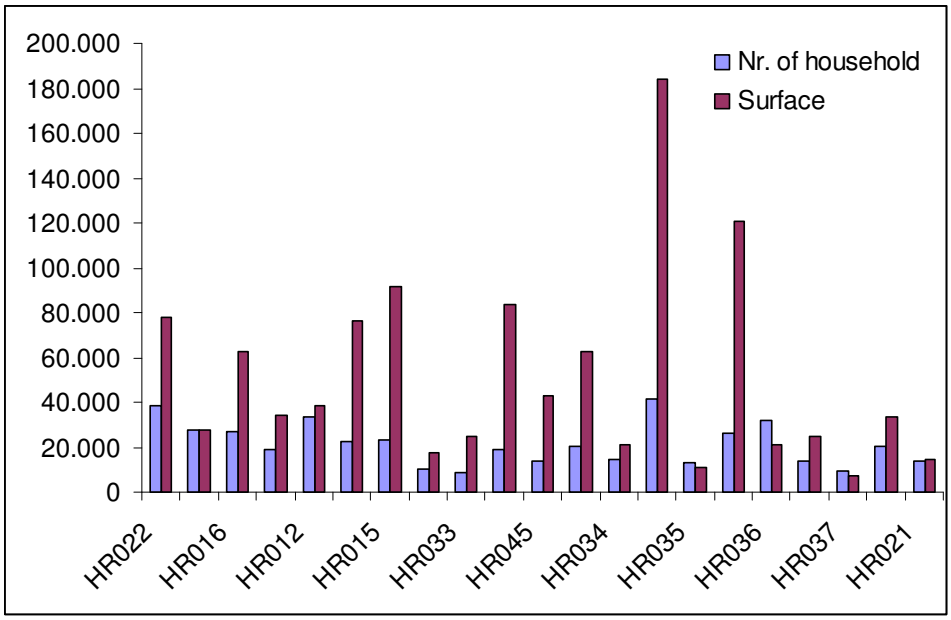
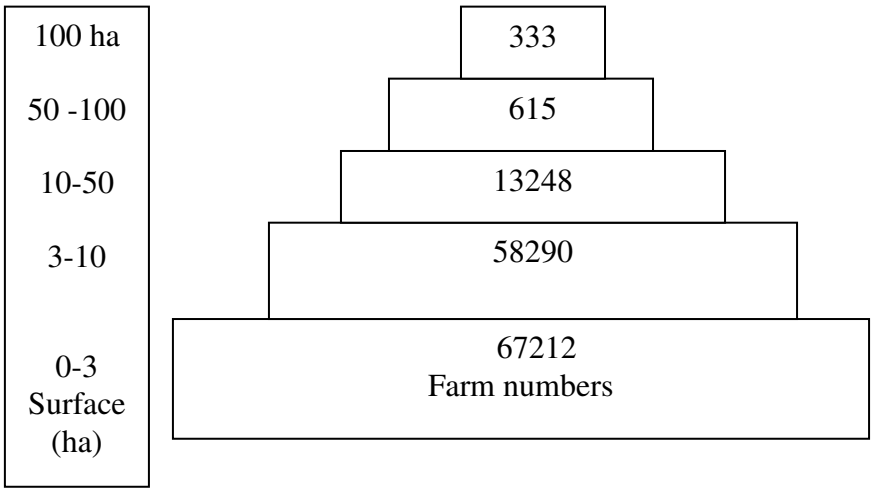


Figure 21 Number of farms and their surface (ha) per counties (Statistical yearbook of Croatia)



In the livestock sector the cattle number is reaching over 480000 heads and is also represented by an important number of pigs 1924600 heads (FAO, 2003)

3.6.3.3 Latvia

Data for Latvia is based on the a former agricultural census (from 2001) as well as new data from Eurostat and from Central Statistical Bureau of Latvia (CSB).. Spatially distributed land cover structure of Latvia is given in figure 21. The dominant color is green followed by yellow areas that according to the European Topic Centre on Land Use and

Spatial Information (Corine Land cover 2000 classification) are representing forests (including woodlands) and agricultural areas. Based on the agricultural census more then 180000 farms could be found with a surface of about 3586000 ha. On the average one farm had 19,8 ha of land

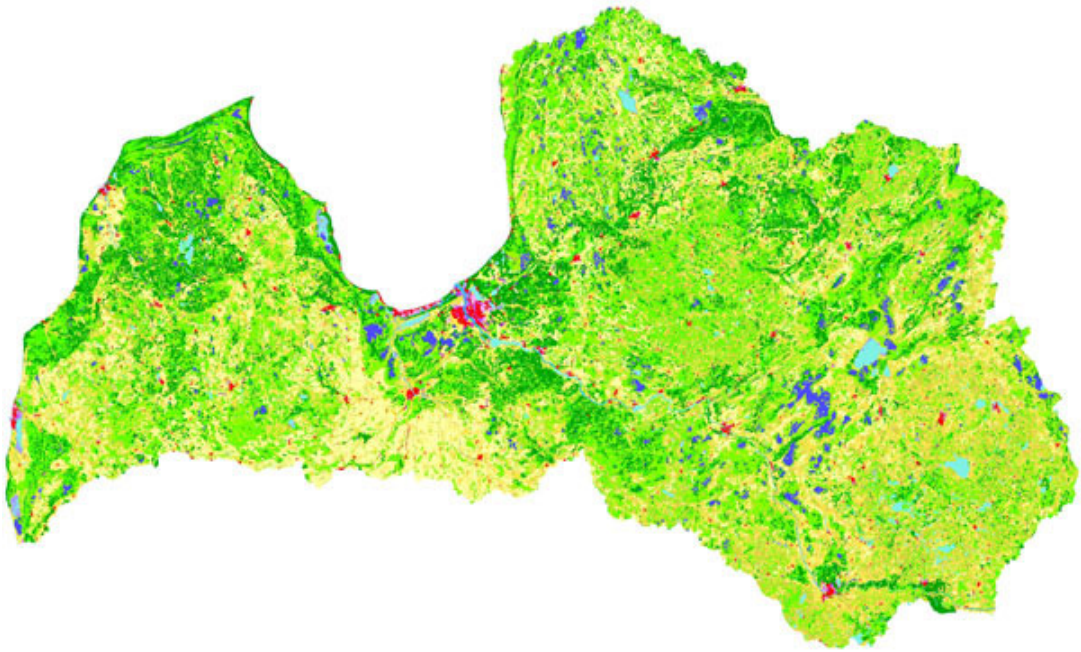


Figure 22 Corine Land Cover 2000 of Latvia (European Topic Centre on Land Use and Spatial Information)

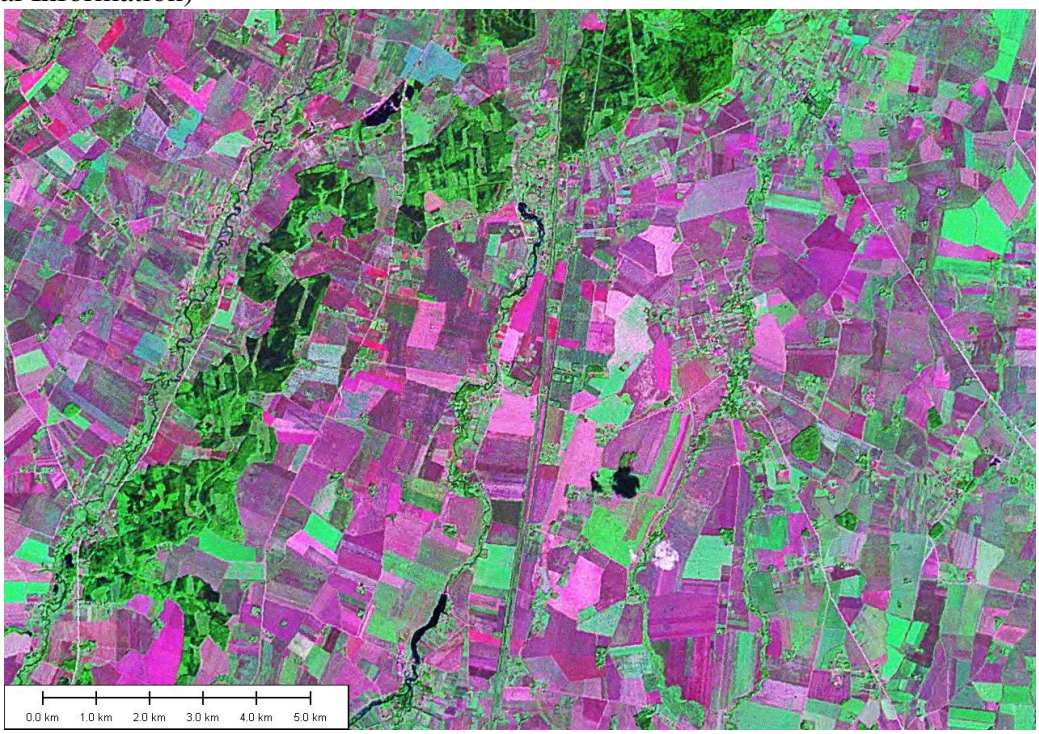


Figure 23 Typical agricultural spatial structure at the local scale in Latvia

An overview of land distribution by use in Latvia (in 2000-2007) is given in Table 2 and shown below (% in 2007) in figure 23.

Table 2 Total land area and its distribution by use (10^3 hectares)

	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL LAND AREA	6458.90	6458.90	6458.90	6458.90	6458.90	6458.90	6458.90	6458.90
Land area (excl. inland waters)	6229.00	6229.00	6229.00	6229.00	6229.00	6229.00	6224.30	6225.00
Utilized agricultural area	1587.20	1581.80	1595.50	1581.80	1642.10	1733.70	1855.30	1839.20
..arable land	969.90	958.20	972.80	956.40	1008.60	1091.80	1205.10	1188.10
..permanent crops	11.50	12.10	12.20	12.00	12.40	12.80	13.20	10.00
..meadows and pastures	605.70	611.30	610.30	613.00	620.90	628.90	636.80	641.00
Forests and woodland	2851.70	2868.20	2861.50	2877.20	2885.50	2904.40	2918.20	2929.00
Other land	1790.10	1779.00	1772.00	1770.00	1701.40	1590.90	1450.80	1456.80

Source: Central Statistical Bureau of Latvia (CSB)

In 2007 28% of total land area of Latvia (i.e. 1839.2 10^3 ha) were utilized as agricultural land. The main part of agricultural land consists of arable land following by meadows and pastures (see Figure 24). There is still a significant part of land in Latvia that could be used for agricultural production – 23% (i.e. 1456.8 10^3 ha in 2007) of land in Latvia is referred as unused for agriculture available land.

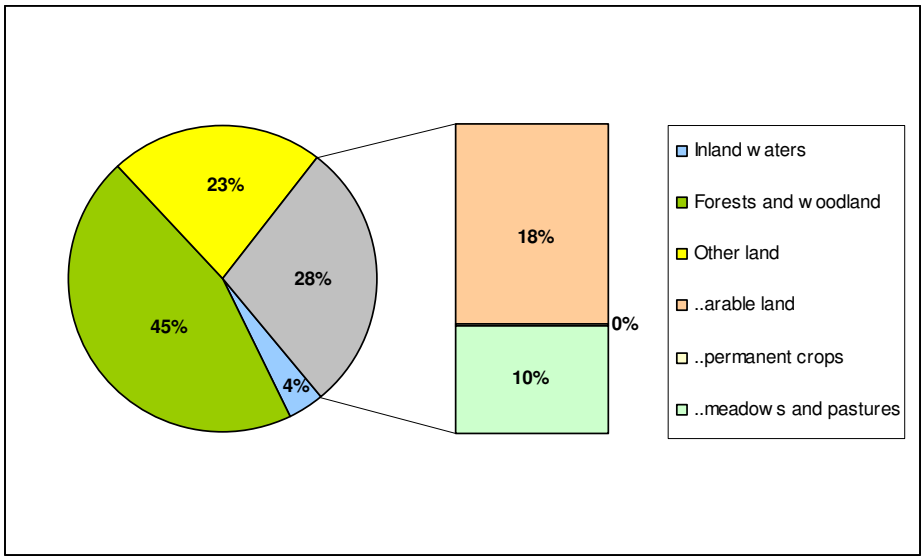


Figure 24 Land area distribution by use (% of total land area) in 2007 in Latvia (CSB, 2007)

Based on the agricultural census more then 180 000 farms could be found with a surface of about 3 586 000 ha. On the average one farm had 19.9 ha of land or 12.4 ha of agricultural land.

By area of agricultural land the farm interval between 5 to 10 hectares are dominating in the agricultural land structure with 331 600 hectares (in total). The distribution of number of farms and agricultural land area by previously defined farm size is given in Table 3.

Table 3 Grouping of farms according to agricultural land area

Size	Number of Farms	% of total farms	Agricultural land area, 10^3 ha	% of total agricultural land area
TOTAL	180263	100	2228.7	100
< 5 ha	76013	42	209.5	9
5 < 20 ha	81884	45	821.5	37
20 < 50 ha	17307	10	507.8	23
> 50 ha	5059	3	689.9	31

Source: Central Statistical Bureau of Latvia (CSB, Agricultural Census 2001)

As shown in table 3, the highest number of farms (45% of total number of farms) has 5 to 20 hectares of agricultural land and is covering the biggest share in total agricultural land area (37% or 821 500 ha in total).

The use of agricultural land in Latvia is quite balanced with more emphases on specialization of field crop growing and mixed crop and livestock growing. Typical agricultural spatial structure in Latvia is given in Figure 24. Traditionally agricultural land in Latvia is alternating with forest lands with higher representation of agricultural lands in Zemgale region (NUTS LV009). The main part of agricultural land in Latvia is in farm ownership. The rest is rented agricultural land with a highest share of rented land in Zemgale region (NUTS LV009).

The temporary crops are dominated by wheat and barley with almost 300 000 hectare. The livestock is dominated by cattle with over 360 000 units and pigs with the same number (FAO, 2000). Significant part of agricultural land is used for growing forage plants and occupied by permanent pasture and meadows. The temporary crops are dominated by cereals (mainly wheat and barley) with starting from 415 000 ha to more than 520 000 ha of sown area (see Table 4).

Table 4 Sown area under principal agricultural crops (10^3 hectares)

	Sown area, total	Cereals	Rape	Sugar beets	Potatoes	Vegetables	Long-fibre flax
2000	881.1	420	6.9	12.7	51.3	9.7	1.6
2001	869.8	443.7	8.4	14.1	55.1	13.3	1.4
2002	877.7	415	18.4	15.9	53.6	12.5	2.1
2003	851.1	428.5	25.9	14.4	54.6	14.3	2.1
2004	899.2	436.7	54.3	13.8	48.9	13.5	2.7
2005	999.6	468.9	71.4	13.5	45.1	12.9	2.2
2006	1 122.7	511.8	83.2	12.7	45.1	13.4	1.5
2007	1 126.2	521.9	99.2	0.3	40.3	11	1.4

Source: Central Statistical Bureau of Latvia (CSB)

The livestock is dominated by pigs with over 410 000 units in 2007 and cattle with almost 400 000 units in 2007 (see Table 5). During the last few years also the number of poultry units has increased significantly reaching more than 4.7 million units in 2007.

Table 5 Number of livestock and poultry at the end of the year (10^3 heads)

	2000	2001	2002	2003	2004	2005	2006	2007
Cattle	367	385	388	379	371	385	377	399
..of which dairy cows	204	209	205	186	186	185	182	180
Pigs	393	429	453	444	436	428	417	414
Sheep	29	29	32	39	39	42	41	54
Goats	10	12	13	15	15	15	14	13
Horses	20	20	19	15	16	14	14	13
Poultry	3 105	3 621	3 882	4 003	4 050	4 092	4 488	4 757

Source: Central Statistical Bureau of Latvia (CSB)

3.6.3.4 Bulgaria

In 2003, 665500 agricultural holdings were operating in Bulgaria. The majority of these holdings (75%) cultivated up to 1 ha, which, however, accounted for less than 7% of the total utilized agricultural area (UAA). On the other hand, only 0.8 % of the holdings managed more than 50 ha, but they farmed the majority of the UAA – 78 %. In 2004 the arable area was 3.3 million ha (61.8 % of UAA), and about 70 % of it was concentrated in

3 NUTS 2 regions – North-East, North Central and South Central region[4] In 2007 the number of holdings was 477 100 and the arable area was 3.04 million ha[5].
The number of agricultural holdings is presented on tables in the report.

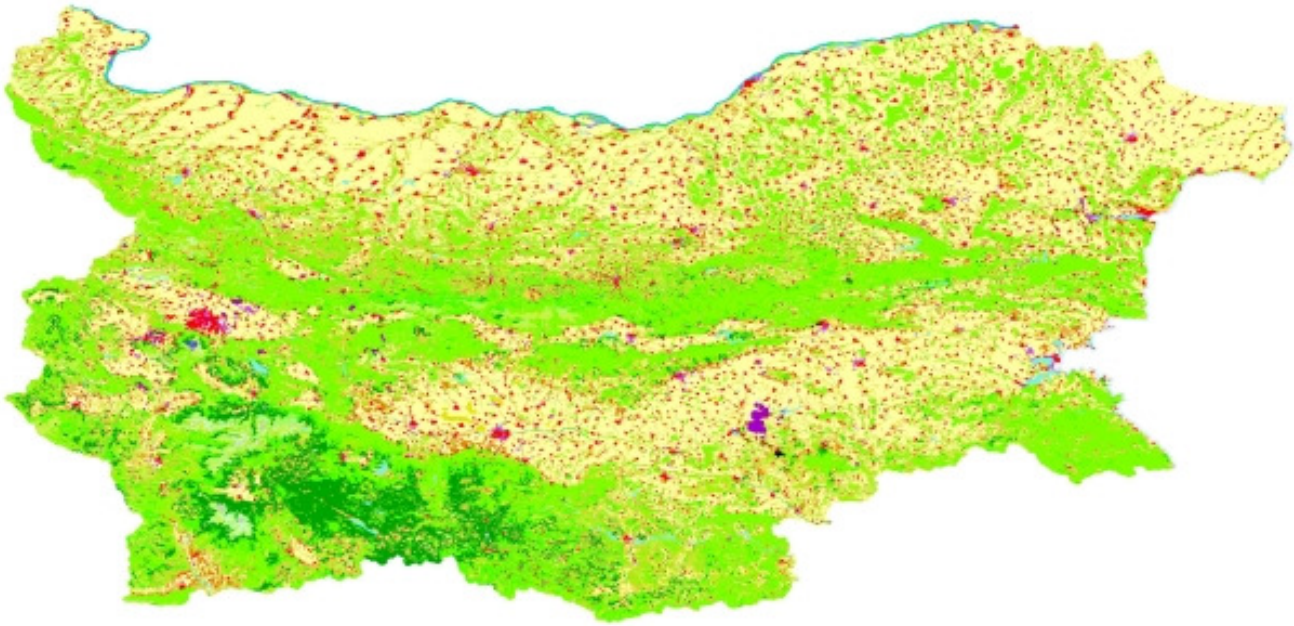


Figure 25 PHARE CORINE land covers distribution for Bulgaria

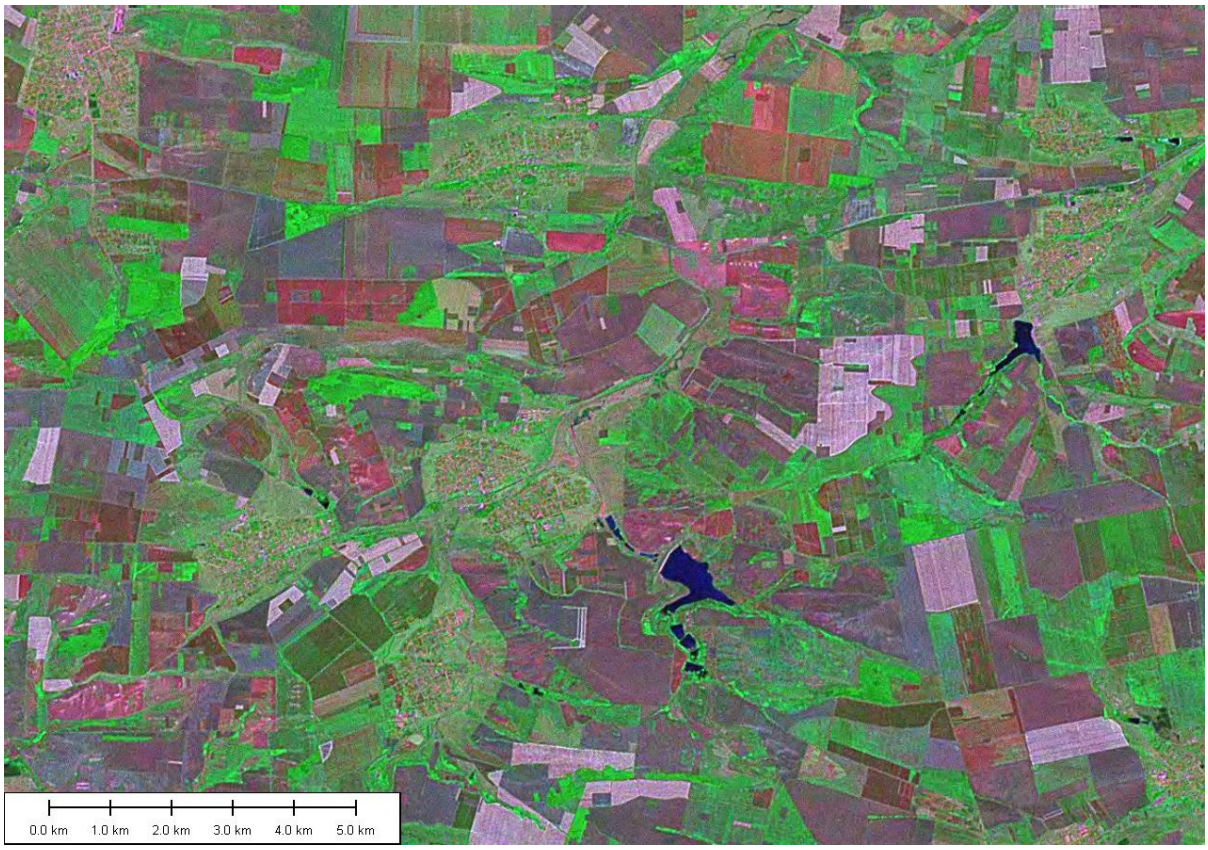


Figure 26 - Typical agricultural spatial structure at the local scale in Bulgaria

[4] FAO report on Bulgaria, 2003: http://www.fao.org/ES/ess/census
[5] Structure of agricultural holdings in Bulgaria 2007, MAF, Agrostatistics Directorate

Secondary production could be also very important for the biogas production. Based on the number (and not on production) it could be concluded that in Bulgaria very important role could play the poultry industry (23 %), the pig farming (15 %) and also the cow and goats farming (10 % and 15 % respectively).
The tables below give the number of livestock breeding holdings and number of heads by size classes of the herds in 2005.

Table 6 Relationship between number of livestock breeding holdings and number of heads

	Class of the herd (number of heads)				
Bovines	**1÷2**	**3÷9**	**10÷19**	**20÷49**	**>=50**
Holdings	115644	43015	4977	2610	957
Heads	171539	183640	63058	75571	107361
Heads/holding	1.48	4.27	12.67	28.95	112.18

Sheep	**1÷9**	**10÷49**	**50÷99**	**100÷199**	**>=200**
Holdings	147731	24660	2147	1186	460
Heads	602644	409049	142540	145624	149187
Heads/holding	4.08	16.59	66.39	122.79	324.32

Goats	**1÷9**	**10÷19**	**20÷49**	**50÷199**	**>=100**
Holdings	157993	3244	1396	374	90
Heads	387250	39942	37249	22970	12700
Heads/holding	2.45	12.31	26.68	61.42	141.11

Pigs	**1÷2**	**3÷9**	**10÷99**	**100÷999**	**>=1000**
Holdings	164968	18944	6590	281	76
Heads	214401	81790	139398	66149	430236
Heads/holding	1.30	4.32	21.15	235.41	5661.00

Poultry	**1÷19**	**20÷99**	**100÷4999**	**5000÷19999**	**>=20000**
Holdings	265553	113544	1442	101	102
Heads	2538529	3485153	769356	916817	11959649
Heads/holding	9.56	31	534	9077	117251

Source: Structure of agricultural holdings in Bulgaria -2005, MAF, Agrostatistics Directorate

For holdings breeding grazing livestock the size of fodder area is considered. There is clear relationship between the number of animals and the fodder area. At the same time a lot of farms do not have lands.

Table 7 Relationship between the number of animals and the fodder area

Number of holdings	**Fodder area, ha**					
Planning region	**all**	**0**	**< 1**	**1÷5**	**5÷10**	**> 10**
Bulgaria	362 312	157 380	186 154	16 863	1102	814
North-West	38 962	20 857	16 064	1770	198	73
North Central	52 546	20 329	27 992	3 836	234	155
North-East	72 432	35 943	33 498	2 665	150	176
South-East	38 687	25 016	12 581	913	84	93
South Central	104 068	43 870	56 331	3 485	215	167
South-West	55 617	11366	39 688	4 193	220	150

Table 8 – Number of heads

Number of heads	Fodder area, ha					
Planning region	**all**	**0**	**< 1**	**1÷5**	**5÷10**	**> 10**
Bulgaria	2 558 503	973 014	1 121 276	283 155	49 228	131 831
North-West	211 644	99 086	76 683	21 864	6 162	7 849
North Central	339 710	107 472	147 014	51 554	8 604	25 066
North-East	592 943	244 682	254 568	53 745	5 975	33 972
South-East	376 460	208 936	113 073	27 771	4 132	22 548
South Central	644 692	243 905	286 757	66 672	15 841	31 518
South-West	393 053	68 932	243 181	61 550	8 513	10 877

Table 9 Heads/holding

Heads/holding	Fodder area, ha					
Planning region	**all**	**0**	**< 1**	**1÷5**	**5÷10**	**> 10**
Bulgaria	7.1	6.2	6.0	17	45	162
North-West	5.4	4.8	4.8	12	31	108
North Central	6.5	5.3	5.3	13	37	162
North-East	8.2	6.8	7.6	20	40	193
South-East	9.7	8.4	9.0	30	49	242
South Central	6.2	5.6	5.1	19	74	189
South-West	7.1	6.1	6.1	15	39	73

Source: Structure of agricultural holdings in Bulgaria 2005, MAF, Agrostatistics Directorate

It could be generalized, that the agricultural structure and its growth in time are favorable for biogas production. The most promising planning regions in Bulgaria are North-East, North Central and South Central. There is a big variety in size, distribution and biomass potential of different farms. There is also a tendency for increase in the number of animals in an average farm. Therefore each potential site should be considered, depending on the region.

3.6.3.5 Slovenia

The dominating farm surface is between 3-10 hectares with almost two thirds of all agricultural land. According to Agricultural census from 2005 (SURS 2006), in Slovenia there are 77,050 family farms and 133 agricultural enterprises. Average size of family farm is 6.3 ha of utilized agricultural area (UAA), which means that since last census, the size of Slovenian farms slightly improved (average UAA in 2000 was 5.9 ha of agricultural land per holding (SURS 2003)).

Figure 27 PHARE CORINE land covers distribution for Slovenia

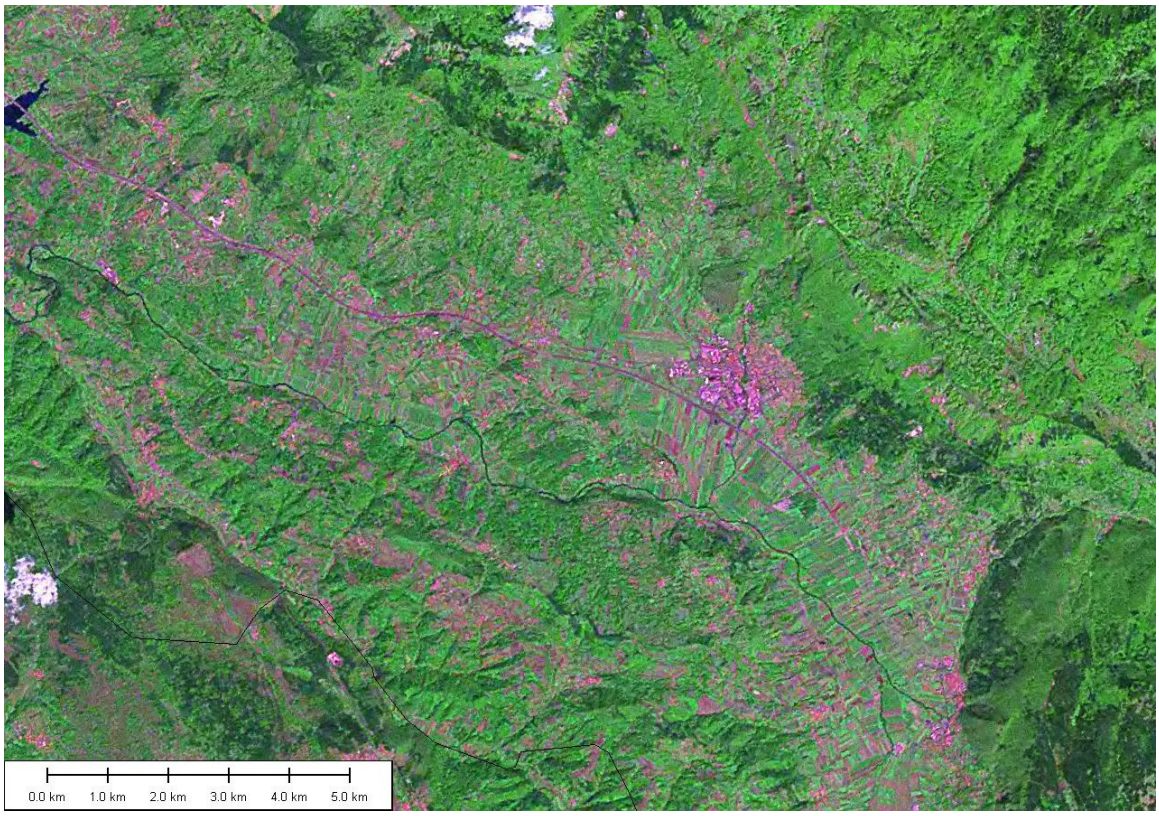


Figure 28 Typical agricultural spatial structure at the local scale in Slovenia

3.6.3.6 Greece

Greek data is based on the agricultural census (from 2000) as well as new data from Eurostat and FAO. Based on the agricultural census more then 817060 farms could be found with a surface of about 3587000 ha.

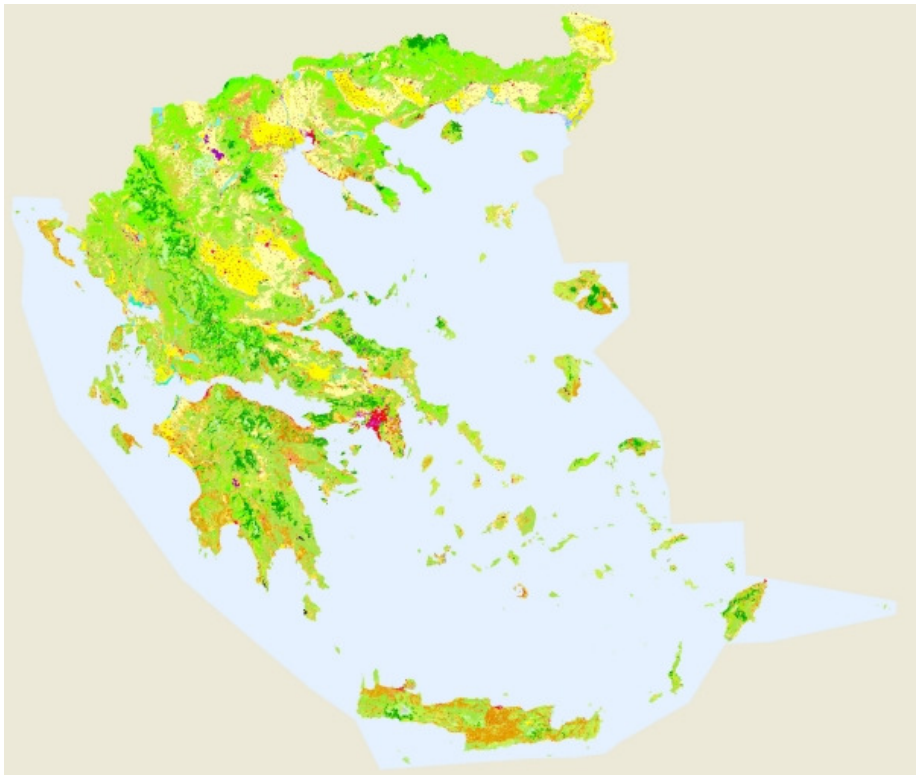


Figure 29 PHARE CORINE land covers distribution for Greece

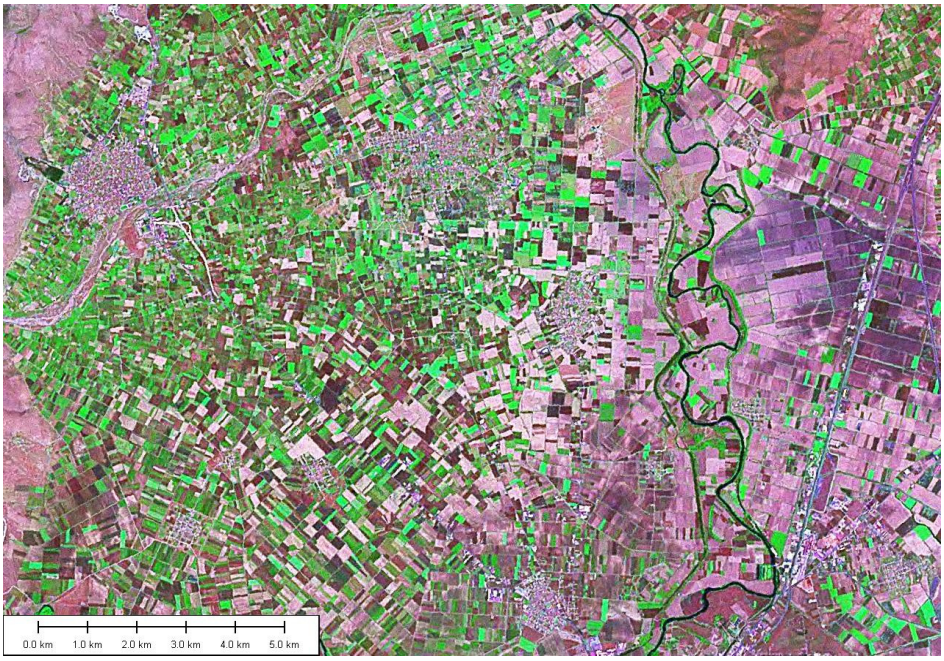


Figure 30 - Typical agricultural spatial structure at the local scale in Greece

In the interval between 0 and 2 hectares there are more than 394950 farms with an area of 440020 hectares. The biggest cumulative surface is encountered for the interval 2-5 hectares with more than 790000 hectares. The temporary crops are dominated by wheat and barley with almost 350000 hectares. The livestock is dominated by cattle with over 652390 units and sheep and goat sector with over 8 and 5 million heads respectively (FAO, 2000).

Figure 31 Generic description of land cover classes from CORINE project

4 Conclusions

1. Presented indicators could be helpful to complete the image of certain sites selected at macro scale. Important areas for biogas production, based on biomass potential, as well as the main types of resources that could be used for biogas generation, could be completed with details related to land fragmentation and crop diversity, ownership structure and livestock peculiarities.
2. The largest potential from the analyzed countries as sources of raw materials for biogas production is Romania (mass terms). But there are also other issues to be taken into consideration when evaluating this potential, and especially at the moment a site is selected based on standard selection strategy (see results in WP 6 of BiG>East project). For example the number of small farms is much larger in some of the target countries and this could have a negative impact on the effective potential sites. Small size biogas production units could be the solution for the high fragmentation of the farming in target European countries. In the same time a more diverse farms (including farm types, size, production capacity and crop heterogeneity) means better diversity in opportunities for different anaerobic digestion patterns.
3. A series of scenarios could be build based on the agricultural production capacity for each target European country. Combining tasks 2.3 and 2.4 and inferring possible effects from the above described indicators could provide a useful tool in the estimation of the potential biogas for the target countries. In order to assign a measure of the impact of different indicators describe inhere in relation to the biomass and biogas potential (described in WP 2, Task 2.3), it could be interesting to develop an expert indexing system. Based on this expert system, could be also possible to asses with a high degree of accuracy the percent of biomass and biogas potential that could be in reality used for biogas production (developed until now only at the level of reasonable assumption).

5 Bibliography

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6 List of Figures

7 List of Tables