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Agro-Economic Study for the Danube River Basin

Synthesis Report

Franz Sinabell, Ina Meyer (WIFO),
Matej Bedrac, Tomaž Cunder (KIS),
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Research assistance: Dietmar Weinberger (WIFO)

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Abstract

This report provides a summary of country studies that analyse the role of the agricultural sector in the Danube River Basin. In addition, it explores ways to reduce the impact of agricultural production in water resources, concerning both the quality and the quantity. The focus of the report is on identifying cost-effectiveness of measures. For this purpose an extensive literature survey was conducted. The report summarises ways to improve the governance of environmental measures at various levels of regulation. A major finding of the study is that the cost of reducing harmful substances varies significantly across the regions. In some parts of the Danube River Basin pressure indicators show a reduction of noxious impacts during the last years. Forecasts about the likely future development of the agricultural sector indicate that environmentally harmful emissions are likely to be reduced even further.

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Executive Summary

This report for the International Commission for the Protection of the Danube (ICPDR) summarises the results of studies on countries in the Danube river basin where the role of agriculture in relation to water use has been studied. These studies examined the current framework conditions for agricultural production and documented changes in the development of agri-environmental indicators. The future development of the agricultural sector was also examined and the challenges for water protection were documented for the individual regions. A great deal of attention was paid to the implementation of water pollution control policies and their effectiveness in relation to costs. This report presents the main findings of the studies carried out in the individual countries and presents conclusions based on them. In addition, fundamental questions on diffuse emissions from agriculture and instruments for the management of water resources will be examined.

In this study, the agricultural sector is considered from an economic point of view. Such an approach should be based on the fact that the priorities are not only costs and profits in the agricultural sector, but also the benefits of society, economic prospects and incentive structures. It should be borne in mind that the most important data bases for the analysis of agriculture are not drawn up from the point of view of expediency for water-relevant questions, but for other purposes. The findings on agriculture in this report are based on data collected for administrative purposes that do not coincide with the hydrographic designation of the Danube river basin. These deviations are small in terms of the whole area, but they can be significant in individual countries.

From an economic point of view, which is also relevant for the agricultural sector, the integrity and health of the people is paramount. Water contaminated with pollutants can lead to diseases that not only cause pain and suffering, but also entail treatment costs. The cleaning of contaminated water also costs money. In accordance with the EU's precautionary principle, such damage should not occur in the first place. The integrity of aquatic ecosystems is the second most important element in a hierarchy of economic objectives. The reason for this is that it not only protects the habitat of animals and plants, but also provides direct or indirect benefits to people, for example when watercourses are used for recreational purposes.

Since agricultural production takes place mainly outdoors and water is an elementary input for production, it is in the highest interest of agriculture to have access to clean and, if necessary, sufficiently available water. This also applies to fisheries and to commercial and industrial users of water. With regard to water use, agriculture competes with other agents, including urban demand. For agriculture, it is just as important that other users make use of water in an economical and cautionary manner.

The importance of agriculture in the river basin under consideration varies. Due to the wide disparity in economic development, agriculture plays only a very small economic role in the

western part of the Danube river basin in terms of regional value added. In these regions, the value-added share of agriculture is usually less than 1%. In eastern, especially south-eastern regions, agriculture is often the source for 10% or more of the regional added value. Not only the economic relevance differs greatly from region to region, but also the farm structure. In the eastern part of the Danube river basin there is a bi-polar business structure with many small family businesses and a few very large farms organized as companies. This special feature is important when it comes to developing adapted measures for water pollution control. Small businesses or enterprises that serve to secure subsistence need different requirements than efficient commercial enterprises which are profit-oriented.

Livestock density, an indicator of the potential emission of nitrate and phosphorus compounds also differs significantly from one region to another. A look at the rate of change shows that regional developments are very different and a uniform pattern cannot be observed. In the easternmost part of the Danube river basin and in the north, livestock density has declined significantly between 2005 and 2013 in numerous peripheral areas. In some regions - especially Austria and Hungary - there has been a significant increase in the number of livestock numbers.

Indicators of potential contamination of groundwater are only indirectly related to changes in the concentration of pollutants in groundwater. In the present study, only values at national level have been available. Results for EU Member States indicate that there has been a general improvement in groundwater quality. However, there were also marked deteriorations in some countries.

The report deals with the central economic approaches to avoid pollution of environmental resources. Two basic approaches are distinguished, which can be observed on numerous examples:

- The polluters pays principle: actors responsible for environmental pollution are economically burdened with the aim of reducing emissions or environmental impacts.
- The beneficiary pays principle: In accordance with this principle, the group of people who benefit from an improvement make contributions to compensate the issuers for reducing the environmental burden.

Each of these approaches is confronted with specific challenges and the practice of implementation differs, so that the focus of regulation in the countries under consideration follows one or the other. Frequently, there are also variants in which both principles come into play. The EU Nitrates Directive is a good example of this. Farms must bear the costs to comply with the requirements of the nitrate action programmes. In many countries, more far-reaching measures to reduce emissions are financed by agri-environmental programmes. In these cases, the tax payer finances the agent who releases fewer substances into the environment than the law requires. The basic water protection regulations are implemented differently in the different countries. In Germany, Slovenia and Austria, for example, the entire territory is designated as a nitrate vulnerable zone (NVZ), while in the other Danube river basin countries of the EU, only a number of individual regions are defined as such.

Environmental economics distinguishes between numerous instruments that can be used by public authorities to induce environmentally friendly behaviour among producers and consumers. Environmental taxes are a frequently used instrument. However, the country studies showed that this instrument is not used in connection with agriculture in the Danube river basin. However, subsidies are frequently used to promote environmentally friendly measures. The agri-environmental programmes (AEP) financed by the common agricultural policy (CAP) form the basis for specific support programmes which provide substantial resources for environmental improvement. Public support for advisory institutions and research activities also plays an important role in many regions. In some of them, especially in Bavaria, co-operations between farmers and water supply facilities are also very widespread.

Since in some countries experience has been gathered for decades on the interactions between agricultural measures and environmental quality, it is possible to compare the effectiveness of different approaches. Such overviews show that the same measures have different effects on different environmental dimensions. It therefore depends on whether the focus is on the Nmin content in the soil or the nitrate content in the groundwater or the contamination with soil particles in the surface water. Very effective measures for water protection include set-aside, organic farming, soil cover that is maintained as long as possible and a significant reduction in fertiliser and pesticides.

In the present study, it was not possible to carry out studies on the cost-effectiveness of individual measures. However, results from the economic literature provide reliable clues for the regions under consideration. The premiums paid under the rural development programme for water conservation measures also provide very useful indications of the scale. The premiums must not be higher than the costs or benefits foregone, and are therefore limited to an upper limit. In addition, findings in the literature show that measures are available in all the regions under consideration that can bring significant environmental benefits and at the same time significantly reduce production costs. Phase feeding in pig farming is an example of this, or the use of machines that are used in precision farming for the application of fertiliser according to actual plant requirements. One of the reasons why these measures are not being implemented is that too little research is being carried out to make these potentials visible and that the transfer of knowledge from research to practice is not working well enough.

For most regions of the Danube river basin, results are available on the future development of the agricultural sector. These were determined using international agricultural sector model CAPRI. In the scenarios analysed with this model, the development observed so far is mainly continued. As a result, the environmental impact of agriculture is likely to decrease in the coming decades. One important reason for this is that agricultural prices of important crop products are currently expected to stagnate. This makes the increased use of yield-enhancing substances such as mineral fertilizers or pesticides uneconomical.

In short, the key messages of this report are the following:

The specific economic situation and agricultural structure influence the impact of agriculture on watercourses:

- High differences in agricultural incomes mean that the costs of changing existing polluting practices vary widely across regions in the Danube river basin.
- In large areas of the Danube river basin there is a dichotomous agricultural structure with very many small farms and few very large ones. It is therefore necessary to develop specific approaches for each of the two groups in order to regulate them.
- The structural change in agriculture is similarly pronounced in all areas of the Danube region. At present, the number of farms is decreasing by about 2% per year and this trend will likely continue.
- The burden of diffuse water pollution is greater in countries with higher incomes than in the other regions. With regard to point polllution, the situation is the other way round.
- The basic approaches to reducing the burden of agriculture are very similar in all the countries considered. Regulatory instruments dominate, and in the countries of the EU also subsidies through agri-environmental programmes play an important role.
- There are findings in the economic literature on the cost-effectiveness of measures to reduce agricultural pollution. A closer look, however, shows that the regional differences are not known very well. Further investigations involving primary surveys are necessary here.

An outlook on the foreseeable developments in agriculture shows:

- Agriculture will play an important economic role in many regions of the Danube river basin in the coming decades.
- At present, model analyses suggest that prices of many crop products will stagnate. Only milk production is expected to see product prices rise. One consequence is that the intensive use of fertilisers and pesticides is becoming uneconomical.
- Results from model-based forecasts suggest that the impact of agriculture on the environment in the Danube river basin is likely to decrease in the coming years and will not increase further. This general conclusion, however, does not apply to every single region to the same extent.

The main conclusions of the study are:

- Particularly in areas with already high levels of pollution and in areas with increasing degradation of environmental quality, further effective steps are needed to reduce the impact of agriculture.
- The current regulations and economic instruments in place must be maintained in the rest of the regions in order to prevent deterioration. The concrete structure of measures should be continuously adjusted in order to improve the effectiveness of the measures.
- Based on the findings of the research, it is obvious that there are many cost-effective measures. However, only a few of them are implemented. It is therefore necessary to understand better why economic advantageous practices, which also contribute to

improving the state of the environment, are not being applied in practice at a wider scale. A better understanding of this issue is a prerequisite for developing appropriate incentives to develop their potential for improving the environmental situation in the Danube region.

1 Introduction and scope of the report

The synthesis report of the ICPDR agro-economic study consists of three distinct but integrated parts: 1) Country reports of signatory members give an overview of the agricultural sectors, the state of agri-environmental indicators, a survey of legislation and farm programmes with an environmental focus and describe perspectives for the future development and challenges. In many cases the 'country' reports focus on those regions that are draining into DRB (Danube River Basin) and not on the whole territory. This is the case in Germany where two Länder are part of DRB. 2) The synthesis report which is this document. It takes a bird's eyes view on the individual territories and their idiosyncratic situation in order to identify core elements of a strategy for agriculture in the DRB. 3) An extensive appendix is a collection of complementary and ancillary information on agriculture in the region. The focus is on economic statistics.

The text is structured in the following way: In the next chapter the economic situation will be shortly described and the characteristics of farming and agricultural households will be summarized. It shows the large heterogeneity of agriculture in the region in almost any aspect from farm structure, income, portfolio of production activities and impact of surface water and groundwater. The review shows that agriculture in the DRB is an important source of food products and agricultural commodities in Europe.

After the description of the economic and agricultural situation the next chapter introduces an economic assessment of the nexus of agricultural production and environmental impacts. Based on literature and on the country reports an overview will be presented of instruments to mitigate agricultural impacts applied in the regions. This survey includes material from countries outside of the DRB in order to give an overview of the full scope of instruments. This part builds heavily on findings and recommendations from the OECD, an international economic organization with a number of member countries that are part of the DRB (Austria, Germany, Czech Republic, Hungary, Slovak Republic, Slovenia, Switzerland).

The implementation of regulatory and economic instruments in order to achieve environmental objectives is not enough to guarantee that they are attained. Decades of regulatory experience show that a fine-tuned tool box of measures and agricultural practices need to be implemented in order to achieve intended environmental outcomes in an effective manner at low costs. Environmental measures can be ranked according to their effectiveness. However, local conditions, in particular varying environmental vulnerability of regions and large variance in site characteristics need to be taken into account carefully in order to achieve cost-effective programmes. Based on the literature and supported by findings in the country studies such an overview is presented.

The final chapter of this study presents the challenges for agri-environmental policy approaches for each of the countries and their regions under consideration. This chapter is based on the expertise of the reviewers and authors of the country studies. They indicate into the direction of the way ahead towards better regulation and more cost-effective agricultural measures. The economic environment is likely to make this more easily possible as argued in the final chapter of this report.

2 Motivations and challenges for environmentally friendly agricultural practices in the DRB

2.1 Agriculture and clean water: main challenges

Water conservation and the prevention of the pollution of surface water and groundwater is not only on the agenda of environmentally concerned interest groups, it is an important issue of the whole society. In Table 1 a detailed overview is presented why it is important to control point and diffuse emissions with detrimental effects on water quality. The overview shows that it is not only human health that suffers from water pollution, many economic activities are impaired when quantity and quality of water resources are degraded.

Table 1: Impacts of water pollution: Economic, social and environmental aspects

Impact	**Examples**
Human health	Polluted water is the world's largest health risk, and continues to threaten both quality of life and public health. Associated with this are health service costs, loss life expectancy, and emergency health costs associated with major pollution events.
Ecosystem health	Damage to freshwater and marine ecosystems (e.g. fish kill, invertebrates, benthic fauna, flora, habitat degradation) and loss of ecosystem services (including the ability to process pollutants), which may require investment in additional or different grey infrastructure alternatives to replicate these services.
Social values	Prohibition from recreational use (e.g. swimming, fishing, kayaking), beach closure, impacts on aesthetics, cultural and spiritual values.
Agricultural productivity	Exclusion of contaminated water for irrigation results in increasing water scarcity. Irrigation with contaminated water causes damage to, and reduced productivity of, pasture and crops, contamination of soil, impacts to livestock health and production, and scouring of infrastructure.
Industrial productivity	Exclusion of contaminated water for industrial use results in increasing water scarcity. Scouring of infrastructure, and clean-up costs from spills/accidents.
Commercial fisheries	Direct and indirect fish kill, contamination of shellfish.
Urban and domestic use	Increased water treatment and inspection costs, maintenance costs from scouring and premature ageing of infrastructure, increased wastewater treatment costs with implementation of more strict regulations. Emergency and clean-up costs from spills/accidents.
Tourism	Losses in fishing, boating, rafting and swimming activities to other tourism activities or to other ventures with superior water quality.
Property values	Waterfront property values can decline because of unsightly pollution and odour.

Source: OECD, 2017.

Van Grinsven et al. (2013) made an attempt to evaluate the economic costs of agricultural water pollution. Their work is no specific to the DRB but covers EU27 in 2008 and their focus is not just on agriculture but on all emitters of nitrogen. The study provides a critical and comprehensive assessment of costs and benefits of the various flows of N on those aspects listed in Table 2. According to their assessment, the social cost of impacts of N was estimated between 75-485 billion € per year. A cost share of around 60% is related to emissions to air. The share of total impacts on human health is about 45%. Air pollution by nitrogen also generates social benefits for climate by present cooling effects of N containing aerosol and C-sequestration driven by N deposition, amounting to an estimated net benefit of about €5 billion/yr. The economic benefit of N in primary agricultural production ranges between 20-80 billion € per year and is lower than the annual cost of pollution by agricultural N which is in the range of 35-230 billion € per year. According to Van Grinsven et al. (2013) an internalisation of these environmental costs would lower the optimum annual N-fertilization rate in Northwestern Europe by about 50 kg/ha. Acknowledging the large uncertainties and conceptual issues of our cost-benefit estimates, the results support the priority for further reduction of NH3 and NOx emissions from the transport sector and from agriculture. Van Grinsven et al. (2013) show that the environmental pressure is much higher in the North-West of Europe. Compared to the South-East in general and the DRB in particular, pressure indicators are considerably lower mainly thanks to much lower livestock densities.

Table 2: Agricultural pollutants and activities and their impact on water quality

Pollutant	**Main agricultural activities that are the source of the pollutant**	**Key water quality issue related to pollutant**
Nutrients (mainly nitrates and phosphates)	Agricultural production (runoff of excess nitrates and phosphates from fertilisers and animal manure into water)	Eutrophication and impairment of drinking water mainly harmful to aquatic life, but also human health in some cases
Toxic contaminants (largely heavy metals, pesticides)	Spreading sewage sludge on agricultural land (heavy metals) and plant protection (pesticides)	Harmful to aquatic life and impairs drinking water (contamination of water)
Soil sediments	Inappropriate soil conservation practices (wind and water soil erosion)	Harmful to aquatic life and water transport systems (turbidity of water)
Organic matter	Manure-spreading on livestock farms	Harmful to aquatic life (deoxygenation of water)
Acid substances	Livestock production (ammonia volatilisation)	Harmful to aquatic life (acidification of water)
Biological contaminants	Faecal discharge from livestock into water	Impairs drinking water (pathogenic bacteria and viruses) and bathing water
Mineral salts	Inappropriate land use (clearing of perennial vegetation and irrigation practices)	Impairs drinking water, the use of water for irrigation, and aquatic life (salinisation of water)

Source: OECD, 2017

Municipal and industrial point sources are relatively easy to control because the places where effluents are dumped into the water courses can be spotted exactly and the sources of pollution can be identified unambiguously. In the case of agriculture, the situation is different and much more complex. The reason is that agricultural production takes place in the open environment.

Purchased inputs like fertilizer, crop production substances, animal manure and slurry which are by-products of livestock production are a valuable source of nutrients in crop production. In traditional farming practices, on organic farms and environmental sensitive production systems nutrients from livestock production are treated as a valuable input and nutrients are recycled on a farm in a careful and sophisticated manner. Emissions to air or water are seen as a loss and as an effect of bad practice in such systems. There are four prototypical situations where the farmer's decisions are not directed towards making only minimum use of such resources. When other considerations become prevalent in decision making, incentives to save nutrients become weaker:

1 The situation is different in livestock production systems where animals are fed almost exclusively or at a large extent with purchased feed. The excrements of animals are waste and not a source of soil fertility. Getting rid of waste at least cost is an important management problem and using environmental media such as air (ammonia) or water (nitrates, phosphates) for waste disposal is economical compared to the alternative treatments such as transport to regions with nutrient deficits or processing for commercial uses. In biogas production, similar problems are imminent. Nutrients, in particular nitrogen are important for the growth of the feedstock such as maize. But in the plant only the carbon fraction of the crops is transformed to energy whereas the protein fraction that contains nitrogen is accumulating in the biogas manure. This is finally spread on the fields where a surplus of nutrients is leaching into groundwater or runs off to surface water.

2 Farmers are exposed to many risks. They are operating in an environment where they cannot control important production conditions such as rain fall, temperature or pressure of harmful organisms. Apart from production risks, farmers are also exposed to price risks. Risk averse farmers are trying to mitigated such risks by applying chemical substances at slightly higher rates than would be necessary from the perspective of a risk-neutral profit maximizing farmer.

3 Another aspect is that many farmers do not know the exact status of fertility of their soils or the vulnerability of their crops towards pests. Such a lack of information can be compensated by spreading and applying substances as a kind of insurance to maintain a certain minimum of production level. Even a risk neutral farmer would do this when the cost of obtaining the information about the actual state of the environment are higher than the cost of applying the substances such as fertilizers or plant protection substances.

4 Farmers make investments not very frequently. Most of the investments are sunk cost (it is not possible to lease a manure tank to another farm). Farmers are therefore technologically locked in over the time of an investment cycle. Even if the farmer

would like to make use of nutrients in the feed more effectively (such as three phase feeding in pork production) he may lack the necessary equipment to achieve it.

The natural conditions under which farmers operate are very heterogeneous and the environmental outcomes of exactly the same agricultural and managerial practices may be very different. In regions with high rainfalls and warm temperatures growing conditions can be such that the double amount of nutrients is extracted from the soil compared to regions that are at very close distances but less fertile. Therefore recommendations for targeted action in one region may be very reasonable their but may turn out to be useless and ineffective in another region.

Another aspect is that not only the actions of individual farmers are important but the actions of all farmers in a region together with the actions of other users of a resource. This is the common pool problem. In order to improve the environmental situation in such cases, integrated approaches that address all users simultaneously are required in such situations. The goal should therefore be a cross-country integrated management plan to reduce emissions in the DRB.

2.2 A short survey of the economic situation in the DRB from the perspective of agriculture

The countries which are part of the DRB are at very different levels of economic development. Measured in PPP (purchasing power parities) the value added per inhabitant ranges from 63 thousand US$ in Switzerland over 19 thousand US$ in Bulgaria and 12 thousand US$ in Bosnia-Herzegovina to 8 thousand US$ in Ukraine and 5 thousand US$ in Moldova in 2016.

It is a well documented observation that in wealthy societies more efforts are made to protect the environment than in poorer societies. For people who are just able to make a living the personal survival and the well being of the close family has the highest priority and the environment is of much lesser importance. An equally known general pattern is that richer societies are exerting a much stronger environmental pressure than poorer ones do. A comparison of environmental indicators of different countries in the DRB confirms this observation.

Agriculture is an important economic activity in all the countries of the DRB. Some of the regions are among the most fertile in the Northern hemisphere. In the rich countries agriculture has only a small share in the value added (e.g. 0.8% in Germany and in Austria). Such a small share does not mean that agriculture is unproductive or a marginal economic activity. On the contrary, in these two countries agriculture is supplying the population to a high degree with domestically produced food. In the Eastern regions, the GVA share of agriculture is significantly larger than 10% in many regions (see Figure 1). In the Western regions agriculture is an important local supplier of commodities that are further transformed into food (mainly milk and meat products, fruits and vegetables). In the Eastern regions agriculture is one of the most important employers in rural regions and an important economic sector. However, its share in gross value added is declining there as well.

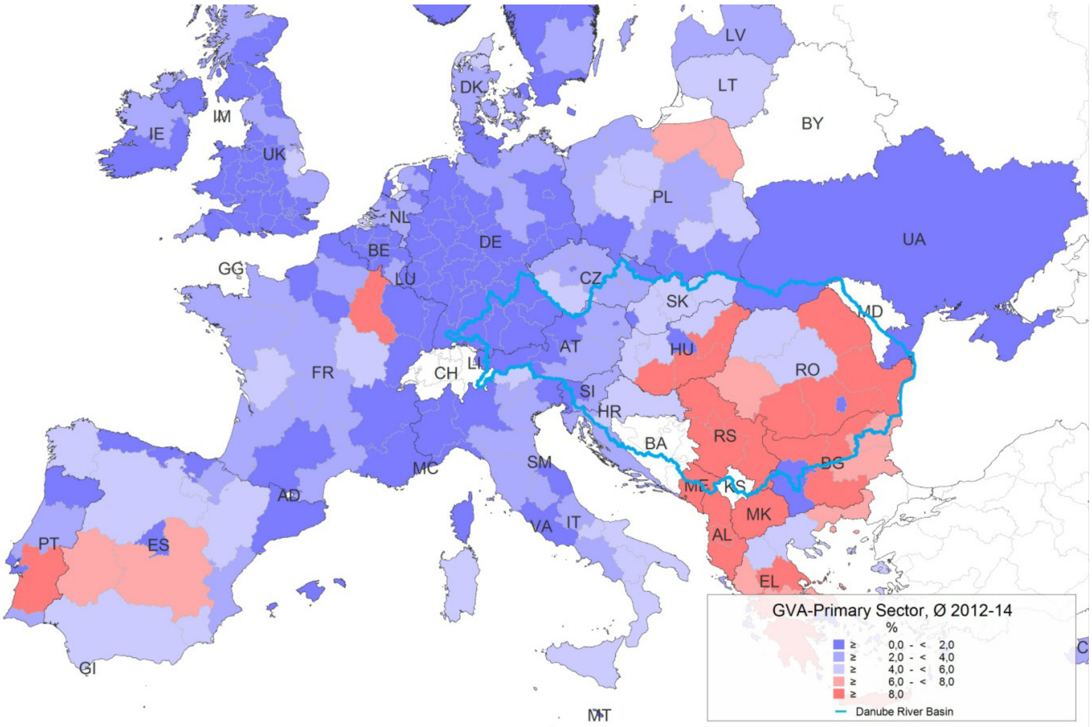


Figure 1: Contribution of Primary Sector (Agriculture, forestry and fishing) to Total Gross Value Added (GVA) at basic prices, Ø 2012/14

Source: EUROSTAT, Gross value added and income by A*10 industry breakdowns. Data online code [nama_10_a10]. Data extracted June 2017.

The production structure in the countries covered in this report is very heterogeneous. A very detailed overview of production is presented in the Appendix. In the Western regions of the DRB (Baden-Württemberg, Bavaria, Austria, Slovenia) livestock production is very important. A consequence is that livestock density (measured as livestock units per hectare utilized agricultural land LU/ha UAA) are relatively high there. Compared to livestock intensive production regions in the rest of the EU (Normandy, Netherlands, Denmark) even in these regions livestock is produced not very intensive. Effluents from livestock production like animal manure and slurry are important polluters of water. In regions with relatively more land per livestock unit, the environmental pressure is consequently much lower.

The description of agricultural production is not sufficient to characterize its role in the society and economy. Farm structure, the number of farms, their size and their legal organisation are important elements as well. In the West of the DRB family farms are the predominant form of farm organisation. Farms in Baden-Württemberg and Bayern are relatively small compared to other farms in Germany and comparable in size in Austria where commercial farms play almost no role.

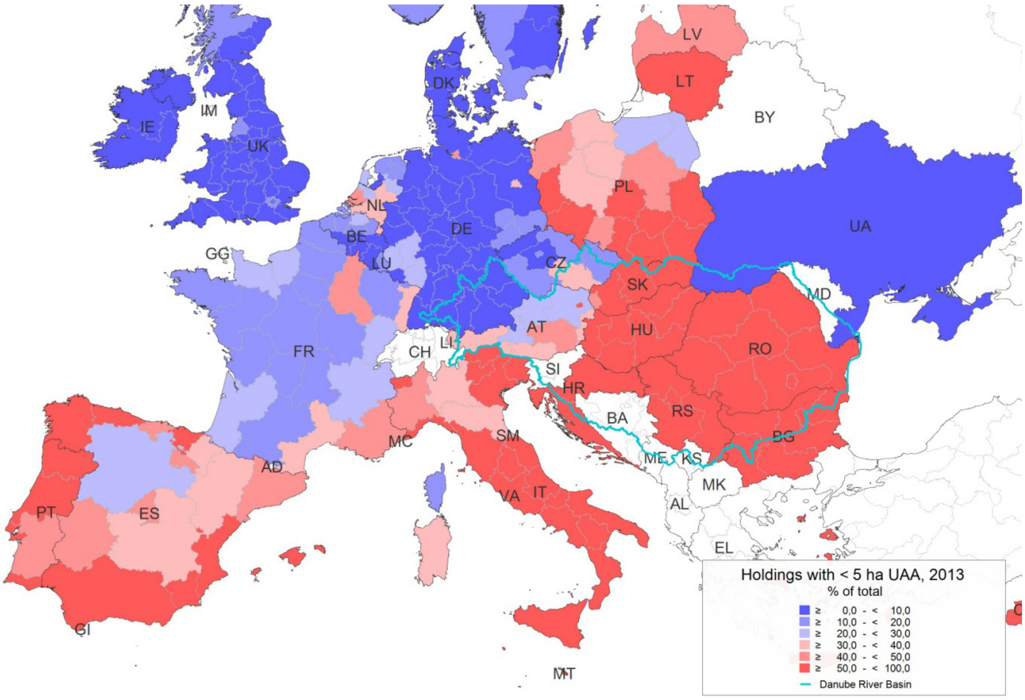


Figure 2: Share of Holdings with less than 5 ha Utilized Agricultural Area (UAA), 2013

Source: Eurostat, Key farm variables: area, livestock (LSU), labour force and standard output (SO) by agricultural size of farm (UAA), legal status of holdings and Nuts 2-Regions. Data online code [ef_kvaareg]. Data extracted June 2017.

In the Czech Republic, in Slovakia and the other countries along the Danube River, large farms run by a professional management are operating at a relatively large share of agricultural land. The farther East the stream flows the more important subsistence farming becomes. In all the regions to the East to Austria, most farms are smaller than 5 hectares. Many of them are not producing for the market but use the resources of the farm to support the livelihood of the farm family. One of the consequences is that agricultural productivity is small by European standards. Gross value added per farmer or farm worker (measured as annual working unit AWU) is below 5,000 Euro in approximately half of the territory of the DRB and significantly lower in Moldova and Ukraine. This is due to very low market revenues per hectare land which is below 1,000 Euro in regions of the Eastern fringe of DRB. Due to intensive vegetable and fruit production and livestock production in the Western part of DRB, output per hectare is more than 3,000 Euro/ha in many regions in Bavaria, Baden-Württemberg and Austria.

2.3 A short survey of the environmental situation in the DRB from the perspective of agriculture

The economic performance is closely and in some regions directly related to environmental pressures. In modern agricultural system intensive livestock production requires the use of commercial feed concentrates. A consequence is that more nutrients are brought into the farm system than can be taken up by the crops produced on the farms. High densities are prevailing in Germany and Austria in the Danube valley but not so in the Alpine regions where extensive pastures prevail. In the regions close to the black sea, livestock densities are very low according to the agricultural structure survey. When the figures of the farm structural surveys in 2005 and 2013 are compared it can be observed that production became less intensive in the Eastern part of DRB. The integration into the EU brought about that livestock farming became less profitable in many regions of Bulgaria and Romania.

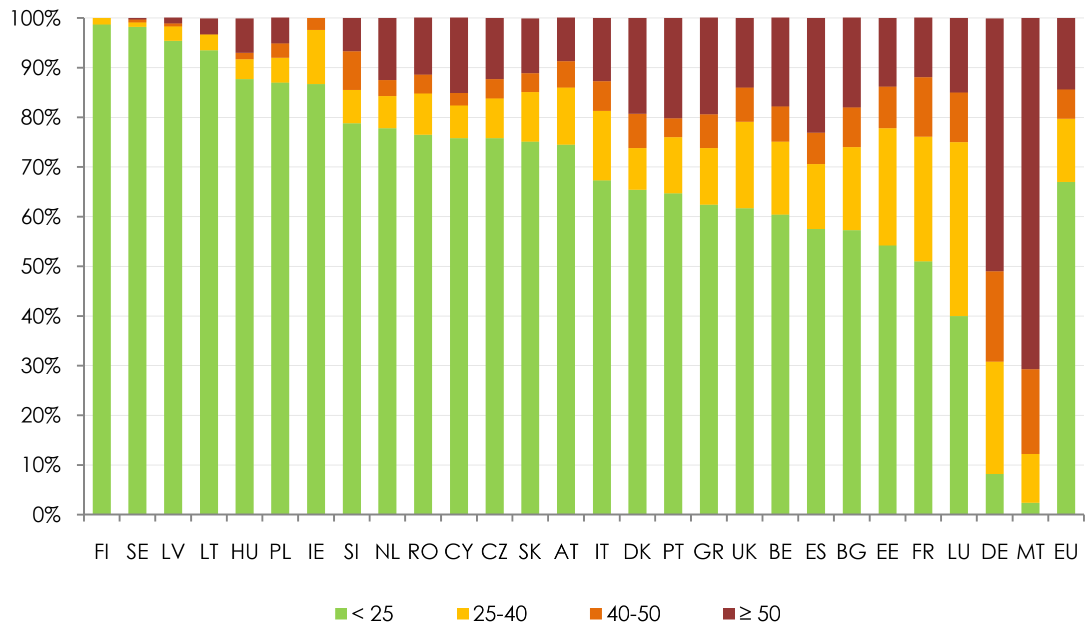


Figure 3: Frequency diagram of groundwater classes (Annual average nitrate concentrations)
Percentage of groundwater monitoring points per water quality class (annual average nitrate concentration) for all stations for EU 27 Member States for the period 2008-2011

Source: European Commission, Document No. SWD(2013) 405 final. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52013SC0405.

Livestock intensity is closely related with emissions of agriculture and eventually with the content of nitrates in groundwater. The status of groundwater quality in the countries of the EU and the change over time is shown in Figure 3.

Bulgaria and Germany are the countries with relatively high levels of nitrate concentrations in the ground water. The comparison between the status over two four-year periods shows some improvements in Bulgaria but further deteriorations in Germany. But not only in Germany the share of monitoring sites with excessive levels of nitrates increased. The same happened in Romania, Slovak Republic and Hungary.

Figure 4 shows that there is a West to East gradient in the density of livestock. This pattern indicates that nutrients are transported from the West to the East and that the overall contribution of countries bordering to the Black Sea is relatively small.

Table 3: Frequency diagram of groundwater classes (Annual average nitrate concentrations) in the DRB-Countries

	Change			
DRB	< 25	25-40	40-50	≥ 50
AT	+	-	+	-
BA	n.a.	n.a.	n.a.	n.a.
BG	+	-	-	-
HR	n.a.	n.a.	n.a.	n.a.
CZ	+	-	+	-
DE	-	+	+	+
HU	-	+	+	+
MD	n.a.	n.a.	n.a.	n.a.
RO	+	-	-	+
RS	n.a.	n.a.	n.a.	n.a.
SK	-	+	+	+
SI	+	-	+	-
UA	n.a.	n.a.	n.a.	n.a.

Source: European Commission, Document No. SWD(2013) 405 final. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52013SC0405.

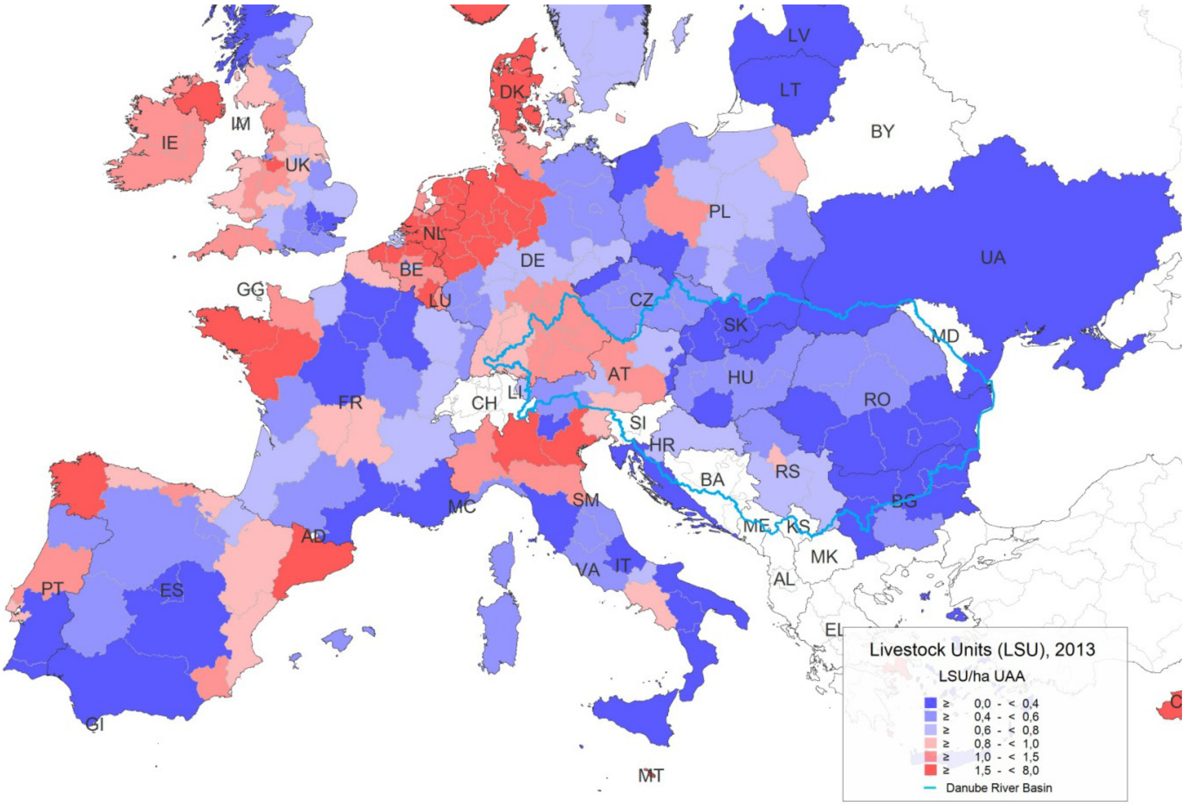


Figure 4: Livestock Units (LSU) per ha Utilized Agricultural Area (UAA), 2013

Source: Eurostat, Number of farm and heads of animals by livestock units (LSU) of farm and Nuts 2-Regions. Data online code [ef_olslsureg]. Data extracted June 2017. Note: Data for Germany Nuts 1.

Figure 4 shows livestock densities throughout Europe. The pattern of colors indicating different levels of livestock production concentration shows that the DRB is comparably less exposed to manure and slurry surpluses compared to the regions in the North-West of the continent.

In the most frequent full sample survey of agricultural structure in the EU farmers were also asked about their irrigation activities. Usually, the more farmland is irrigated the higher is the level of water abstraction. The quantitative status of water resources is as important as the qualitative one. An overview of irrigation intensity in 2010 is presented in Figure 5. It shows that there are some regions close to the river Danube in Austria, the Slovak Republic and Hungary where irrigation plays a major role. The same is true in the south of Bulgaria. Based on the evidence of the country reports of this study, irrigation declined due to the lack of adequate equipment and investments. The increases in crop yields are not high enough to make private investment profitable. A lack of public support to make new investments is the main reason why irrigation is less important today than it was decades ago.

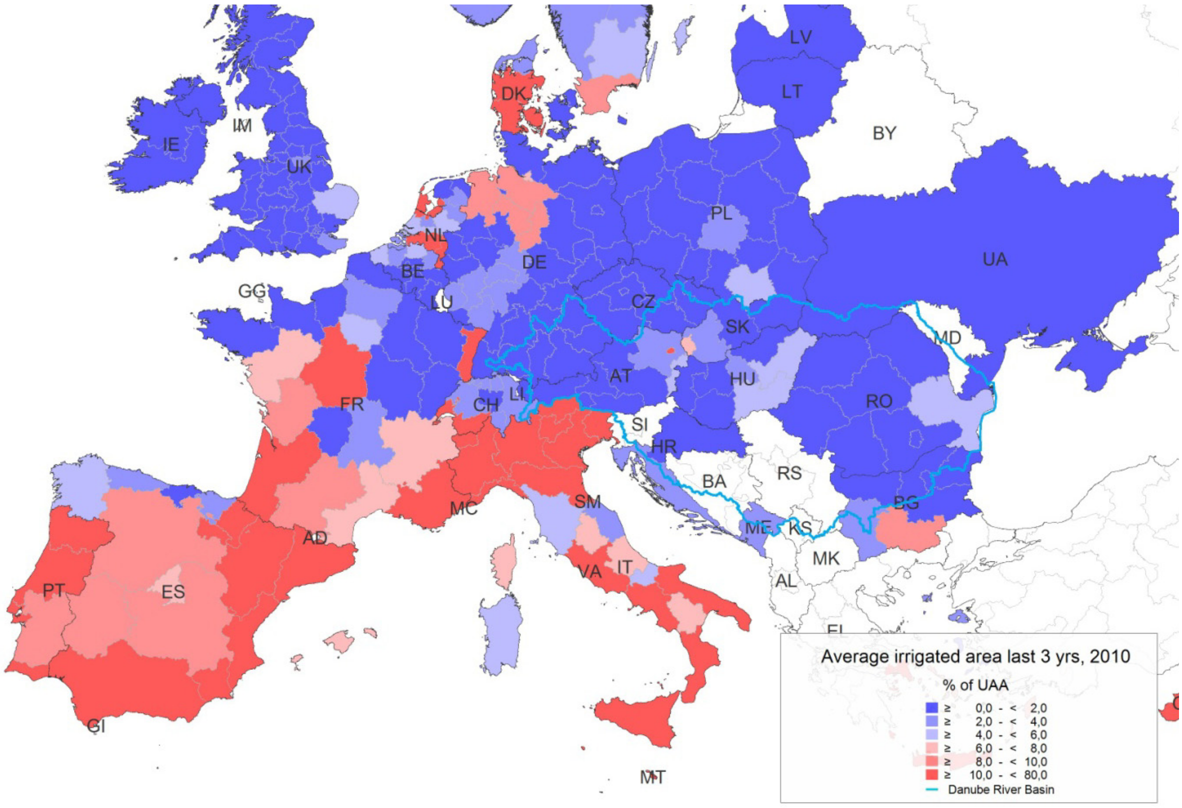


Figure 5: Average Area Irrigated in the last 3 years, 2010

Source: Eurostat, Irrigation: number of farms, areas and equipment by size of irrigated area and Nuts 2-Regions. Data online code [ed_poirrig]. Data extracted June 2017.

In a European context the comparison with other countries shows that irrigation is very important in all the Mediterranean countries and even in some northern countries where precipitation is too low for intensive vegetable production. In the case of irrigation one can conclude that a lack of public involvement contributed to a lower use of water for irrigation in the DRB.

Figure 6 gives an overview of estimates of soil erosion in Europe. Due to the lack of information not all regions of the DRB are shown in this map. For those countries were data are available, it shows that Alpine and Carpartian regions are erosion prone. Throughout the DRB soil erosion is a major environmental threat. The relevance for water quality is evident. Soil erosion may not only affect physical parameters of surface water courses but also chemical parameters. Nutrients and residues of plant protection substances are attached to soil particles which affect water quality in a detrimental manner.

The pressure indicators reviewed in this section and the overview of status indicators show that water in the DRB is affected by agriculture negatively. Not all regions are affected in the same way or to the same extent. There is considerable heterogeneity and variance even within small countries. Compared to the rest of Europe and compared to other river basins, the situation in the DRB seems to be a bit better. One important reason is that agriculture is much less intensive in large areas of the DRB than in many other regions of Europe. Another reason is that the economic situations in the Eastern part is such that the governments are not capable to support the agricultural sector to make it more productive which might end up in environmentally harmful outcomes.

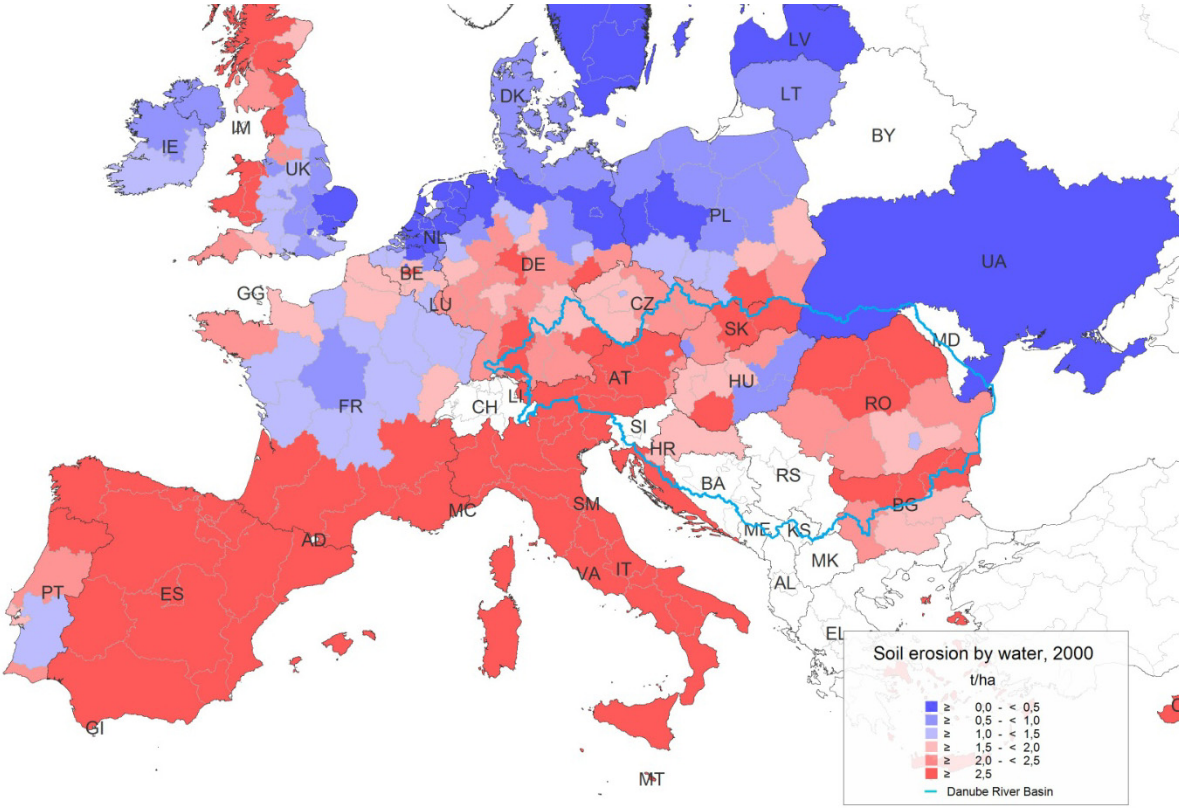


Figure 6: Estimated soil erosion by water, 2000

Source: Eurostat, Estimated soil erosion by water, by Nuts 3-Regions (source: JRC). Data Online Code [aei_pr_soiler]

3 A review of policy approaches and policy instruments

3.1 Instruments to control non-point source pollution

The **Polluter Pays Principle (PPP)** was established as a policy paradigm in OECD countries around 1970 (OECD, 1972; 1974). In a nutshell it says, if society decides that a certain level of pollution must not be exceeded, the party responsible for pollution has to pay for the cost of cleaning equipment or cleanup efforts and it has to accept that revenues and income flows are restrained. The PPP implicitly assumes that the public has a ‘property right' of an intact environment. Other parties that impair this ‘right' by degrading the resource have to compensate or restore the original state similar as in liability cases. There are different interpretations of the PPP but it essentially puts the burden of adjustment to the polluter.

The PPP creates conditions to make pollution a costly activity and to either influence behaviour to reduce pollution, or generate revenues to alleviate pollution and compensate for social costs (OECD 2012). Examples include pollution charges, taxes on inputs (such as fertilisers and pesticides) and sewer user charges. The polluter pays principle should not be accompanied by conflicting subsidies, tax advantages or other measures that encourage polluters to pollute, or assist polluters in bearing the costs of pollution, thereby creating distortions in the market.

An important aspect of PPP is the notion of a “payment" that offsets the damage. It is following the tradition of the British economist Pigou who proposed charges for polluters in order to motivate them to make efforts to reduce emissions or to compensate those who suffer from the damages. This is called “internalisation". It means that a polluting firm has to consider the costs into its accounting. Otherwise the firm is externalising costs which means that it is making higher profits because the costs have to be borne by external parties.

The **Beneficiary Pays Principle** allows sharing of the financial burden of water quality management (OECD, 2017). A requisite is that private benefits attached to water resources management are inventoried and valued, beneficiaries are identified, and mechanisms are set to harness them (OECD 2012). For example, wastewater treatment plants help to protect water quality in rivers and lakes, and green infrastructure, such as wetlands and forested catchments, provide water filtration ecosystem services. Beneficiaries include city residents provided with quality drinking water; reduced water treatment costs for utilities and health systems, and downstream industrial and agricultural users; improved business for fisheries and tourism operators; and benefits for recreational users, waterfront property owners, the environment, and society at large.

The Beneficiary Pays Principle is basically the same as PPP with the difference that the polluting firm is reducing the level of emission and gets compensations from those who benefit from better ambient environmental quality. The rationale for such a situation can also be found in the allocation of property rights. If a firm has the right to apply 170kg of nitrogen per ha in order to grow crops it may request for a compensation if it lowers the amount of fertilizer to 150kg. If the actual profitable level of fertilizer is 130kg per ha it may use the private knowledge about optimal intensity to make a windfall profit in such a case – it gets an extra revenue for making no additional efforts. Compliance with baseline regulations must be achieved before a payment for ecosystem service scheme is implemented. This is required to ensure additionality and to prevent polluters being rewarded

The survey of water protection regulations in the DRB showed that in many countries both principles are applied in the same regions. Farmers have to bear the cost of complying with regulations such as minimum storage capacities for animal manure. The same farmer may get money from the water work or from an agri-environmental programme if he or she expands storage capacity even further to meet high standards.

Table 4: Two alternative policy approaches: Polluter Pays Principle and Beneficiary Pays Principle

Polluter Pays Principle	**Beneficiary Pays Principle**
Challenges	
• Poor enforcement of existing regulations on diffuse pollution. • Diffuse pollution sources are not easily directly measured at reasonable cost with current monitoring technologies (although computer modelling is a cost-effective alternative). • Difficulty with identifying and targeting the polluters. • Undefined property rights. • High transaction costs associated with multiple polluters. Difficulty with determining reliable estimates of potential costs and benefits. • Strong political opposition from polluters.	• Seen as “rewarding” the polluter. • Beneficiaries of water-related services do not usually pay the full cost of the provision of ecosystems, or may free ride. • Difficulty with determining reliable estimates of potential costs and benefits. • Private financiers are not guaranteed to benefit from payments and may have a reduced incentive to support them: changes in land use management may not lead to water quality benefits, long time-lag before improvements are visible, landowners or their managers may not comply. • Difficulty with identifying and targeting the polluters. • Undefined property rights.

Sources: OECD (2015c,d; 2013; 2012a,b); Smith and Porter (2010).

An overview of advantages and challenges of these two paradigmatic approaches is presented in Table 4. This overview is based on various sources and focuses on problems associated with diffuse sources. The reason is that regulating point sources including farm operations is relatively easy compared to non-point sources. Such a general conclusion holds when farms have a certain minimum size. It may not hold in the case of many regions in the DRB where the majority of farms has less than 5 ha. Point source pollution due to leaking manure storage tanks or because of too little storage capacity is a major challenge in such a case that is usually deemed to be relatively easy to handle.

3.2 Source directed approaches to control diffuse emission

In this section an overview is presented of options to regulate and control emission of diffuse sources which is the prevalent problem in agriculture. The overview is based on OECD (2017). Here we use the terminology and prototypical examples which are found in the environmental economic literature. Not all the options listed in the following overviews are found in practice in the DRB. One reason is that different countries have different preferences for certain types of approaches to change the behaviour of farmers. This may be due to traditions and other factors like political power in environmental policy making.

The **Principle of Treatment at Source** considers that pollution control measures should be applied as close to the source as possible (OECD 2017). In effect, the later the stage of control, the less effective it is likely to be due to wider dispersion of the contaminants. Particularly strict measures of control should be enforced for certain categories of hazardous pollutants with a view to preventing their dispersion into the environment. This applies especially to toxic substances which are persistent in the environment and/or subject to bioaccumulation in living organisms and concentration through the food chain.

Regulations are applied in every country under consideration. They come in three different forms:

Standards

E.g. Planning requirements (i.e. environmental impact assessments,

Nutrient accounting, nutrient management plans, protection zones)

Mandatory use of best management practices (i.e. manure storage, riparian zones)

Restrictions or bans on the use of chemicals

Pesticides and hazardous chemicals registration

Cap on modeled diffuse pollution

Restrictions on pesticides, fertilizer, manure, effluent, biosolids application rates and timing

Input quotas per hectare and restrictions on livestock densities

Land retirement requirements (such as riparian buffer strips)

Standards to induce the use of new tools, including monitoring and information communication technology.

Liability rules

E.g. Negligence liability rules

Performance labeling

Government requirements for labeling on level of environmental performance

In the countries covered in our study regulations play a very important role. In each of the countries or regions investigated in more depth in the country studies very similar regulations are in place. One reason is that in EU Member States basic laws have to be implemented everywhere. The Water Framework Directive (WFT), the Nitrates Directive and many other regulations like those related to plant protection substances are universal in the EU. An interesting observation made during the study is that the EU approaches are taken on board in neighbour countries as well. One reason is that candidate countries such as Serbia have to comply with the Aquis Communautaire before accession negotiations can be finished.

Producers are required to comply with the standards otherwise they have to shut down the operation and depending on the environmental harm they may even be subject to environmental criminal law in some countries. The producers have to bear the costs to meet the standards and must reduce the production intensities which frequently implies lower profits and / or higher production costs.

The compliance of producers with standards is critical and public administration has to have the capacity to monitor and verify it. Fines which are imposed in the case of non-compliance must be sufficiently high in order to enforce standards in a sustainable manner. Otherwise such an approach only works on paper but not in reality.

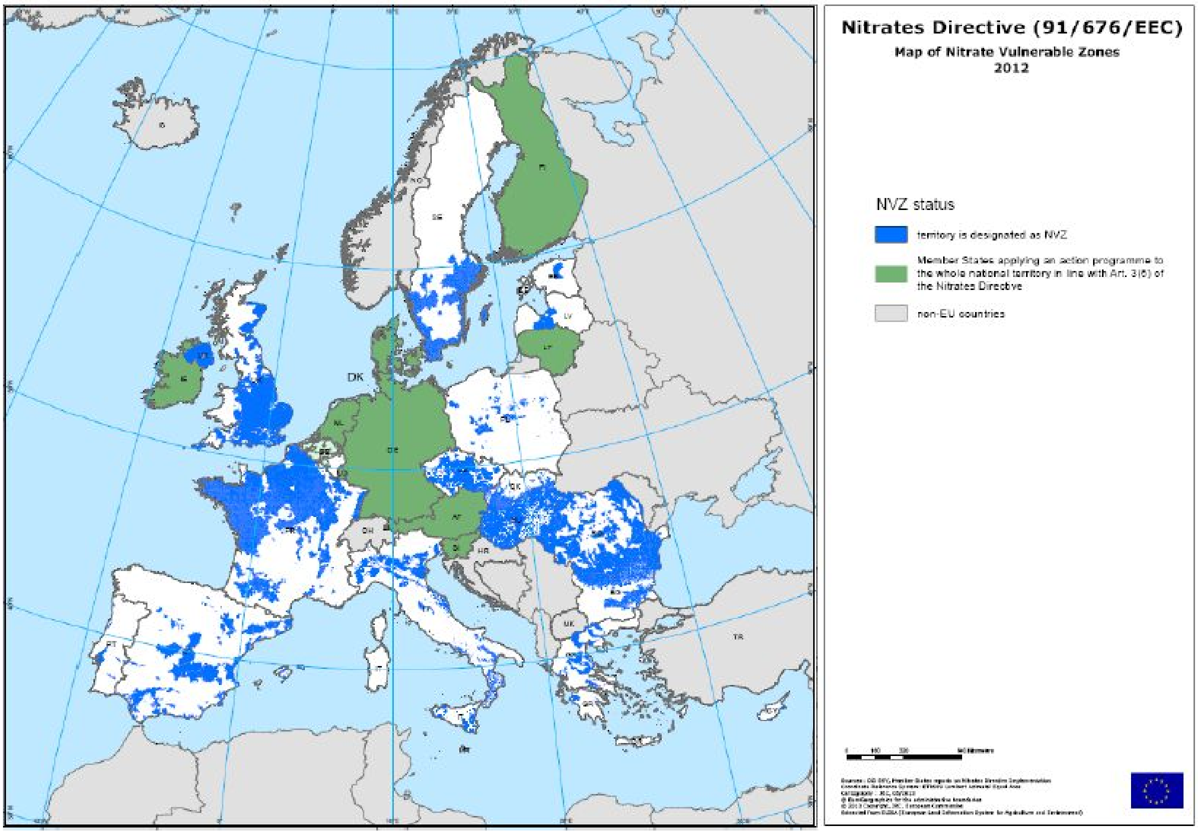


Figure 7: Implementation of Article 3 of the Nitrates Directive in 2012

Source: European Commission, 2013, SWD(2013) 405 final.

The Nitrates Directive (introduced in 1991) is the most frequently mentioned regulation in the country reports. It aims to protect water quality across Europe by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices. The Nitrates Directive complements the Water Framework Directive and is a key instrument in the protection of waters against agricultural pressures. The first step in implementation of the Directive is the identification of waters that are polluted or could become polluted if no action is taken. These are considered as waters where the concentration of nitrates is above 50 mg/L or that could contain (if no action is taken to reverse the trend) more than 50 mg/L of nitrates and waters that are eutrophic or could become eutrophic if no action is taken. Eutrophication caused by phosphorus as well as nitrates must be considered when designating nitrate vulnerable zones (NVZs).

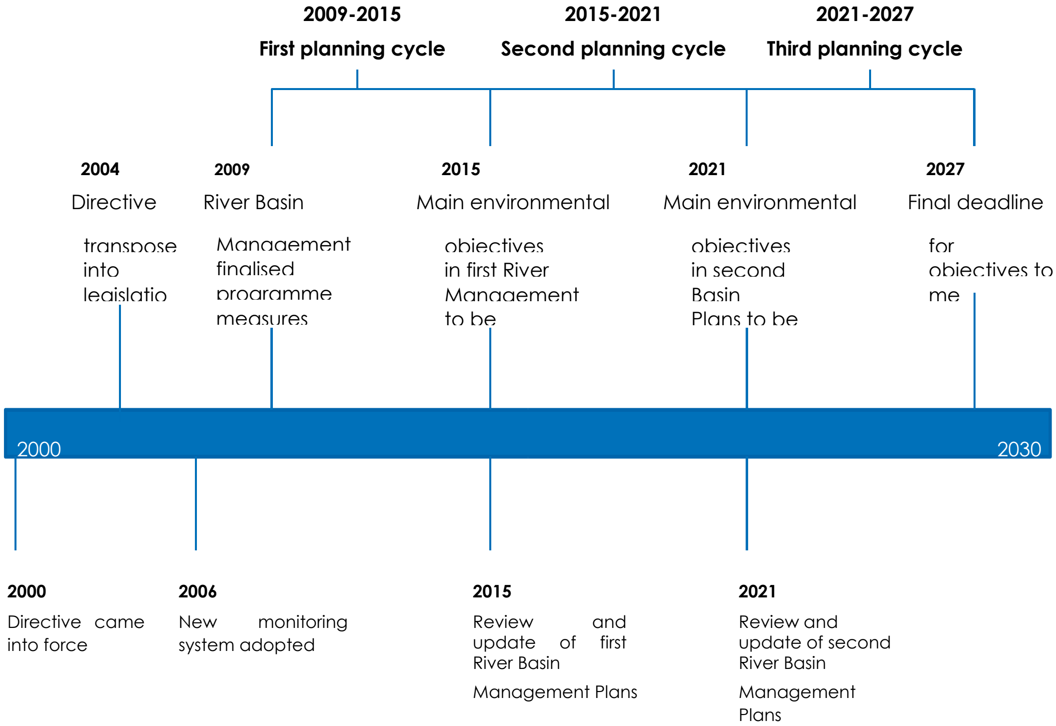
Member states can also choose to apply measures to their whole territory rather than designating specific zones (Figure 7). In most of the countries of the DRB which are part of the EU, Member States designated specific zones. Farmers within NVZs must comply with specific measures such as:

- Limiting when nitrogen fertilizers can be applied on land in order to target application to periods when crops require nitrogen and prevent nutrient losses to waters;
- Limiting the conditions for fertilizer application (on steeply sloping ground, frozen or snow covered ground, near water courses, etc.) to prevent nitrate losses from leaching and run-off;
- Requirements for a minimum storage capacity for livestock manure;
- Crop rotations, soil winter cover, and catch crops to prevent nitrate leaching and runoff during wet seasons; and
- Limits on the total amount of livestock manure that may be applied to land.

Every four years member states are required to report on: *i)* nitrates concentrations in groundwaters and surface waters; *ii)* eutrophication of surface waters; *iii)* assessment of the impact of action programme(s) on water quality and agricultural practices; *iv)* revision of NVZs and action programme(s); and *v)* an estimation of future trends in water quality. Many of the figures presented in this report and in the country studies are based on the reporting requirements of the Nitrates Directive and the WFD.

The regular reporting contributes significantly to our knowledge about the state of the environment. An important aspect is that countries like Switzerland and Norway apply the WFD in their countries and therefore are part of the integrated river basin management approach. The steps that were, have been and will be take over more three decades in order to implement the WFD are presented in Table 5.

Table 5: Dynamic implementation of the Water Framework Directive



Source: OECD, (2017) based on National Audit Office (2010),

Economic Instruments are an alternative approach to control emissions. Such instruments are much less frequently used in the DRB. One reason is that many lawyers who are designing environmental legislation are not (yet) familiar with such approaches and sometimes policy makers have an aversion of economic instruments. The following overview gives examples for three types of economic instruments:

Taxes

E.g. Taxes on chemical and solvent purchases
Taxes on fertilizer or pesticide purchases
Taxes on manure applications
Taxes on domestic products such as personal care products, detergents

Subsidies

Subsidies that reward inputs, practices, or technologies that prevent pollution
Agricultural land retirement subsidies
Subsidies for R&D or to induce uptake of new technologies, including monitoring technologies.

Payment for Ecosystem Services

E.g. payment by downstream users to upstream users, in exchange for practices
that reduce pollution and protect water quality.

In the survey of emission control approaches in the DRB, environmental taxes are never mentioned. Only in the case of irrigation, there are examples of charges that farmers have to pay in some countries if they extract water. In most countries, the abstraction is limited or regulated by licenses but farmers are not charged for the water they use. Payments for ecosystem services are observed in several countries where farmer make contracts with water suppliers in order to limit emissions below the threshold defined in the water regulations of the respective countries.

In many other countries outside of the DRB, environmental taxes are important. OECD (2017) presents an overview of such taxes in the context of agricultural diffuse pollution:

Sweden: a per unit pesticide tax on the active ingredients for all pesticides;

Norway: a tax on pesticide based on its negative human health and environmental effects. In doing so, it makes specific the value of the potential environmental and health damage, instead of relating the tax just to the price of the pesticide.

Flanders: manure tax and water pollution tax

Canada: pesticide tax of 0.7568 € per litre of pesticides in British Columbia

Denmark: tax on pesticides: 35% of retail value for chemical products for disinfection of soil and insecticides; 25% of retail value for chemical deterrents of insects and mammals, chemical products for reduction of plant growth, fungicides, and herbicides; and 3% of retail value for deterrents against rats, mice, moles and rabbits, and fungicides for wood protection.

a tax on fertilizers: 0.67 € per kg of nitrogen

France Pesticides: Seven pesticide categories with rates ranging from 0.38 € per kg to 1.68 € per kg

Italy tax on fertilizers and pesticides

Netherlands: tax on surplus nitrogen and phosphate in excess of approved farm nutrient budget.

Levy on water pollution; and tax on pollution of surface waters

United States: tax on fertilizers in Louisiana

Voluntary measures and Information are the third source oriented approach to pollution control. The range of instruments is very broad and the examples shown in the overview below (based on OECD, 2017) give evidence that many producers use special practices in order to differentiate their product from “standard” production methods that just comply with minimum legal requirements. Water conservation and reduction of emission is not only a concern of producers. There are consumers with a positive willingness to pay for food that is produced in an environmentally friendly manner (e.g. organic food). Producers can make use of such market opportunities by delivering services such consumers are willing to pay for. In the case of organic food a side effect is that most crop protection substances may not be applied and therefore cannot end up in the environment.

Contracts/Bonds

E.g. Land retirement contracts

Contracts involving the adoption of conservation practices

Contracts involving the adoption of nutrient management practices

Best Environmental Practices

E.g. best practices for fertilizer and pesticide applications to reduce runoff

Advisory services

E.g. Farm advisory services and demonstration projects to encourage greater uptake of best environmental practices and improve productivity

Environmental labeling

Products that meet certain environmental standards can be marketed and sold at a premium and/or subsidized.

Corporate Social Responsibility

Investment in practices that reduce pollution to improve corporate image, water stewardship metrics and ISO water footprint standards.

Covenants and negotiated agreements

Industry code of conduct

Private standards (e.g. food and beverage companies requiring suppliers to comply with certain environmental conditions)

Benchmarking

Publicizing and ranking polluter's performance

Self-regulation

Polluters acting to regulate themselves

Community-based regulation and co-operation agreements

Research and knowledge building

Private and public research to improve understanding of water quality risks

Knowledge sharing and problem solving at the community level

Information campaigns

E.g. targeted at households to reduce disposal of chemical waste and unused pharmaceuticals in toilets

Many of the examples of voluntary measures listed in this overview are applied in practice in the DRB. Advisory services are frequently supported by the agri-environmental programme that is part of the Second Pillar (the Rural Development Programme) of the Common Agricultural Policy (CAP). Many other initiatives are financed or co-financed by regional governments that are thriving to reach environmental objectives. Representative organizations of farmers are also involved in such activities by financing campaigns, disseminating the knowledge of best practices in their journals and financing programmes that raise the awareness about environmental issues among farmers.

In the Member States of the EU significant publicly funded resources are made available in order to finance source directed approaches to limit emissions of non-point sources. An overview of expenditures in the current programme period that has started in 2015 and will run until 2020 is presented in Table 6.

Table 6: Overview of financial support for agri-environmental programmes and water efficiency measures

Priority / Focus area / Country	P4: Restoring, preserving and enhancing ecosystems related to agriculture and forestry	P5: Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors 5A: Water efficiency	Total public allocations
		million €	
Austria - RDP (National)	4,980.4	21.3	7,699.7
Bulgaria - RDP (National)	983.1	105.3	2,917.8
Czech – RDP (National)	2,098.5	0.0	3,547.2
Germany - RDP - Baden-Württemberg	798.2	0.0	1,344.5
Germany - RDP - Bavaria	1,776.9	0.0	2,631.8
Croatia – RDP (National)	659.7	0.0	2,383.3
Hungary - RDP (National)	1,203.4	41.1	4,174.0
Romania - RDP (National)	2,519.4	406.0	8,559.0
Slovenia - RDP (National)	573.2	0.0	1,107.2
Slovakia - RDP (National)	896.5	0.0	2,099.2
EU TOTAL Amount	66,766.5	2,985.0	149,638.8

Source: European Commission, European Structural & Investment Funds Data, https://cohesiondata.ec.europa.eu/https://cohesiondata.ec.europa.eu/dataset/ESIF-2014-2020-Finance-Implementation-Details/99js-gm52

The overview Table 6 lists only measures directly linked the priority 4 objective. Substantial additional funds are made available that have effects on water quality like the support of organic farming or extensive farming practices that are primarily motivated to promote biodiversity. The specificities of this programme are varying among countries and are reported in more detail in the country reports.

For those countries that are members of the OECD a detailed overview of measures that promote water related agri-environmental practices is presented in Table 7 shows that the range of supported practices is very broad and that each country has its own profile. One reason is that the vulnerability is different in different regions and that each country has different preferences about how much money is going to be spent following the Beneficiary Pays Principle. Actually, in the case of agri-environmental payments it's the tax-payer who covers the cost and it is not the beneficiary.

For Austria and Slovakia more detailed and more recent overviews of water related agri-environmental measures are available. In the appendix Table 24 summarizes the information from the programme documents. The table also shows the uptake of measures.

Table 7: Agri-environmental payments directly addressing water quality, 2008

	1. Payments directly impacting water quality					
	Land improve-ment (liming, soil erosion prevention)	Payments for nitrate reduction	Nutrient management plan	Maintenance of wetlands and ponds[5])	Conversion of farmland into wetlands and ponds	Shelter belts/ Buffer strips
AT	X	X				X
CA	X		X			X
DE	X	X				X
HU			X	X		X
SK	X	X				
CH		X		X		X

	2. Payments indirectly impacting water quality						
	Extensive crop production	Organic farming	Integrated production wine, fruits and vegetables	Integrated farming	Reduced tillage/ Mechanical weed control	Green manure crops	Green set-aside/ Fallows
AT	X	X	X		X		X
CZ		X	X	X			
DE	X	X			X		
HU	X	X	X	X	X		X
SK		X	X				

	2. Payments indirectly impacting water quality (cont.)							
	Catch crops, green/ winter cover	Extensive manage-ment of all land	Extensive grassland management (pastures/ meadows)	Conversion of arable land into grassland (pastures/ meadows)	Grassland/ biodiversity/ habitat schemes	Maintaining and improving groundcover	Long term set-aside	Afforest-ation
AT	X				X		X	
CZ	X		X	X	X			X
DE	X		X	X	X		X	
HU		X	X	X	X			X
SK			X	X	X			X

Source: OECD, Water Quality and Agriculture: meeting the policy challenge, 2012, Table 4.2. Agri-environmental payments to address water quality in OECD member countries: 2008. –[1]) In Australia and New Zealand, there is very limited use of payments to farmers (and, where payments are made, this is in the form of one-off or transitional payments) and support to agri-environmental programmes is provided mostly through general services; –[2]) In Belgium, only programmes used in the Flanders region are reported; –[3]) In Finland, Greece and the Netherlands, the information for 2008 is not available and the programmes in the table correspond to programmes applied in 2000-06; –[4]) In United Kingdom, only programmes used in England are reported ; –[5]) In Spain, the payments for water quality in wetlands are included in this line.
Note: AT Austria, AU Australia, CZ Czech Republic, DE Germany, HU Hungary, SK Slovak Republic, SE Sweden, CH Switzerland, TR Turkey, US United States, UK United Kingdom.

3.3 End of pipe approaches to control diffuse emission

In the EU the precautionary principle is guiding sector policies like the agricultural policy and also fiscal and environmental policies. Therefore end of pipe instruments are important but not the first priority approaches because the most emphasis is put into instruments that prevent pollution in the first place.

Regulations do not play a very important role for non-point sources like agriculture:

Standards

E.g. Permits for discharges with quantity and quality conditions

Restrictions on modeled diffuse pollution (i.e. nutrient loadings)

Non-compliance penalties and fines

Non-renewal of resource permits

greater restriction on current permits

In none of the countries surveyed for this study, a case was mentioned that fits into the classification provided by OECD (2017). The same is true for **Economic instruments** that can be applied as end of pipe approaches to control diffuse of agriculture:

Taxes

Taxes on modeled diffuse pollution (i.e. nutrient loadings)

Taxes on estimated soil loss

User charges

Sewer surcharge (can incentivise reductions in wastewater from businesses and households and raise revenue to finance wastewater treatment plant upgrades)

Markets

Water quality trading of point discharge permits

Water quality trading of modeled diffuse pollution discharge permits

Point-non-point trading

Loans

E.g. For investment in WWTPs or artificial wetlands

Subsidies

Subsidies for inputs, practices, or technologies that reduce pollution

Subsidies for R&D or to induce uptake of new technologies, including monitoring technologies

Water quality offsets

Liability for pollution and payment for compensation of damage

Taxes on atmospheric pollutant emissions (which can lead to water pollution, i.e. acidification)

Based on the survey in the countries of the DRB there are no examples that apply for agriculture where end of pipe approaches to control diffuse sources are applied.

4 Measures to reduce emissions of agriculture

4.1 Source related emission control

The effectiveness of source related emission control is given when the equipment and facilities are constructed adequately and when maintenance is done properly. A slurry tank must be tight and the capacity must meet the standards. The same applies for silage storage facilities, manure storage platforms and similar facilities.

Regular inspections and monitoring are adequate approaches to control compliance with such source emission control measures.

4.2 An overview of measures and their effectiveness to reduce diffuse emission in groundwater and surface water

One element of the country reports was to explore the effectiveness of measures that are implemented to reduce the loads of pollutants. It turned out that there is very little literature available on evaluations of measures in place. An interesting aspect is that the EU Commission requires evaluation reports for the Programmes of Rural Development. An explicit requirement is the assessment of the (cost-) effectiveness of measures. However, the screening of such evaluation reports was not very successful. There are very few studies that show the effectiveness of single measure and the relation to the cost of implementing it. In many cases the program with all the measures is assessed but even in such cases very rarely in quantitative terms.

A second source for identifying the effectiveness of measures is the scientific literature. Because the topic is interdisciplinary (agronomy, environmental sciences, livestock sciences, economics) it is hard to pin down those measures that are relevant for the practice. A thorough meta-analysis would be needed to achieve that.

A third source for an assessment of measures to attain environmental goals are handbooks offered to consultants who work with farmers in compulsory or voluntary programs that aim at reducing agricultural emissions. One example is a manual published by the Niedersächsischer Landesbetrieb für Wasserwirtschaft (2015) which offers detailed overviews of measures and measure combinations that are effective and useful in practical situations on the farm. The assessments given in this manual are not quantitative but only qualitative and on an ordinal scale. The reason is that conditions are very site specific and expert knowledge is needed to fine tune practices and variants of practices to a given situation.

Table 8 and Table 9 give an overview of measures (see left most columns) and their effectiveness in order to reduce negative impact on surface water and groundwater. It turns out that the scope of measures is considerable and that even low cost options are likely to achieve much. However, the assessments provided in Table 8 and Table 9 are indications of likely effect and no one can guarantee that the effects actually materialize. Short run success may be observed but is likely due to luck and special favourable site characteristics. The assessment given by the experts contributing to the publication listed in Table 8 and Table 9 is very reliable because it builds on the expertise of more than ten years consulting in water quality enhancing practices and hundreds of field experiments that were surveyed.

Table 8: Effectiveness of measures implemented to reduce impacts on surface water

Measure Overview:	reduction emission of nitrate	reduction emission of phosphate	reduction of sediment dischage	reduction plant protection subsances	overall assessment
Measures (voluntary agreements) according to the catalogue of measures listed		-/0/+/++/n.a.-			
I. A) Limitation of the application of livestock manure	++	++	0	0	+
I. B) Renunciation of the use of livestock manure	+	+	0	0	+
I. C) Water-friendly application of agricultural fertilizers	+	+	0	0	+
I. D) Farm fertiliser and soil analyses	0	0	0	0	0
I. E) Active greening					
I. E a) Intermediate crop cultivation, underseeds	+	++	++	0	+
I. E b) Greenery on fallow land	++	++	++	++	++
I. F) Seed rotation design that is gentle to the aquatic environment	++	+	+	+	+
I. G) Extensive management of grassland	++	+	0	+	+
I. H) Unprecedented grassland renewal	++	+	++	0	+
I. I) Reduced N-fertilization	+	n.a.	n.a.	0	+
I. J) Reduced tillage	+	+	+	-	+
I. K) Corn Seed1)	0	+	+	0	0
I. L) Underfoot fertilization (purely mineral)	+	+	0	0	+
I. M) Use of stabilized N-fertilizer	+	0	0	0	0
I. N) Reduced use of herbicides	n.a.	n.a.	n.a.	+	+
I. O) Organic farming	++	+	0	++	+
II) Conversion of farmland to extensive grassland/extensive field grass	++	++	++	++	++
III) Forest erosion protection	+	+	++	+	+

Notes: Measures: Evaluation: ++ very positive; + positive; + positive; 0 neutral; - negative; - negative; n/a not applicable
Source: Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz, 2015

Table 9: Effectiveness of measures implemented to reduce impacts on groundwater

Environmental assessment	Groundwater			
	autumn-N_{min} / N-load	N-Saldo	overall assessment	reduction plant protection substances emission
no indication		-/0/+/++/n.a.-		
Measures (voluntary agreements) according to the listed MU catalogue of measures	+	+	+	0
I. A) Limitation of the application of livestock manure	+	+	+	0
I. B) Renunciation of the use of livestock manure	0	+	+	0
I. C) Water-friendly application of agricultural fertilizers	0	+	+	0
I. D) Farm fertilizer and soil analyses				
I. E) Active greening	++	0	+	0
I. E a) Intermediate crop cultivation, underseeds	++	++	++	++
I. E b) Greenery on fallow land	++	+	++	+
I. F) Seed rotation design that is gentle to the aquatic environment	+	+	+	+
I. G) Extensive management of grassland	++	+	++	0
I. H) Unprecedented grassland renewal	+	++	++	0
I. I) Reduced N-fertilization	+	0	+	-
I. J) Reduced tillage	0	0	0	0
I. K) Corn Seed1)	+	+	+	0
I. L) Underfoot fertilization (purely mineral)	+	+	+	0
I. M) Use of stabilized N-fertilizer	0	0	0	++
I. N) Reduced use of herbicides	++	++	++	++
I. O) Organic farming	++	++	++	++
II) Conversion of farmland to extensive grassland/extensive field grass	n.a.	n.a.	n.a.	n.a.
III) Forest erosion protection	+	+	+	n.a.

Notes: Measures: Evaluation: ++ very positive; + positive; + positive; 0 neutral; - negative; - negative; n/a
Source: Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz, 2015

4.3 An overview of measures and their effectiveness to reduce soil erosion

Table 11 and Table 10 are listing different agricultural practices that are implemented in order to reduce soil erosion. Soil particles that are transported into surface waters contain nutrients and residues of crop protection substances and are therefore the vectors of problematic pollutants.

Table 10: Environmental assessment of voluntary agreements from the perspective of soil protection

Environmental assessment	Soil		
	Erosion	humus balance	overall score
Measures (voluntary agreements) according to the listed MU catalogue of measures (MU 2007)		-/0/+/++/k. A.-	
I. A) Limitation of the application of livestock manure	0	0	0
I. B) Renunciation of the use of livestock manure	0	-	-
I. C) Water-friendly application of agricultural fertilizers	0	0	0
I. D) Farm fertiliser and soil analyses	0	0	0
I. E) Active greening			
I. E a) Intermediate crop cultivation, underseeds	++	+	++
I. E b) Greenery on fallow land	++	+	++
I. F) Seed rotation design that is gentle to the aquatic environment	+	+	+
I. G) Extensive management of grassland	0	0	0
I. H) Unprecedented grassland renewal	+	+	+
I. I) Reduced N-fertilization	0	0	0
I. J) Reduced tillage	+	0	+
I. K) Corn Seed1)	+	0	+
I. L) Underfoot fertilization (purely mineral)	0	0	0
I. M) Use of stabilized N-fertilizer	0	0	0
I. N) Reduced use of herbicides	0	0	0
I. O) Organic farming	0	+	+
II) Conversion of arable land into extensive grassland / extensive field grass	++	++	++
III) Forest erosion protection	++	+	++
IV) Forest conversion	+	+	+

Notes: Measures: Evaluation: ++ very positive; + positive; + positive; 0 neutral; - negative; - negative; n/a
Source: Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz, 2015.

gives an overview of the effectiveness of practices provided by Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz, 2015. Whether this assessment is valid of all the regions of the DRB is an open question. When we compare the outcome of an evaluation of such measures that were part of the Austrian Agri-Environmental programme, we can conclude that such measures are actually effective at least in Central Europe.

Table 11 however, also reveals that the same measure has larger or lower effects depending on the regional conditions (the columns in Table 11 are are indicating 9 different subregions; of Austria; the last one labelled "AT" is for the whole country).

Table 11: Reduction of soil degradation by directly effective erosion control measures in ÖPUL in 2008 (in tons/ha/year) for the federal states and Austria

	BGLD	KTN	NÖ	OÖ	SBG	STK	TIR	VBG	WI	AT
Soil removal without ÖPUL	2,9	1,8	3,8	6,0	1,8	5,6	1,2	3,4	2,6	3,8
Reduction through erosion protection in the	0,2	0,1	0,1	0,0	0,0	1,0	0,0	0,0	0,3	0,2
Fruit and viticulture	0,1	0,0	0,3	0,5	0,0	0,0	0,0	0,0	0,1	0,2
Reduction through greening in the	2,6	1,7	3,4	5,5	1,8	4,6	1,2	3,4	2,2	3,4
Arable farming and mulching and direct sowing Soil removal with ÖPUL	10%	3%	11%	8%	0%	18%	1%	0%	13%	10%

Notes:Thea The table gives an overview of the effectiveness of soil erosion control measures in the Austria Agri-Environmental Programme (ÖPUL); columns are subregions, AT is the whole country

Source: Baumgarten et al., 2012

4.4 In search of cross border cost-effectiveness

The study of agricultural measures to reduce water pollution in DRB showed many details of environmental impacts and strategies of the respective society to cope with pollution and how to reduce it. It also showed that every country is taking action in order to prevent that water quality deteriorates. Depending on the level of economic development and the seriousness of pollution these measures are restricting agricultural activities very much or to a lesser extent.

One finding of our study is that the cost-effectiveness of measures is not well known. The reason is that most studies either look at the effects on nitrogen balances (e.g. Sinabell, 2017; Schönbeck, 2010) or on mineralized N in autumn in top soils. These are widely used proxies for nitrate pollution but nitrate in groundwater is the most important indicator. When it comes to other substances like residues of plant control substances, there is no evidence at all that would allow to evaluate the cost-effectiveness of measures.

An important lesson learned from the country studies and reviews of the literature is that organic farming is a system that – on average – is performing significantly better in environmental terms than the standard practice of non-organic farms. Because organic farms are following an integrated approach, it is not possible to pick out one or two particular practices that are emission reducing. Therefore the cost-effectiveness of single practices cannot be assessed.

In all EU Member States organic farming is supported by the agri-environmental programmes. Given the positive environmental effects, this is a prudent strategy to reduce the environmental costs of agriculture. Whether such support is performing better in terms of cost-effectiveness compared to alternative approaches is still an open question.

Table 12: Costs and cost-effectiveness of known measures to reduce nitrogen input in groundwater and surface waters

measure	cost[€/ha]	reduction of N-emission [kg N/ha]	cost-effectiveness [€/kg N]
Spring min analysis to support the fertilization planning	20 to 80 €/plot	0 to 30	6
riparian strip	800	working under special conditions	-
Use of stabilised N-mineral fertilizers for winter cereals and potatoes	25 to 35	0 to 20	3
Conversion of arable land into extensive grassland	400 to 600	30 to 70	8
organic farming	80 to 200	0 to 50	8,5
Intermediate crop cultivation with late upheaval	40 to 120	25 to 50	2,6
reduced N fertilizer: 10%-20% below optimum max 80 kg fertilizing cycle	50 to 300	0 to 10	16

Source: BMUB and BMEL, 2017. Based on: Osterburg et al. 2007.

Table 13: Mitigation effects and the average cost-effectiveness of selected measures

measure	Number of observations (n); significance level (p)*	reduction of the potential N-discharge in kg N/ha Average: median comparison	regression model	cost-effectiveness in €/ kg N
Intermediate fruit/ undersowing	n=6136; p=0,00	30	26	3
Crop rotation design for organic farming	n=119; p=0,00	29	27	5
Extensive crops/ Red. herbicide use	n=52; p=0,00	22	19	5
Conventional crop rotation design	n=805; p=0,00	21	27	6
Reduced tillage	n=705; p=0,00	13	12	3
extensive grassland	n=135; p=0,00	24	28	5
conversion of arable land to extensive grassland	n=112; p=0,00	45	39	8
set aside land	n=347; p=0,00	.	48	13

Note: p: statistical significance level for the difference to the comparison group without measure in pairs.
Source: Schmidt T.G., Osterburg B. (2010) Wirkungen von Wasserschutzmaßnahmen auf den mineralischen Stickstoffgehalt von Böden. In: NLWKN, WAgriCo 2 Projektbericht. Gewässerbewirtschaftung in Kooperation mit der Landwirtschaft in niedersächsischen Pilotgebieten. Hannover.

In its most recent nitrates report the German government published data on cost-effectiveness under conditions in Germany. The figures in Table 12 and Table 13 show that the range of costs is quite broad. Organic farming (Table 12) is viewed to be a low cost strategy to reduce the emission of nitrogen compounds. Setting aside land (Table 13) is the most costly strategy. The cost indicated in the tables may not be representative for regions in the East of the DRB. But they certainly are good estimates for those regions where environmental pressure is relatively strong.

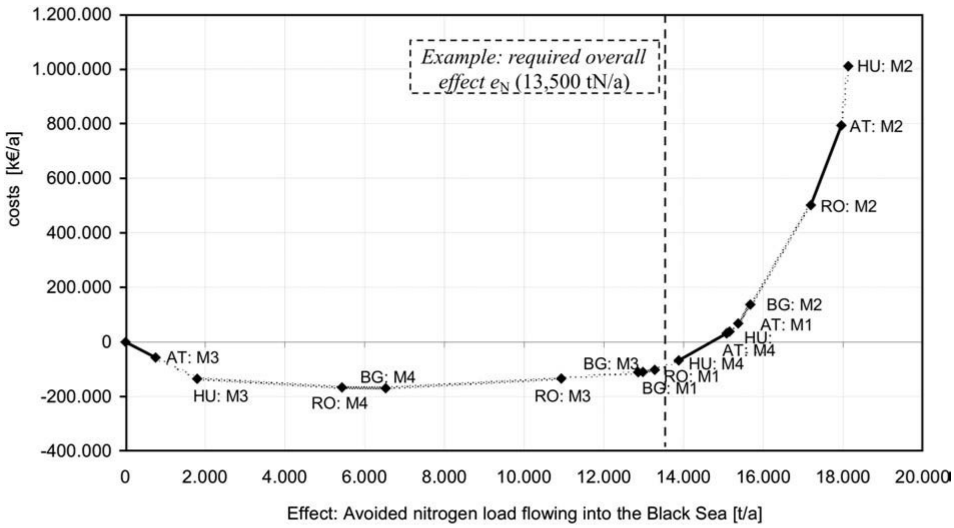


Figure 8: Cost-efficient combination of measures to avoid nitrogen loads in the DRB

Notes: M1: Accurate application of fertilizers regarding fertilizer amount and time-related application rates, M2: Reduction of nitrogen emissions from manure, M3: Increase of plant productivity by application of capital-intensive production techniques, M4: Reduction of nitrogen emission directly into the hydrosphere; k€=1000 €.
Source: Fröschl et al., 2008.

Further economic research is necessary to identify cost-effectiveness ratios in other countries. A systematic overview based on the same methodology would allow to identify least cost combinations. In the literature survey, one study was identified that made such an analysis. Figure 8 shows cost-efficient combination of measures to avoid nitrogen load flowing into the Black Sea chosen jointly in Austria, Bulgaria, Hungary and Romania according to their cost–effect ratios (Fröschl et al., 2008).

The graph shows two interesting aspects. The first is that there are measures that are not costly but they are profitable. Precision farming, more effective fertilizing equipment, phase feeding in pork production are practices that farmers should adopt if they are profit maximizing. The second aspect is that co-ordination of activities across countries should be promoted. The figure shows that there are very costly measures in each of the countries. Combining lower cost measures across countries would make it more overall-cost-effective to reduce the loads of nutrients into the Black Sea.

5 County specific syntheses from the country reports

5.1 Austria

5.1.1 Challenges for policy making

It is important to have in mind that the scenarios on which these forecasts are based make the assumption that environmental legislation and environmental programmers will become more stringent in future. From an environmental perspective the future is likely to look better. But this does not happen "automatically" but only if existing programmes and regulations are continuously adapted to changing situations. If the prices of agricultural outputs increase significantly, then farmers will also increase the amount of fertilizer. Currently, price expectations for the next decade are moderate. OECD and FAO (2017) expect that prices of major commodities will be below current levels in real terms. Therefore market conditions seem to contribute to less intensive agricultural practice in the near future.

Whereas the main drivers to reduce environmental impact were water related policies in the past (Nitrates Directive from 1991; Water Framework Directive from 2000) it will be climate related policies and programmes in the future. In general climate change mitigation policies will reduce the number of livestock (mainly ruminants) and nutrient losses from mineral fertilizers. If this happens, we may expect positive effects for the quality of water as well.

When expected prices are low we may also expect that farm incomes will be low in the near future. This will put pressure on structural change in agriculture and a reluctance of policy makers to put additional pressures on the sector. The main challenges for policy making will therefore be to facilitate structural change that is socially acceptable and economically favorable. The promotion of education, training and the adoption of new, efficiency enhancing technologies should have the highest priorities.

5.1.2 Priorities in data and information gaps

In Austria there is a very unsymmetrical state of knowledge about agri-environmental indicators. The status of water be it groundwater or surface water is very well known and reported regularly in an easily accessible manner. However, the status of indicators that are closely related like the nutrient balance on field plots is practically unknown to the public. The farmers know their farm balances and many of them even know it at the plot level. But this information is not collected and not even made available for evaluation studies. Therefore it is very hard - even from a conceptual point of view - to evaluate the (cost-)effectiveness of policy measures aiming at reducing the environmental foot print of farming in Austria. The highest priority in data and information gaps is to systematically collect the information farmers in Austria have already. This information should be made available for effectiveness and efficiency analyses.

5.1.3 Consequences for water related policy goals

From an economic point of view water quality goals should not be questioned but they have to be taken as they are given because they are based on a social consensus made in the national and Länder parliaments.

However, cost-effectiveness is an economic topic. Better information about how different farmers respond to economic incentives and what effects they have on nutrient balances and water quality enhancing practices is essential. Water related policy goals therefore should not only be focused on achieving target values of chemical concentration but should simultaneously have cost-effectiveness as an equally important goal.

5.1.4 Consequences for policy instruments in place

Given the lack of information and the resulting lack of knowledge about the cost-effectiveness of measure in Austria it is very hard to identify prudent recommendations for consequences for policy instruments in place. A conclusion in the previous chapters was that due to economic factors and because of climate change mitigation efforts it is likely that unfavorable pressure on the good status of water quality will not increase but more likely decline. Such a prospect is a good precondition to motivate farmers to provide the information they have. Because they need not to fear that more costly regulations will be imposed on them. Better information will make it possible to design more effective and less costly measures that contribute to a better status of water quality in Austria.

5.2 Bosnia and Herzegovina

5.2.1 Challenges for policy making

Agriculture will remain the most important economic activity in rural areas. BiH harmonization of the legislation with the EU regulations is under process but the changes in the implementation of agricultural policy and water management issues are slow. Adoption of the Rural Development Programme for Bosnia and Herzegovina will be basis for the applications of pre accession funds.

There is a need for a capacity building in strengthening agricultural research institutions for the purpose of monitoring the environmental impacts of agriculture and establishment of efficient extension service which promote Good Agricultural Practice

5.2.2 Priorities in data and information gaps

There is a need for establishing monitoring and evaluation system and conducting of Farm Structure Survey. That is crucial for obtaining good quality data for agri-environmental indicators.

5.2.3 Consequences for water related policy goals

The improvement of existing and the adoption of new agriculture and environmental legislation is crucial in the process of accession to the European Union. BiH will have to adopt country wide strategic documents which will be a basis for the introduction of agri environmental measures. If this can be achieved, the implementation of various measures will have positive impacts on the proper use of fertilizers, pesticides and irrigation water. The investments on manure storage facilities on agricultural holdings will improve the situation on disposal of animal waste.

5.3 Bulgaria

5.3.1 Challenges for policy making

In Bulgaria, challenges for policy making are related to many factors as: Climate change, socio-economic factors and technological developments.

Climate change is only one driver among many that will shape agriculture and rural areas in future decades. As well, socio-economic factors and technological developments will need to be considered alongside agro-climatic changes to determine future trends[1] in the Bulgarian agriculture. Some studies[2] concluded that socio-economic assumptions have a much greater effect on the scenario results of future changes in agricultural production and land use then the climate scenarios.

Important challenges are related to optimization of soil treatment and phytosanitary measures. Some of the directions to be taking in case of soil treatment could be mentioned:

- Optimal dates and terms of sowing of main crops.
- Soil monitoring.
- Measures for improvement of the water content in soils.
- Measures to improve the soil structure and performance.
- Actions against erosion and for better nutrition mode.
- Up-to-date technologies in soil treatment that keep soil water and structure.
- Effective use of mineral fertilizers relevant to the soils diversity.
- Overcoming of the misbalance of the main nutrients and normalization of the mineral/organic fertilizers ratio.

Many practices, that were used in the past in Bulgaria, such as conservation tilling, furrow diking, terracing, contouring, and planting vegetation to act as windbreaks, will protect fields from water and wind erosion and can help retain moisture by reducing evaporation and increasing water infiltration.

In the case of phytosanitary there are significant challenges:

- Development of special sub-models incorporated into models of agroecosystems which simulate plant-protection situations, related to climate change.
- Assessment of already used pesticides and the way of their utilization and potential effectiveness of the chemical method against crop diseases and pests.

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[1] For instance, the European population is expected to decline by about 8% over the period from 2000 to 2030. As well the agricultural land in Europe has already diminished by about 13% in the 40 years since 1960

[2] Jacqueline de Chazal, Mark D.A. Rounsevell., Land-use and climate change within assessments of biodiversity change: A review., Global Environmental Change 19 (2009) 306–315

- Improving technologies for plant protection and priority development of nonchemical methods against crop diseases and pests.
- Improving the monitoring for the phytosanitary situation in the country.

In Bulgaria, the state of environment is likely to improve in the future as requirements will become more stringent. On the other hand, the cost of applying these regulations will be higher and higher. In these circumstances, it is not certain that small farmers will have enough financial sources to comply. Some small niches as bio-products and regional specialities will provide some extra revenues but this will not be a match for large scale agriculture.

As regarding the environmental indicators, could be noticed important improvement due to reduction of chemical fertilisers. In Bulgaria is applied one of the lowest rate of fertilizer/ha in EU.

5.3.2 Priorities in data and information gaps

In Bulgaria, the data on nutrients load are scarce.

There is missing information regarding nutrient balance for different plots of land that sustain large animal flocs or there are deposits of stable garbage.

Another field where are information gaps is related to efficiency and effectiveness. In practice, it is well known the cost of measures that are included in various budgets but the monitoring and evaluation of effects is very limited. This is why it is not possible to estimate the cost-efficiency and to compare among themselves various measures.

It is necessary to devise a methodology to estimate the efficiency (ex-post) and to see which measure has the highest cost-efficiency. This indicator could be used in planning process to allocate money available.

5.3.3 Consequences for water related policy goals

The consequences for water related policy goals are those derived from Water Framework Directive and Water Law. So far, from the research on the internet, were found limited amount of information about cost effectiveness. The main practice was to focus on expenditures assuming if the money was spent the goals will materialise automatically, which is not the case in many instances. The EU acquis on environment will be the driving force in this respect and, as many reports show, the quality of waters has improved in Bulgaria.

Pricing policy for water and agricultural crops

In the scenario of reducing population of Bulgaria and increasing temperatures a pricing policy is needed.

The sustainable growth of agricultural production in Bulgaria should be given one of the highest priorities among all national development programs. Pricing policy can also be used to steer agriculture in a direction more adaptive to climate change. Using pricing policy, the government could make the national agriculture relatively adaptable to climate change.

5.3.4 Consequences for policy instruments in place; adaptation strategies

Due to climate change and temperature increase, some adaptation strategies should be devised.

Several other measures can be taken to reduce the vulnerability of Bulgarian agriculture to climate change, such as changes in types of crops and soil optimization. Other challenges are:

- New zoning of the agroclimatic resources and agricultural crops.
- Expanding areas of the most important agricultural crops over new regions characterized by improved thermal and moisture conditions.
- Utilization of a variety of cultivars and hybrids, especially long-maturing, high-productive cultivars and hybrids with better industrial qualities.
- Cultivation of new agricultural crops grown with Mediterranean origin.
- New horticultural variety and hybrids to be adapted to climate change.

The new horticultural variety of winter crops will have to pass through the winter season organogenesis under higher temperatures without deviations from the normal crop growth and development.

As well, the new horticultural variety and hybrids has to be with higher dry-resistance, especially at the end of the vegetative period and at the beginning of the reproductive period.

It is important that higher maximum air temperatures would not to provoke thermal stress effects, especially during crop flowering and formation of the reproductive organs.

The new cultivars and hybrids would have to grow and photosynthesis under an increased concentration of carbon dioxide.

Crop diversification would allow farmers to cope with climate variation from year to year. The climate in southern Bulgaria is influenced by the Mediterranean. Warming may cause a natural northward shift of some agricultural crops and trees grown in the upper areas of neighboring countries such as Greece, Turkey, and so forth.

5.4 Croatia

5.4.1 Challenges for policy making

Croatia has to continue the transposition of the Urban Waste Water Treatment directive in Croatia. Croatia made significant progress in reaching conformity; still some legislatives amendments will be necessary to fully align the national legislation with the Directive.

5.4.2 Priorities in data and information gaps

In Croatia there is a lack of knowledge about agri-environmental indicators. There is a need of systematic and long-term collecting the necessary data, not only to get quality and timely follow trends of agricultural influence on the environment but also for better policy programming. Consequences for water related policy goalsAccording to the EU Environmental Implementation Review Croatia could do a more detailed assessment of pressures to improve monitoring to know the status of water bodies and design effective Programmes of Measures that address all the main pressures identified. Prompt implementation of projects necessary for the fulfilment of the requirements of the Accession Treaty with respect to Urban Waste Water TreatmentDirective and Drinking Water Directive.

5.4.3 Consequences for policy instruments in place

In the field of water quality, a transitional period was provided by the end of 2023 as the deadline for the construction of sewerage systems. For drinking water, a transitional period in terms of microbiological indicators is provided by the end of 2018, and as a Member State, Croatia will request an additional extension of the deadline for achieving the prescribed chemical parameters three years after EU accession. According to the European Commission's estimates it is expected that for the implementation of the Nitrates Directive, Croatian agricultural producers had to invest at least 125 million € in the first four year after the accession to the EU.

5.5 Czech Republic

5.5.1 Challenges for policy making

Agricultural nutrient pollution in surface water and ground water is relatively high in the Czech Republic, i.e. 54% of the surface water body is failing to achieve good status due to high concentrations of N and P which are predominantly emitted by agriculture. A substantial increase in fertilizer use has been observed recently such that the contribution of the agricultural sector to nitrogen leaching into water bodies is increasing. The management of nutrients, and, in particular, financial support for manure storage facilities, for monitoring stations of water quality and compensation for organic farming (in the early phase) seem to represent major challenges for policy making. Financing investments into sustainable agricultural technologies and management practices may thus require innovative financing approaches that may complement public support schemes. For instance, the Nordic Environment Finance Corporation (NEFCO), an international financial institution that offers green financing to small and medium-sized projects with demonstration value may a viable approach for Eastern Europe.

There is some indication that the development of organic farming was a success story but recent developments need to be assessed and further support is probably needed in order to proceed with the Action Plan on organic farming.

5.5.2 Priorities in data and information gaps

Data on monitoring the water quality must be enhanced. In particular, data are needed that are more up-to-date (than 2006) and geographically more explicit so that data with respect to the relevant Czech DRB regions may be specifically synthesized. The knowledge of average data for the Czech Republic is not sufficient to derive recommendations for a sustainable management of the Danube River Basin area. The literature mentions an elaborate system of nitrates and phosphorous monitoring. Thus a straightforward evaluation of the situation in the DRB management area should not be a problem. The same holds for specific measures taken in the different agricultural and agri-environmental programs (CAP, RDP, Action plan on organic farming). There is thus no specific information on the status of the Czech water bodies in the DRB region and the status of the agricultural sector.

5.5.3 Consequences for water related policy goals

Water related policies and objectives as formulated in different EU Directives and other legislation are important elements in a strategy that secures healthy drinking water quality and other ecosystem services that derive from a good quality in surface waters. Different statutory thresholds for nitrogen and phosphorous should thus be achieved.

5.5.4 Consequences for policy instruments in place

Due to the heterogeneity of agricultural regions in the Danube River Basin, policy measures and economic instruments to reduce run-off of nutrients from the fields should be specified according to regional backgrounds. This includes compulsory legal requirements as well as voluntary advisory services and agri-environment measures including economic compensations and incentives. It appears that few large holdings based on former collectivized farms, mostly situated in favorable areas, may represent a point of reference for sound agro-environmental production.

Generally, Best Environmental Practice (BEP) and Best Available Techniques (BAT) are two approaches to reduce undesirable pollutions from agricultural activities. Fertilizer application (legislation, implementation, education), reduced fertilizer input and financial compensation of the farmers are powerful measure to reduce nutrient emissions but very unlikely to be implemented by farmers without incentives or financial compensation.

To ensure that manure is not produced in excess to the amount of agricultural land available for manure spreading there must be a balance between the number of animals on the farm and the amount of land available for spreading manure. To be environmentally effective, this balance must be achieved in practice at site level and not only at farm level on paper.

Further efforts are necessary to evaluate the effectiveness of different measures in order to detect those with the best cost-effectiveness ratio at a local/regional scale.

5.6 Germany

5.6.1 Challenges for policy making

The challenges in the field of nitrogen pollution were discussed in detail in a report by the Environment Ministry in 2017 (BMUNBR, 2017). The report first of all draws attention to the significant achievements in reducing emissions over the last two decades. Nitrogen emissions fell by about 40% in 1995 and 2010. Nevertheless, 1.6 million tonnes of nitrogen compounds were released into the environment per year in the reference period 2005-2010. The share of agriculture was 63%. In the course of implementing environmental policy, limit values for water, air and soil or emission values and technical standards were laid down. The Fertilizer Ordinance in particular has a regulating effect on the quantity of nitrogen compounds from agriculture in water and soil.
According to the German Sustainability Strategy, it is a priority objective to reduce the nitrogen surplus in agriculture to 70 kg per hectare in the target period 2028-2030. Ammonia and nitrogen oxides are also to be reduced.

According to estimates (LAWA, 2014), the amended Fertiliser Ordinance will contribute to reducing agricultural emissions by 15%. Such a lowering is necessary in order to achieve the good status of the water bodies. Another aim of the agricultural policy is to increase the share of organic farming to 20% of agricultural land (6.8% at present). Another objective of the German Federal Government is to reduce wasted food. The lower material throughput also reduces the load potential.

The challenges in the area of exposure to plant protection products have been identified in a recent report by the Council of Environmental Experts (SRU, 2016). Several approaches have been presented to prevent unwanted release into the environment.

The SRU recommends the introduction of a levy on plant protection products. This generates financial resources to expand monitoring, consulting and further measures. In addition, a levy can have a steering effect and lead to an overall reduction in the use of pesticides. If the levy rates are differentiated accordingly, it can also contribute to the substitution of products with high risk potential.

Refuges and buffer zones must be created which are free of any pesticides. These include, for example, waterfront strips and flowering strips at the edges of fields. It is urgent to clarify whether the establishment of such ecological compensation areas can be established by imposing conditions on the use of plant protection products. In addition, such areas can be created through agri-environmental and climate protection measures and through environmental requirements within the framework of European direct payments for agricultural land (so-called greening).

5.6.2 Priorities in data and information gaps

A necessary prerequisite for tackling the challenges is the elimination of knowledge deficits. The new fertilizer ordinance will has provisions that will make monitoring and information collection more effective.

With respect to plant protection substances more needs to be done according to SRU (2016). Both the application data that professional users are required to maintain in accordance with the Crop Protection Act and data obtained within the framework of statutory statistical surveys should be made available to the competent authorities on a regular basis. The aim should be a systematic and spatially differentiated collection of application data. A programme for monitoring the exposure of small water bodies to pesticides should be established. A comprehensive biodiversity monitoring system should also be set up in order to identify changes in the environment more quickly.

5.6.3 Consequences for an policy integrating agriculture and environment

According to the views of the SRU (2016), the obstacles to the ecological transformation of the agricultural sector are currently great. There is no shared vision for this. The actors who define the political model are rather sceptical about an ecological reform and the scope for other constructive groups of actors to participate is too small. There is a clear asymmetry between the influence of some production interests and the protection interests.

Publicly financed support measures can increase the shares of a relatively environmentally friendly agriculture. This in turn brings with it further innovations and strengthens reform-oriented constellations of actors (as observed in other areas. The transfer of innovative approaches from research to practice is also the aim of the "European Innovation Partnership on Agricultural Productivity and Production" launched in 2012.

Political reform projects, such as the amended fertiliser ordinance, the review of the greening of the common agricultural policy or changes in the air pollution control policy, require actors in the sector to deal with new solutions. At the same time, the state should give much greater support to those actors whose economic practices already implement environmental compatibility beyond the legal minimum, and who are thus among the pioneers of the sector. The promotion of organic farming is an example of this.

For an effective integration of environmental concerns into the practice of farming, the conditions must be created for environmental actors to be able to play a greater role, particularly in the direction of European agricultural policy and legislation. Institutional conditions must also be created for this. For example, consideration should be given to strengthening the right of the Environment Ministry to participate in shaping agricultural policy issues of considerable ecological significance. The SRU (2016) proposes to grant the Ministry of the Environment a suspensive right of appeal in the cabinet when it comes to such matters. In its special report, the SRU discussed several organisational and institutional options for strengthening environmental concerns in political decision-making processes in the context of its proposal for a nitrogen strategy (SRU, 2015). In many cases, these can be transferred to the wider agricultural and agri-environmental policy. The ultimate aim should be to integrate the content of the policy in such a way that ecological aspects are always taken into account in agricultural policy.

5.7 Hungary

Hungarian agriculture was a prosperous sector of the economy prior to the transition. The privatization of land and the loss of its major markets made it vulnerable. Its production shrank, it became more extensive and profitability decreased. Profitability improved only due to EU subsidies provided after the accession. The food industry became dominated by transnational firms. However, many of them have shut down their Hungarian branches recently, owing to other orientations and changing EU rules. The agricultural trade balance is still positive but the share of unprocessed products and grain is growing in the exports. Earlier, animals and animal products, fresh and processed vegetables and fruits made up the major part of exports. It is a promising sign that the concentration of farm holdings is advancing. Large corporate and individual farms produce the bulk of the traded products. Unfortunately, only rarely do small farms cooperate for the sake of increasing their efficiency and trade opportunities. Hopefully, the lifting of restrictions in the near future relating to the selling and buying of land will promote concentration.

In Hungary, the agricultural area has decreased with 1.7 million ha in the period 1960-2015. The agricultural area was mostly taken up by arable land (82.3%) and grassland and meadows (14%).

The ownership of the land in Hungary registered a significant concentration in the period 2000-2010 (576,790 agricultural holdings were recorded in Hungary, in 2010). In this period, about 390,000 farms ceased their activities (–40.3%). As the number of holdings decreased and the agricultural land increased, the average size of the holdings grew: it almost doubled, from 4.7 ha per farm in 2000 to 8 ha in 2010.

The Hungarian farm animal population was about 2.5 million livestock units (LSU) in 2010: compared to 2000, a 20 % decrease was observed (–613,750 LSU). This translates to 0.25 LSU per person, an average value among survey countries.

The economic size of the Hungarian agricultural holdings reached 5,237 million € in 2010.

The biggest size class, agricultural holdings with 500,000 € or more of standard output, proved to be by far the most important, as it accounted for 43% of the Hungarian standard output in 2010: +3.8% compared to 2007.

From among the Hungarian regions, the Southern Great Plain recorded the highest value (1,389 million €), corresponding to 26 % of the Hungarian standard output. The Northern Great Plain (1.167 million €) was found to account for 22.3 %; the territory of "Del-Dunántúl" recorded the third highest share (14.5 %), followed by the neighbouring regions of "Nyugat-Dunántúl" (11.7 %) and "Közép-Dunántúl" (11.6 %).

As regarding fertilizers, in the period 2000-2016, it was recorded an increase of quantity administered from 61 kg/ha to 103 kg/ha. In 2016, it was recorder a quantity of 554,000 tons of fertiliser sold compared with 355,000 tons in 2000. Gross input of organic fertiliser (manure) was constant in the analysed period (139.853 tons).

5.8 Moldova

The Republic of Moldova has unique land resources characterized by predominant black earth soils with high productivity potential and very high utilization rate (>75%), and a rugged topography (above 80% of the total arable land is located on hill slopes). The agricultural land area is 74.0% of the Republic of Moldova's total available land. The arable land area is 53.8% of the total available land. Only 13% of the arable land in Moldova is irrigated. Irrigation is difficult because of inappropriate water quality and the need for pumping, making irrigation too expensive. As a consequence, the costs of irrigation often exceed its potential benefits. This makes the agriculture sector highly dependent on natural precipitation. Moldova could serve as a model example of a non-irrigated agriculture-crop response to the increasing drought tendency in southeastern Europe.

Due to its overwhelming dependence on climate conditions, agriculture is the most vulnerable sector of the Moldovan economy to climate change. Climate volatility is one of the main causes of unstable harvests and is an inherent risk of Moldovan agriculture. However, a number of macroeconomic and structural evolutions have also determined the current depressed state of agriculture. Among these factors the most important are: the growing share of subsistence farming at the expense of commercial farming; an inefficient system of agricultural subsidies; lack of investment funds; excessive fragmentation of farming land; and an outdated irrigation system that was costly and with significant water losses.

The risk of overwintering and summer crops in Moldova being exposed to severe drought during their growing cycle is increasing. This is an immediate and fundamental problem, because the majority of the rural population depends either directly or indirectly on agriculture for their livelihoods.

5.9 Romania

5.9.1 Challenges for policy making

In Romania, challenges for policy making are related to the significant fragmentation of the agricultural land, dray periods in summer, lack of irrigations, low revenues for farmers, lack of investment in research. Poverty is higher in rural areas compared with urban areas. Negative effects are particularly felt by small farms. The lack of adequate subsidies, compared to those in other European countries, the impossibility of investing, exposes domestic farms, especially small ones, to the risk of default.

An important step ahead, in Romanian agriculture, is the CAP of the EU. This has provided money to farmers while important environmental friendly practices were promoted. The PDR, despite the fact that was modified 19 times in 9 years, provided a clear direction for development.

The state of environment is likely to improve in the future as requirements will become more stringent. On the other hand, the cost of applying these regulations will be high and it is not certain that small farmers will have enough financial sources and will to conform. Some small niches as bio-products will provide some extra revenues but this will not be a match for large scale agriculture.

As regarding the environmental indicators, could be noticed important improvement due to reduction of chemical fertilizers. In Romania is applied one of the lowest rate of fertilizer/ha in EU.

The EU acquis on environment will be the driving force in this respect and, as many reports show, the quality of waters has improved in Romania.

5.9.2 Priorities in data and information gaps

In Romania, the data on nutrients load are scarce. ANAR publishes regular reports on water quality (surface waters and underground waters).

There is missing information regarding nutrient balance for different plots of land that sustain large animal flocs or there are deposits of stable garbage.

Another field where are information gaps is related to efficiency and effectiveness. In practice, it is well known the cost of measures that are included in various budgets but the monitoring and evaluation of effects is very limited. This is why it is not possible to estimate the cost-efficiency and to compare among themselves various measures.

It is necessary to devise a methodology to estimate the efficiency (ex-post) and to see which measure has the highest cost-efficiency. This indicator could be used in planning process to allocate money available.

5.9.3 Consequences for water related policy goals

The consequences for water related policy goals are those derived from Water Framework Directive and Water Law. So far there are only some mentions of cost effectiveness but not clear rules on how to apply it. The current practice was to focus on expenditures assuming if the money was spent the goals will materialize automatically, which is not the case in many instances.

5.9.4 Consequences for policy instruments in place

The existing policy instruments that are in place are likely to remain unchanged. There are not significant driving forces to alter them significantly. As the existing paradigm is focusing on individual projects and expenditures and not on strategies and outcomes it is not likely to have significant changes towards eco-efficiency and efficacy.

In Romania, challenges for policy making are related to financing sources as well. As it was said, measures to comply with Nitrates Directive were financed with a loan from World Bank. The first loan was of 126 million € and the extension of the loan was 48 million €. The second phase of the loan will cover the period 2017-2020. The fact that Romania is taking a loan from World Bank shows the lack of resources to address the nitrates issues. It is not clear how the facilities that have been constructed will be operated after reception.

5.10 Serbia

5.10.1 Challenges for policy making

Implementation of the EU Nitrate Directive will be important for Serbia's EU integration and will require considerable investments, including IPARD funds once available. Budget support may be needed to sustain long-term water and soil quality monitoring in intervention areas. Project outcomes—including the demonstrated cost-effective ways to reduce nutrient runoff and the strengthened capacity of agricultural advisors and farmers to prepare and implement Nutrient Management Plans and prepare to implement the Nitrate Directive can be replicated in other parts of Serbia. This can be seen in the continued investment interest in environmentally sustainable agriculture, including in new areas such as biogas production, even after the project closed. The effective implementation of the Nitrate Directive can also have important benefits for public health through improvement in air quality and moderating the effects of climate change, since the poor management of animal manure is also linked to increased emissions from agriculture.

5.11 Slovakia

5.11.1 Challenges for policy making

The challenge for policy making is to combine and pool different instruments and measures from various programmes (CAP, RDP, Programme for Quality of Environment), i.e. bans on fertilizer use, organic farming, and information and education actions, in a coherent and consistent way towards improving the quality of water bodies and toward risk areas (of water pollution and climate change impacts). The effectiveness of instruments and measures should be monitored on a regular basis (as recommended by the European Court of Auditors). The quality of water should be addressed as a cross-cutting issue.

There is some indication that the development of organic farming was very successful but developments need to be assessed and action be directed to NVZ and zones at risk of hazards from climate change.

5.11.2 Priorities in data and information gaps

The establishment of monitoring sites on nutrient pollution was effective (Holubec et al., 2011). However, regular and rigorous monitoring needs to be enforced. In particular, a comprehensive compilation of geographically referenced data on instruments and measures from different programmes and directives needs to be established and combined with water quality status information, e.g. by a GIS system, in order to effectively monitor the progress in water pollution-related fields and the effectiveness of instruments. This is in particular a prerequisite for a future target-oriented allocation of measures to those areas that are high at risk of water pollution, climate change impacts or other soil-related hazards. The information on fertilizer use needs to be improved.

5.11.3 Consequences for water related policy goals

Water related policies and objectives as formulated in different EU Directives and other legislation are important elements in a strategy that secures healthy drinking water quality and other ecosystem services that derive from a good quality in surface waters. Different statutory thresholds for nitrogen and phosphorous should thus be achieved. The nexus of water issues, climate change impacts and agriculture (food security) needs to be addressed in a comprehensive way. The mainstreaming of water-related issues into other policy areas such as agriculture and land-use is strongly recommended.

5.11.4 Consequences for policy instruments in place

Due to the heterogeneity of geographical zones (mountainous regions versus low-lands), policy measures and agri-economic instruments to reduce run-off of nutrients from the fields should be specified and targeted toward regional backgrounds. This includes compulsory legal requirements as well as voluntary advisory services and agri-environment measures including economic compensations and incentives. It appears that few large holdings based on former collectivized farms, may represent a point of reference for sound agro-environmental production policy. In particular, the coherence or trade-offs of instruments from different programms (CAP and Rural Development Programme) require analysis.

Generally, Best Environmental Practice (BEP) and Best Available Techniques (BAT) are two approaches to reduce undesirable pollutions from agricultural activities. Fertilizer application (legislation, implementation, education), reduced fertilizer input and financial compensation of the farmers are powerful measure to reduce nutrient emissions but very unlikely to be implemented by farmers without incentives or financial compensation.

To ensure that manure is not produced in excess to the amount of agricultural land available for manure spreading there must be a balance between the number of animals on the farm and the amount of land available for spreading manure. To be environmentally effective, this balance must be achieved in practice at site level and not only at farm level on paper.

Further efforts are necessary to evaluate the effectiveness of different measures in order to detect those with the best cost-effectiveness ratio at a local/regional scale. Scaling up organic farming practices may be one issue to be addressed.

5.12 Slovenia

5.12.1 Challenges for policy making

Over the last ten years, Slovenia has established a comprehensive framework of primary environmental legislation and successfully transposed EU environmental directives. According to the OECD (2012) the extent of municipality's autonomy and the absence of regional administrative level have led to an important environmental governance gap between the national and the local level. Despite the small share of agricultural land in Slovenia and progress in reducing pollution from agriculture, further integration of agricultural policies and water management is needed. Several regulatory measures have been introduced to reduce and prevent water pollution by nitrates. They have focused on: periods in which land application of nitrogen is prohibited; rules for fertilizer application on steep slopes and on water-saturated, flooded, frozen or snow covered ground; and rules for fertiliser application in the vicinity of water sources. There is also a need for increased capacity of safe storage of livestock manure that will prevent leaching.

5.12.2 Priorities in data and information gaps

For efficient water management is an essential availability of data about water, water infrastructure, water use and economic issues in a form that would enable analysis to be carried out. According to the review of existing documents, the biggest obstacle remains dispersed governance between different departments. The collected data are scattered and stored in various forms. The Ministry of Environment and spatial planning constantly complement existing databases, which are also publicly available but the further work on gathering the data about water infrastructure will enable the preparation and monitoring of maintenance and investment maintenance plans and long-term investment plans needs to be done.

5.12.3 Consequences for policy instruments in place

The main problem is that it is not possible to evaluate the actual impact of the implementation of the measures on the status of waters. The vast majority of investment and subsidy programs do not monitor their impact on the environment.

5.13 Ukraine

Ukraine, along with Denmark and Moldova, are the only three countries in the world in which arable land represents more than 50% of total land. Given its large size, Ukraine has more arable land than any other country in Europe with 32.5 million hectares. Ukraine's arable land is about 4 times the size of the arable land of Italy, 3 times the arable land of Germany, 6 times the arable land of the UK, and equal to the combined arable lands of France and Spain. This gives Ukraine 0.71 hectares of arable land per capita, compared to only 0.26 ha for the EU-27.

The country is richly endowed with black soil, one of the most fertile soils worldwide. Black soil contains a very high percentage of humus (3% to 15%) along with phosphoric acids, phosphorus, and ammonia. It occupies 41% of Ukraine's total area and even more of its agricultural land (54%), and plow land (58%). In fact, thirty per cent of the world's black soil is in Ukraine. By virtue of its unspoiled soil, Ukraine is also emerging as a major producer of organic food. Already, hundreds of thousands of acres are devoted to organic farming and agricultural officials and outside experts believe that Ukraine can become a major exporter and help satisfy the increasing demand in Western Europe for such products.

Winter wheat is the largest crop in terms of area, dominating 95% of the agricultural land, with central and southern Ukraine being the key production zones. Spring barley is grown in eastern Ukraine and winter barley in the south

Anyhow, the area of the Danube River Basin in Ukraine (rivers basin Prut, Tisa and Siret) is situated in the mountains and do not share the same characteristics with the big Ukrainian plains.

5.13.1 Vulnerabilities in Ukraine.

Winter barley is not cold tolerant and as temperatures rise it is likely that its habitable zone will expand northwards, as long as soil conditions, light levels and water availability are adequate. Roughly 5% of grains and 10% of potatoes, vegetables and forage crops in Ukraine are irrigated. As summer temperatures rise and rainfall decreases, the need for irrigation may increase. Large increases in the yield of rain-fed winter wheat have been projected for northern Europe in the future, with smaller increases further south. With decreases in frost days predicted, winter wheat crops, which are particularly susceptible to frost damage, are more likely to survive in to spring. The zone of assured winter wheat cultivation will probably move in the direction of northern latitudes, on the territories of western Polyssia and right-bank Forest-steppe.

Conditions will become more favourable for crops such as barley, oat, corn, and legumes, as well as green fodder. This will stimulate the forming of intensive dairy cattle production and meat livestock production.

6 Concluding remarks and outlook

The future of agricultural emission in the DRB and the cost to reduce them crucially depend on the development of international agricultural markets. Forecasts for the next decade to come are made annually by OECD and FAO (2017). In it's most recent report the key messages are:

- Over the ten-year outlook period, agricultural markets are projected to remain weak.
- Future growth in crop production will be attained mostly by increasing yields, and growth in meat and dairy production.
- Agricultural trade is expected to grow more slowly, but remain less sensitive to weak economic conditions than other sectors.
- Real prices are expected to remain flat or decline for most commodities.

These are bad news for farmers but good ones for those who are environmentally concerned. Low prices are usually a signal to reduce the intensity of production and to use less inputs. But there is a catch. When farming becomes less profitable, investments in better equipment and more productive technologies are not made. Therefore the environmental outcomes may be ambiguous and depend on the current state of technology.

Based on recent scenario analyses carried out with the model CAPRI (www.capri-model.org) it is possible to make assessments of the environmental consequences of such a scenario. For the project MACSUR a team of researchers in Bonn and Sevilla compared the base-line situation in 2015 with a base-run simulation for the year 2030. In the scenario the assumption was made that policies will not change and that climate change does not take place. However, prices change because higher demand and higher productivity in agriculture will make a new equilibrium. The results confirm the judgement of OECD and FAO. Agricultural production in the regions of the DRB is likely to become less intensive. This will bring about less emission if the scenario assumptions turn out to materialise in the reality (detailed results are provided in the Annex).

Such perspectives should not be understood in such a way that nothing needs to be done. On the contrary, market conditions are supporting efforts to reach an environmental goal are good news because a better environmental status can be reached at lower cost and may even earlier be reached than anticipated a few years ago.

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Appendix

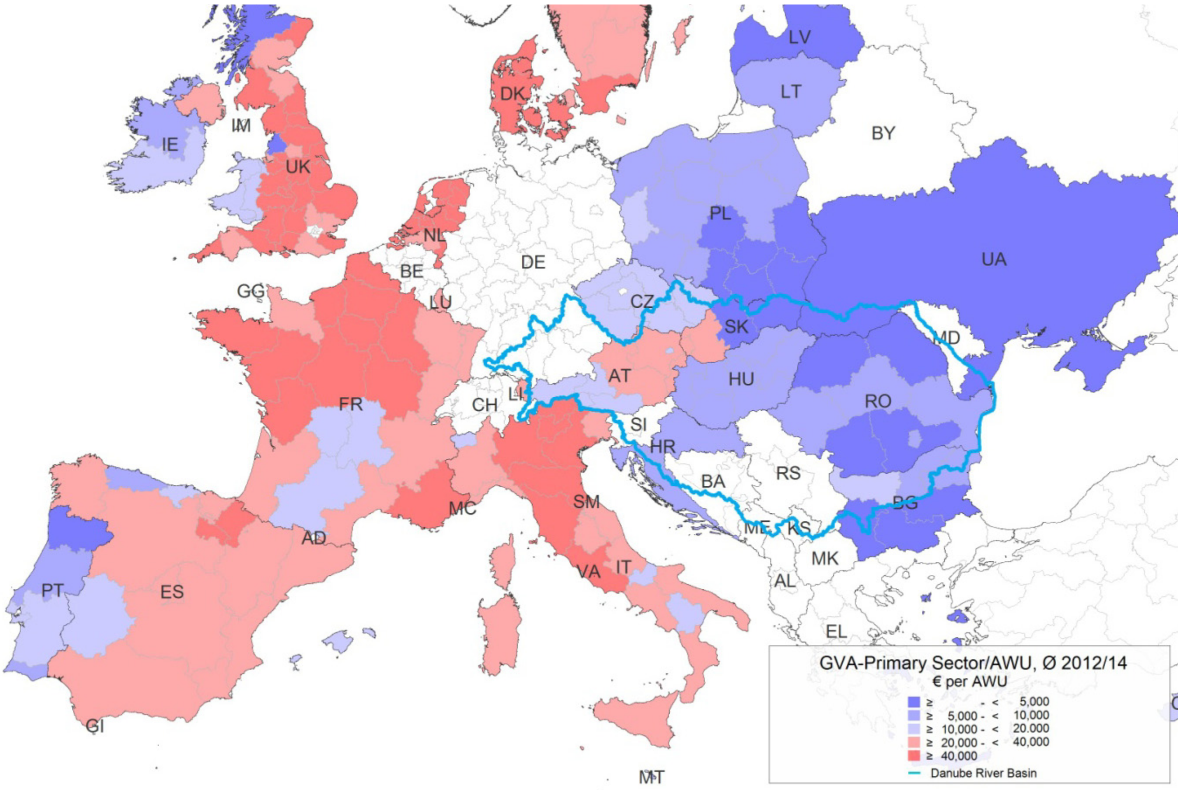

Figure 9: Gross value added (GVA) at basic prices of Primary Sector (Agriculture, forestry and fishing) per Annual Working Unit (AWU), Ø 2012/14

Source: EUROSTAT, Gross value added and income by A*10 industry breakdowns. Data online code [nama_10_a10].

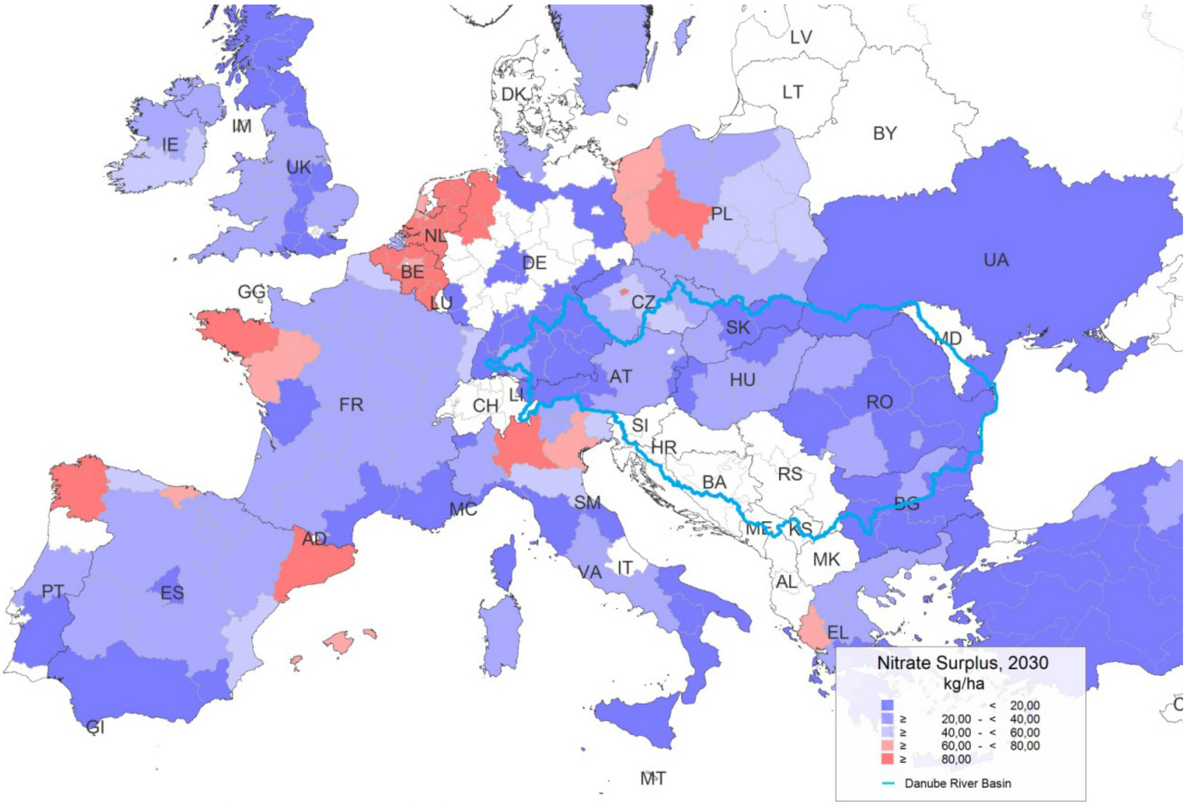

Figure 10: Nitrate Surplus in kg per hectare Utilized Agricultural Area (UAA), 2030

Source: CAPRI Model.

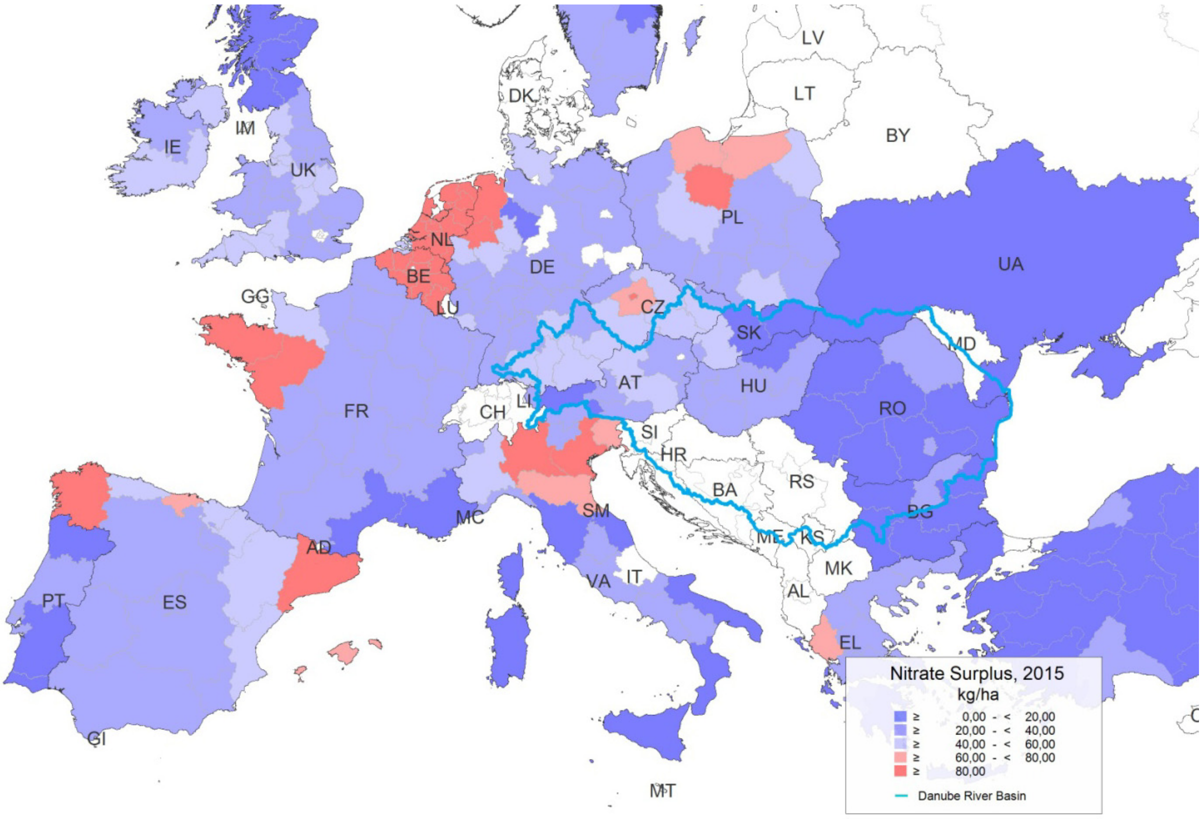

Figure 11: Nitrate Surplus in kg per hectare Utilized Agricultural Area (UAA), 2015

Source: CAPRI Model.

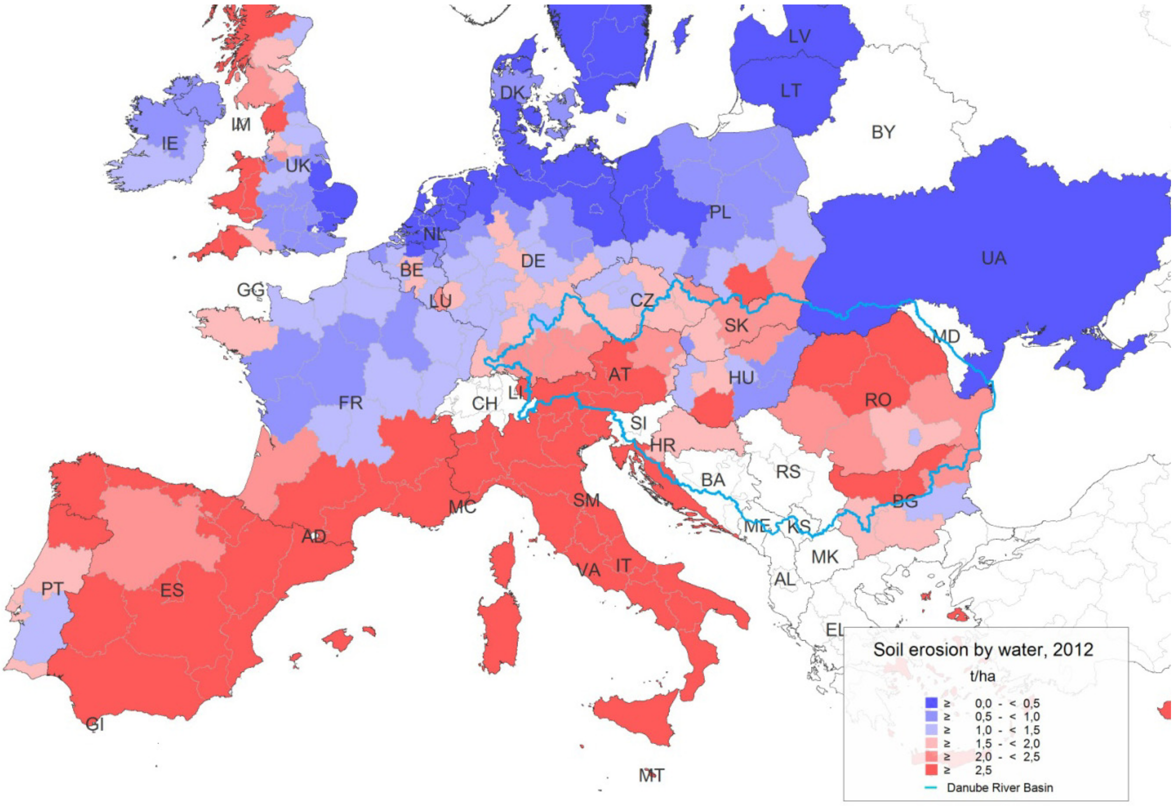

Figure 12: Estimated soil erosion by water, 2012

Source: Eurostat, Estimated soil erosion by water, by Nuts 3-Regions (source: JRC). Data Online Code [aei_pr_soiler]

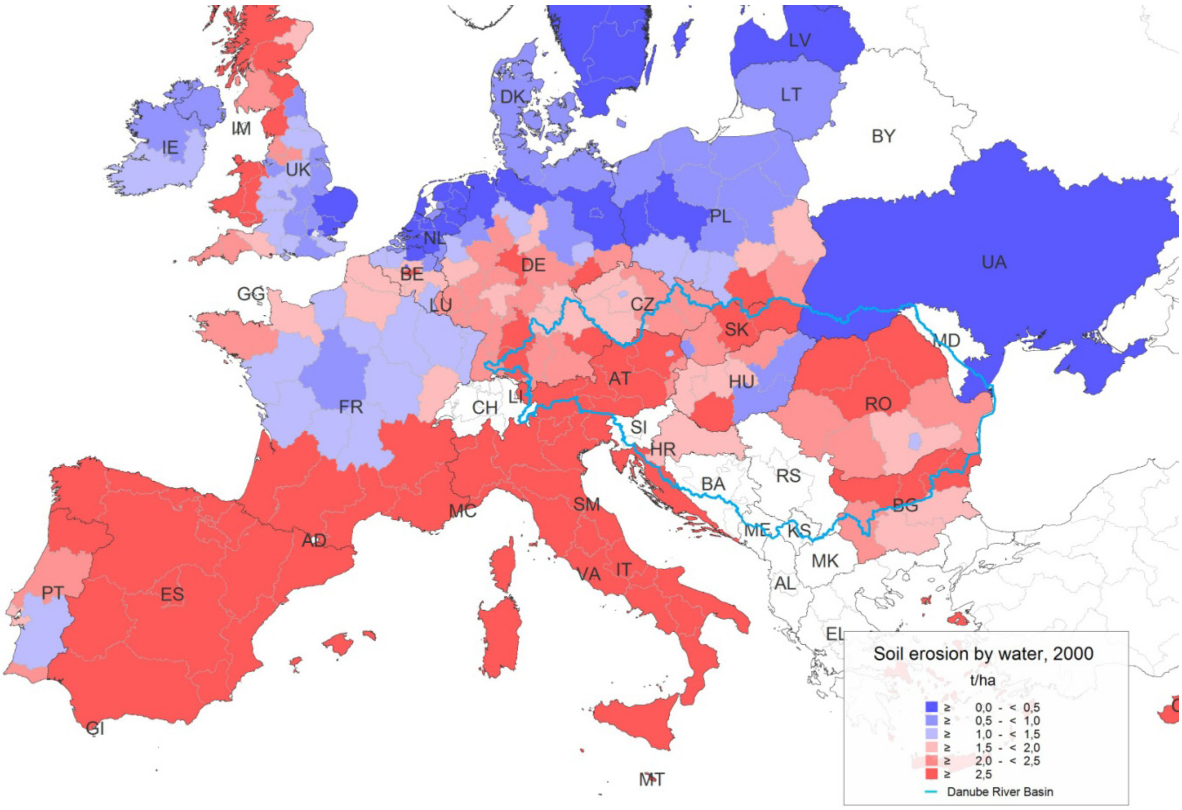

Figure 13: Estimated soil erosion by water, 2000

Source: Eurostat, Estimated soil erosion by water, by Nuts 3-Regions (source: JRC). Data Online Code [aei_pr_soiler]

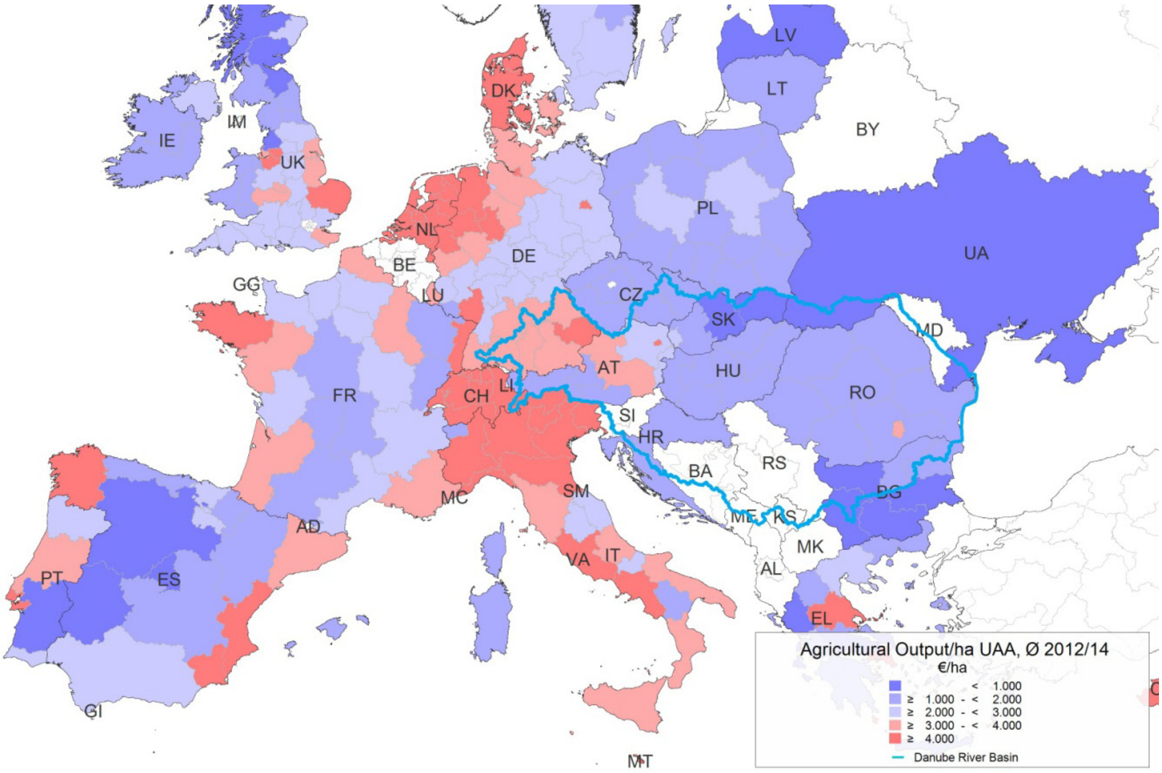

Figure 14: Output of the agricultural industry at basic prices per ha Utilized Agricultural Area (UAA), Ø 2012/14

Source: Eurostat, Key farm variables: area, livestock (LSU), labour force and standard output (SO) by agricultural size of farm (UAA), legal status of holdings and Nuts 2-Regions. Data online code [ef_kvaareg]. Eurostat, Economic Accounts for Agriculture by Nuts 2-Regions. Data online code [agr_r_accts]. Data extracted June 2017.

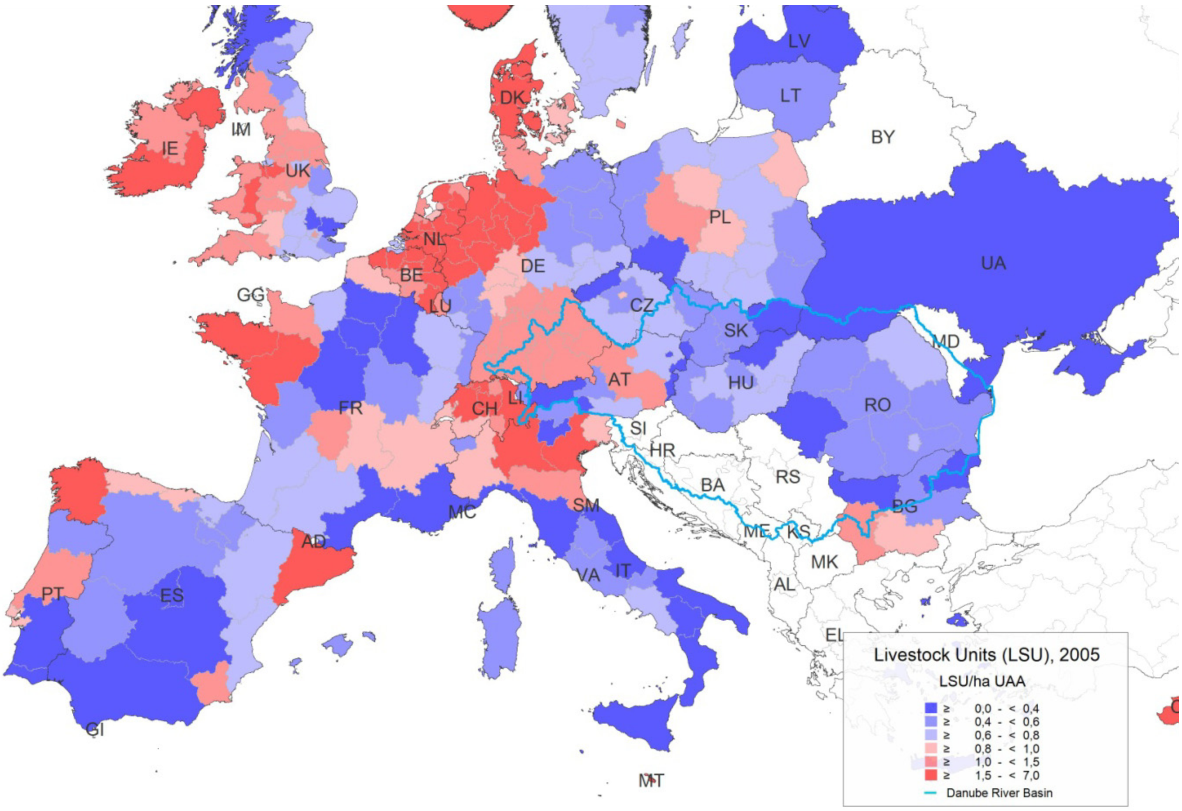

Figure 15: Livestock Units (LSU) per ha Utilized Agricultural Area (UAA), 2005

Source: Eurostat, Number of farm and heads of animals by livestock units (LSU) of farm and Nuts 2-Regions. Data online code [ef_olslsureg]. Data extracted June 2017. Note: Data for Germany Nuts 1.

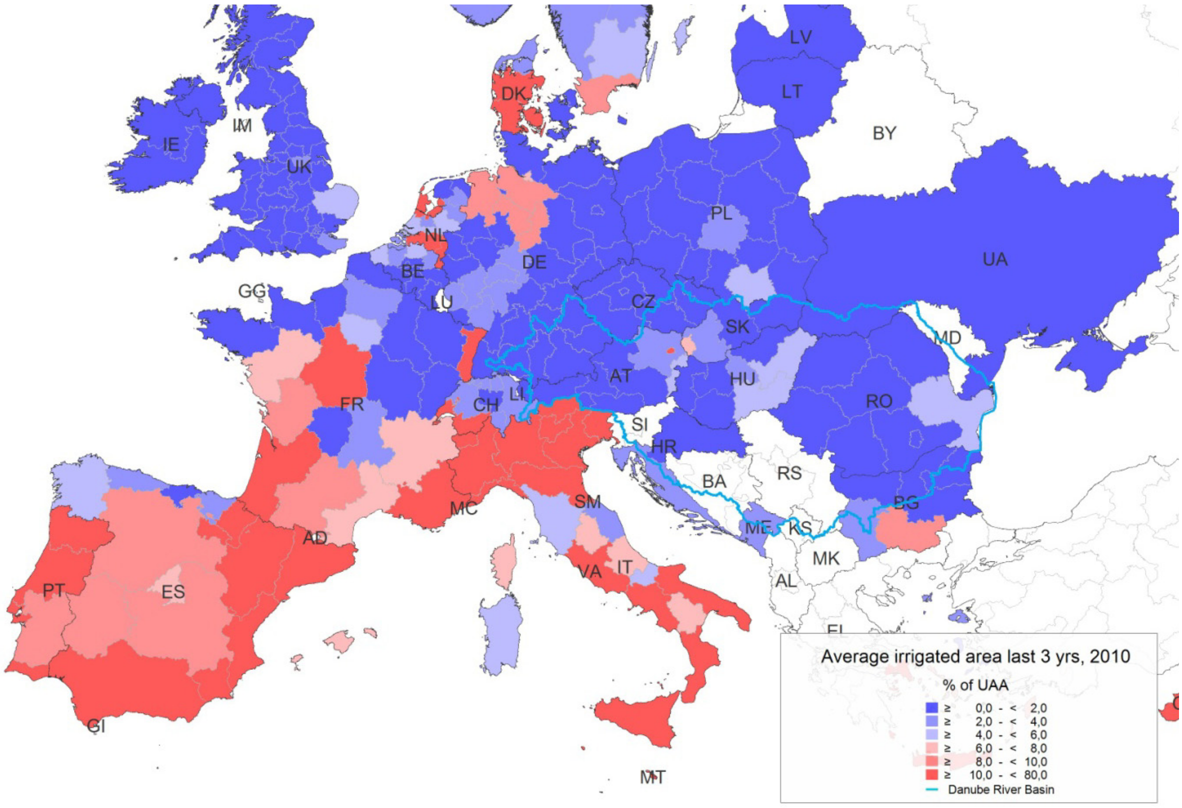

Figure 16: Average Area Irrigated in the last 3 years, 2010

Source: Eurostat, Irrigation: number of farms, areas and equipment by size of irrigated area and Nuts 2-Regions. Data online code [ed_poirrig]. Data extracted June 2017.

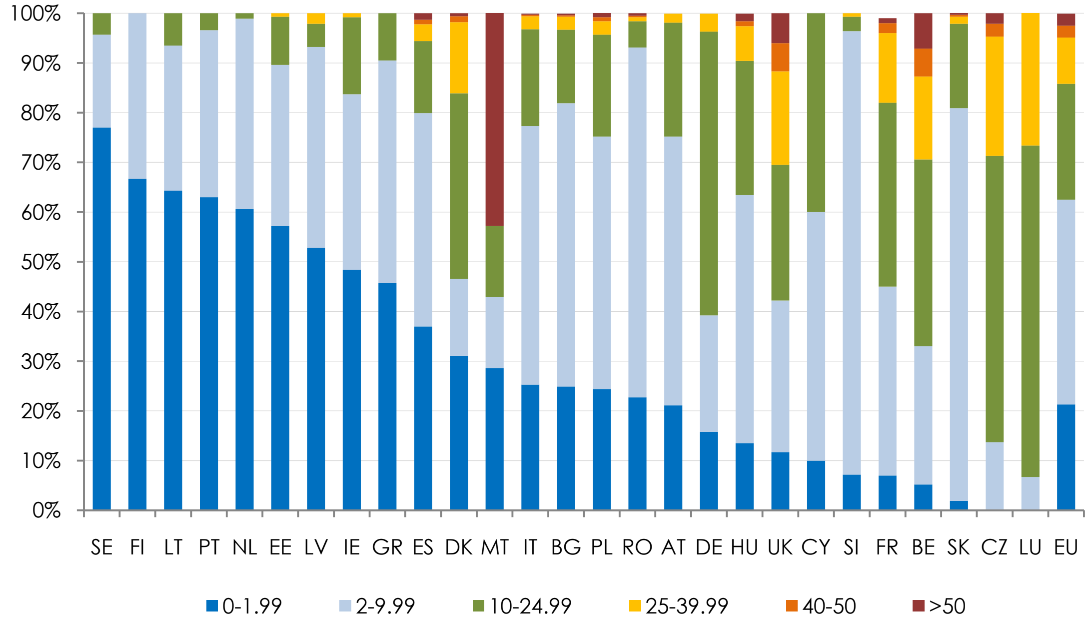

Figure 17: Frequency diagram of average nitrate concentrations in fresh surface water classes (annual average nitrate concentrations)

Percentage of points per water quality class (annual average nitrate concentration) for river and lake stations for the period 2008-2011

Source: European Commission, Document No. SWD(2013) 405 final. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52013SC0405.

Table 14: CAPRI-Results Population und Income in the Danube River Basin Countries, 2030 versus 2015

		Population		Total income
		2015	2030/15	2030/15
Country		million	%	%
AL	Albania	2.88	– 4.5	+ 64.4
AT	Austria	8.46	+ 10.6	+ 62.6
BA	Bosnia and Herzegovina	3.83	– 12.6	+ 70.4
BG	Bulgaria	7.30	– 13.7	+ 18.1
HR	Croatia	4.29	– 6.2	+ 25.6
CZ	Czech Republic	10.55	+ 2.1	+ 25.5
DE	Germany	80.48	– 1.3	+ 61.7
HU	Hungary	9.96	– 2.8	+ 43.9
IT	Italy	59.74	+ 8.0	+ 41.0
MK	Macedonia	2.07	– 14.3	+ 91.4
MD	Moldova	.	.	.
ME	Montenegro	0.62	– 9.9	+ 32.5
PL	Poland	38.61	– 2.4	+ 91.8
RO	Romania	19.94	– 6.3	+ 9.1
RS	Serbia	7.10	– 7.2	+ 265.5
SK	Slovakia	5.42	– 2.3	+ 31.3
SI	Slovenia	2.06	+ 1.2	+ 58.1
CH	Switzerland	8.02	+ 17.5	+ 77.9
UA	Ukraine	44.42	– 2.8	+ 13.1

Source: CAPRI Model. Note: Scenario 2015: RES_2_0815MTR_RD_REF_2; Scenario 2030: RES_2_0830AGMIP_AGCLIM50_SSP2.

Table 15: CAPRI-Results Agricultural income and Animal Output in the Danube River Basin Countries, 2030 versus 2015

	Agricultural income	Premiums	EAA Output	Output crops	Output animals	EAA Input	Fertiliser	Feeding-stuff
	2030/15	2030/15	2030/15	2030/15	2030/15	2030/15	2030/15	2030/15
Country				%-change				
AL	+ 17.3	+ 13.5	+ 170.7	+ 242.1	+ 103.8	+ 247.3	+ 186.5	+ 436.0
AT	+ 62.9	– 1.7	+ 33.8	+ 29.0	+ 36.8	+ 15.6	+ 70.5	+ 0.4
BA	+ 71.6	+ 9.1	+ 33.8	+ 94.0	+ 0.4	+ 19.6	+ 82.9	+ 36.7
BG	+ 67.7	+ 10.2	+ 37.7	+ 31.1	+ 47.4	+ 24.3	+ 154.8	– 18.8
HR	+ 24.6	– 1.5	+ 38.2	+ 52.5	+ 19.9	+ 43.3	+ 44.1	+ 57.2
CZ	+ 109.0	– 0.5	+ 16.7	+ 20.5	+ 12.9	+ 1.2	+ 53.7	– 16.0
DE	+ 124.7	– 4.3	+ 29.7	+ 36.3	+ 24.9	+ 11.7	+ 42.0	+ 0.7
HU	+ 38.6	– 0.6	+ 30.9	+ 37.1	+ 24.3	+ 22.8	+ 73.7	+ 1.3
IT	+ 77.6	– 3.6	+ 36.4	+ 46.0	+ 24.0	+ 7.8	+ 5.4	+ 2.8
MK	– 6.2	– 27.3	+ 72.9	+ 83.6	+ 52.9	+ 305.2	.	+ 110.9
MD	.	.	.	.	.	.	.	.
ME	+ 86.1	+ 9.6	+ 47.7	+ 72.8	+ 20.9	+ 27.8	+ 52.0	+ 10.8
PL	+ 110.9	– 0.1	+ 36.8	+ 32.9	+ 39.9	+ 13.8	+ 22.7	+ 7.9
RO	+ 903.5	+ 10.2	+ 33.7	+ 39.9	+ 22.6	– 6.7	+ 45.6	– 22.1
RS	+ 93.0	– 3.4	+ 40.1	+ 56.1	+ 21.4	+ 19.1	+ 71.0	– 0.3
SK	+ 58.1	+ 0.0	+ 14.0	+ 24.3	+ 6.1	+ 2.3	+ 46.6	– 13.7
SI	+ 61.4	– 1.8	+ 19.0	+ 17.2	+ 20.3	+ 3.8	+ 1.7	+ 6.6
CH	+ 29.4	–	–	–	–	–	–	–
UA	+ 24.4	–	–	–	–	–	–	–

Source: CAPRI Model. Note: Scenario 2015: RES_2_0815MTR_RD_REF_2; Scenario 2030: RES_2_0830AGMIP_AGCLIM50_SSP2.

Table 16: CAPRI-Results Nitrate Balance in the Danube River Basin Countries, 2030 versus 2015

	Surplus total					
	2015	2030	2030/15	2015	2030	2030/15
Country		kg/ha			1,000 tons	
AL	-2.8	-3.7	– 0.9	-3.5	-4.5	– 1.0
AT	33.5	27.0	– 6.5	98.0	79.3	– 18.8
BA	10.7	9.5	– 1.2	23.4	20.9	– 2.6
BG	16.5	18.0	+ 1.6	84.7	90.0	+ 5.3
HR	75.8	61.8	– 13.9	101.3	80.0	– 21.4
CZ	50.4	40.4	– 10.0	193.4	149.6	– 43.8
DE	40.8	12.4	– 28.4	687.2	202.5	– 484.7
HU	23.9	24.2	+ 0.3	133.7	132.0	– 1.7
IT	42.0	35.9	– 6.1	602.6	498.7	– 103.9
MK	11.7	14.3	+ 2.6	14.2	14.2	– 0.0
MD	.	.	.	.	.	.
ME	2.2	-1.7	– 4.0	1.1	-0.8	– 1.9
PL	44.7	46.8	+ 2.0	718.4	724.5	+ 6.1
RO	18.0	16.7	– 1.4	251.0	222.1	– 28.9
RS	12.8	6.3	– 6.5	56.2	27.1	– 29.0
SK	22.7	18.3	– 4.4	44.8	34.8	– 10.0
SI	50.2	52.3	+ 2.2	24.3	24.7	+ 0.4
CH	.	.	.	.	.	.
UA	.	.	.	.	.	.

Source: CAPRI Model. Note: Scenario 2015: RES_2_0815MTR_RD_REF_2; Scenario 2030: RES_2_0830AGMIP_AGCLIM50_SSP2.

Table 17: CAPRI-Results Supply Details in the Danube River Basin Countries, 2030 versus 2015

		All cattle activities		
		2015	2030	2030/15
Country		1,000 heads	1,000 heads	%
AL	Albania	370.51	472.79	+ 27.6
AT	Austria	1,388.62	1,322.18	– 4.8
BA	Bosnia and Herzegovina	320.39	314.67	– 1.8
BG	Bulgaria	524.01	383.74	– 26.8
HR	Croatia	312.97	314.72	+ 0.6
CZ	Czech Republic	933.70	742.35	– 20.5
DE	Germany	9,484.29	7,940.59	– 16.3
HU	Hungary	664.10	502.67	– 24.3
IT	Italy	4,402.12	4,070.58	– 7.5
MK	Macedonia	216.55	194.93	– 10.0
MD	Moldova	.	.	.
ME	Montenegro	76.13	62.26	– 18.2
PL	Poland	4,402.34	3,634.37	– 17.4
RO	Romania	1,688.62	1,049.32	– 37.9
RS	Serbia	753.23	464.91	– 38.3
SK	Slovakia	236.80	144.36	– 39.0
SI	Slovenia	350.77	327.14	– 6.7
CH	Switzerland	.	.	.
UA	Ukraine	.	.	.

Source: CAPRI Model. Note: Scenario 2015: RES_2_0815MTR_RD_REF_2; Scenario 2030: RES_2_0830AGMIP_AGCLIM50_SSP2.

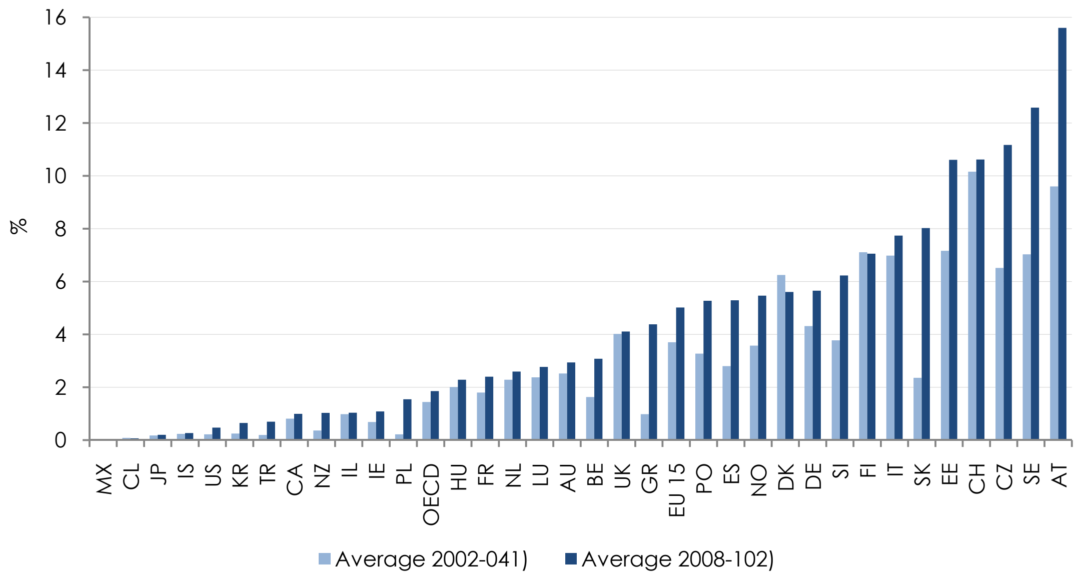

Figure 18: Percentage- share of Agricultural land area under certified organic farm management in the OECD countries, 2002-2010

Source: OECD, Compendium of Agri-environmental Indicators – 2013, Figure 3.8. After IFOAM (International Federation of Organic Agriculture Movements), http://www.organic-world.net/statistics-data-sources.html; Statistical Office of the European Community (EUROSTAT, see http://epp.eurostat.ec.europa.eu/); and national data. –[1]) Data for 2002-04 average equal to the: year 2005 for Estonia and Japan; 2003-04 average for Chile and Korea, 2003-05 average for Israel and Poland, year 2003 for Greece; –[2]) Data for the 2008-10 average equal to the: 2007-09 average for Austria, Canada, Chile, Denmark, Iceland, Israel, Korea, Mexico and Spain; 2007-08 average for Italy; year 2007 for Greece; –[3]) Data for Chile exclude wild harvesting areas and forests; –[4]) In the case of Switzerland, organic farming as a share of the Utilized Agriculture Area (hectares), including arable and permanent cropland, but excluding summer pastures.

MX Mexico, CL Chile, JP Japan, IS Iceland, US United States, KR Korea, TR Turkey, CA Canada, NZ New Zealand, IL Israel, IE Ireland, PL Poland, HU Hungary, FR France, NL Netherlands, LU Luxembourg, AU Australia, BE Belgium, UK United Kingdom, GR Greece, PO Portugal, ES Spain, NO Norway, DK Denmark, DE Germany, SI Slovenia, FI Finland, IT Italy, SK Slovak Republic, EE Estonia, CH Switzerland, CZ Czech Republic, SE Sweden, AT Austria.

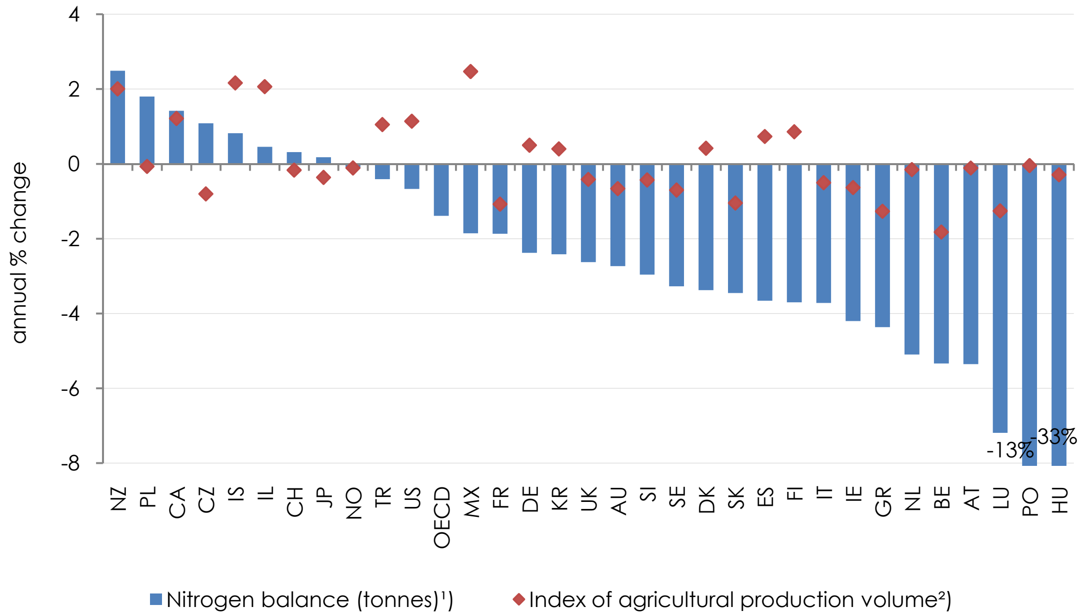

Figure 19: Nitrogen balance and agricultural production volume in OECD countries, 1998-00 to 2007-09

Source: OECD, Compendium of Agri-environmental Indicators – 2013, Figure 4.6. After FAOSTAT Food and Agriculture Organization of the United Nations http://faostat.fao.org/; OECD/Eurostat agri-environmental indicator database http://epp.eurostat.ec.europa.eu/. –[1]) The gross nitrogen balance (surplus or deficit) calculates the difference between the nitrogen inputs entering a farming system (i.e. mainly livestock manure and fertilizers) and the nitrogen outputs leaving the system (i.e. the uptake of nitrogen for crop and pasture production); –[2]) The FAO indices of agricultural production show the relative level of the aggregate volume of agricultural production for each year in comparison with the base period 2004-06. They are based on the sum of price weighted quantities of different agricultural commodities produced after deductions of quantities used as seed and feed weighted in a similar manner. The resulting aggregate represents, therefore, disposable production for any use except as seed and feed. All the indices at the country, regional and world levels are calculated by the Laspeyres formula. Production quantities of each commodity are weighted by 2004-06 average international commodity prices and summed for each year. To obtain the index, the aggregate for a given year is divided by the average aggregate for the base period 2004-06.

NZ New Zealand, PL Poland, CA Canada, CZ Czech Republic, IS Iceland, IL Israel, CH Switzerland, JP Japan, NO Norway, TR Turkey, US United States, MX Mexico, FR France, DE Germany, KR Korea, UK United Kingdom AU Australia SI Slovenia, SE Sweden, DK Denmark, SK Slovak Republic, ES Spain, FI Finland, IT Italy, IE Ireland, GR Greece, NL Netherlands, BE Belgium, AT Austria, LU Luxembourg, PO Portugal, HU Hungary.

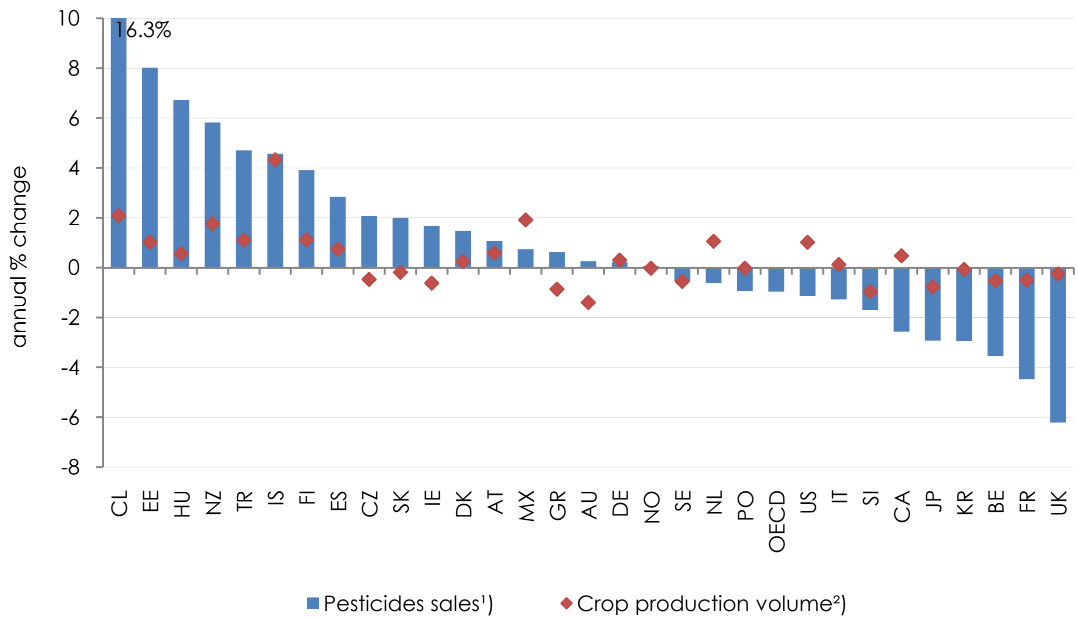

Figure 20: Pesticide sales and Crop production volume in OECD countries, 1998-00 to 2007-09

Source: OECD, Compendium of Agri-environmental Indicators – 2013, Figure 4.6. After FAOSTAT Food and Agriculture Organization of the United Nations http://faostat.fao.org/; OECD/Eurostat agri-environmental indicator database http://epp.eurostat.ec.europa.eu/. –[1]) Pesticide sales cover agriculture and non-agricultural uses (eg. forestry, gardens), except for Finland which does not include forestry and for the following countries which only include agriculture: Belgium, Denmark and Sweden. The data are expressed in tonnes of active ingredients except for Chile for which data are expressed in tonnes of formulated product. The following countries are not included in the figure: Israel (time series are incomplete), Luxembourg (included in Belgium), Poland (break in time series from 2005, data not comparable), and Switzerland (break in time series from 2006, data not comparable); –[2]) The FAO indices of crop production show the relative level of the aggregate volume of crop production for each year in comparison with the base period 2004-06. They are based on the sum of price weighted quantities of different crop commodities produced after deductions of quantities used as seed and feed weighted in a similar manner. The resulting aggregate represents, therefore, disposable production for any use except as seed and feed. All the indices at the country, regional and world levels are calculated by the Laspeyres formula. Production quantities of each commodity are weighted by 2004-06 average international commodity prices and summed for each year. To obtain the index, the aggregate for a given year is divided by the average aggregate for the base period 2004-06. Due to technical reasons it is not possible to provide an OECD or EU average.

CL Chile, EE Estonia, HU Hungary, NZ New Zealand, TR Turkey, IS Iceland, FI Finland, ES Spain, CZ Czech Republic, SK Slovak Republic, IE Ireland, DK Denmark, AT Austria, MX Mexico, GR Greece, AU Australia, DE Germany, NO Norway, SE Sweden, NL Netherlands, PO Portugal, US United States, IT Italy, SI Slovenia, CA Canada, JP Japan, KR Korea, BE Belgium, FR France, UK United Kingdom.

Table 18: Statistical Data of DRB Nuts 2-Regions – Part 1

		Area	Population			Agricultural holdings			
									<5 ha UAA
		2016	2010	2016	2016	2010	2013	2013/10	2013
Code	Nuts 2-Region	km²	persons	persons	Persons /km²	number	number	%	%
BG31	Severozapaden	19,047	865,332	783,909	41.2	51,340	30,430	-40.7	83.8
BG32	Severen tsentralen	14,667	873,801	815,441	55.6	43,320	28,670	-33.8	81.4
BG33	Severoiztochen	14,645	971,932	944,458	64.5	43,780	28,030	-36.0	82.4
BG41	Yugozapaden	20,040	2,132,634	2,121,185	105.8	65,560	52,130	-20.5	90.1
CZ06	Jihovýchod	13,991	1,671,993	1,684,500	120.4	5,590	6,340	13.4	36.8
CZ07	Strední Morava	9,230	1,229,931	1,219,394	132.1	2,570	3,150	22.6	14.9
DE11	Stuttgart	10,557	4,000,848	4,069,533	385.5	14,397	13,520	-6.1	8.6
DE13	Freiburg	9,357	2,196,018	2,224,535	237.7	13,611	13,060	-4.0	8.6
DE14	Tübingen	8,918	1,807,552	1,823,573	204.5	11,574	11,060	-4.4	8.6
DE21	Oberbayern	17,531	4,346,465	4,588,944	261.8	25,246	24,250	-3.9	3.9
DE22	Niederbayern	10,329	1,189,194	1,212,119	117.4	16,674	15,780	-5.4	3.9
DE23	Oberpfalz	9,690	1,081,417	1,092,339	112.7	12,282	11,800	-3.9	3.9
DE25	Mittelfranken	7,245	1,710,145	1,738,686	240.0	9,938	9,170	-7.7	3.9
DE27	Schwaben	9,993	1,784,753	1,846,020	184.7	15,836	15,280	-3.5	3.9
HR03	Jadranska Hrvatska	24,705	1,415,971	1,394,290	56.4	54,410	37,000	-32.0	84.4
HR04	Kontinentalna Hrvatska	31,889	2,886,876	2,796,379	87.7	178,870	120,440	-32.7	64.8
HU10	Közép-Magyarország	6,915	2,951,436	2,993,948	433.0	46,320	46,240	-0.2	89.7
HU21	Közép-Dunántúl	11,085	1,098,654	1,060,703	95.7	52,560	45,090	-14.2	86.6
HU22	Nyugat-Dunántúl	11,328	996,390	983,933	86.9	61,110	49,550	-18.9	86.4
HU23	Dél-Dunántúl	14,197	947,986	900,868	63.5	74,970	61,360	-18.2	87.4
HU31	Észak-Magyarország	13,428	1,209,142	1,153,714	85.9	73,570	58,410	-20.6	87.6
HU32	Észak-Alföld	17,723	1,492,502	1,474,383	83.2	143,910	124,310	-13.6	83.2
HU33	Dél-Alföld	18,335	1,318,214	1,262,936	68.9	124,380	106,380	-14.5	79.0
AT11	Burgenland	3,962	283,697	290,608	73.3	8,040	6,860	-14.7	39.8
AT12	Niederösterreich	19,186	1,605,897	1,652,324	86.1	36,460	34,590	-5.1	22.5
AT13	Wien	415	1,689,995	1,837,438	4,427.6	540	540	0.0	74.1
AT21	Kärnten	9,538	557,998	559,846	58.7	13,940	13,340	-4.3	36.0
AT22	Steiermark	16,401	1,205,045	1,230,756	75.0	33,820	30,700	-9.2	41.1
AT31	Oberösterreich	11,980	1,409,253	1,451,918	121.2	30,030	27,770	-7.5	23.4
AT32	Salzburg	7,156	526,730	545,074	76.2	9,020	8,720	-3.3	20.4
AT33	Tirol	12,640	704,662	738,455	58.4	14,410	14,090	-2.2	37.2
AT34	Vorarlberg	2,601	368,366	383,657	147.5	3,910	3,830	-2.0	32.1
RO11	Nord-Vest	34,161	2,719,719	2,576,777	75.4	528,460	499,860	-5.4	87.8
RO12	Centru	34,100	2,524,418	2,341,749	68.7	394,650	358,470	-9.2	85.3
RO21	Nord-Est	36,850	3,712,396	3,256,282	88.4	790,790	754,530	-4.6	95.2
RO22	Sud-Est	35,762	2,811,218	2,469,801	69.1	460,330	433,040	-5.9	93.7
RO31	Sud - Muntenia	34,453	3,267,270	3,031,386	88.0	800,830	753,590	-5.9	96.7
RO32	Bucuresti - Ilfov	1,821	2,261,698	2,288,538	1,256.7	33,490	25,320	-24.4	98.2
RO41	Sud-Vest Oltenia	29,212	2,246,033	1,993,741	68.3	576,600	557,850	-3.3	93.4
RO42	Vest	32,033	1,919,434	1,802,040	56.3	273,890	247,000	-9.8	82.5
SI03	Vzhodna Slovenija	12,433	1,099,674	1,092,193	87.8	53,380	51,340	-3.8	60.7
SI04	Zahodna Slovenija	7,840	947,302	971,995	124.0	21,260	21,040	-1.0	57.7
SK01	Bratislavský kraj	2,053	597,999	633,288	308.5	550	540	-1.8	46.3
SK02	Západné Slovensko	14,992	1,842,763	1,832,159	122.2	8,170	7,820	-4.3	53.3
SK03	Stredné Slovensko	16,263	1,350,286	1,343,458	82.6	9,130	8,790	-3.7	66.4
SK04	Východné Slovensko	15,727	1,599,362	1,617,347	102.8	6,620	6,410	-3.2	56.6
CH05	Ostschweiz	11,527	1,094,202	1,153,485	100.1	12,590	:	:	:
ME00	Crna Gora	13,812	619,001	622,303	45.1	48,870	:	:	:
RS11	Belgrade	3,234	:	1,683,962	520.7	:	33,244	:	82.6
RS12	Vojvodina	21,614	:	1,881,357	87.0	:	147,624	:	65.7
RS21	Šumadija i zapadna Srbija	26,493	:	1,956,786	73.9	:	262,940	:	77.1
RS22	Južna i istočna Srbija	26,248	:	1,536,217	58.5	:	187,744	:	81.8
BA01	Bosnia-Herzegovina	26,110	:	2,223,856	85.2	:	:	:	:

BA02	Republic of Srpska	24,641	:	1,157,516	47.0	:	:	:	:
BA03	Brčko District of BIH	493	:	83,000	168.4	:	:	:	:
MD	Basarabeasca	:	:	28,501	:	6,825	:	:	:
MD	Briceni	:	:	72,893	:	31,285	:	:	:
MD	Cahul	:	:	124,647	:	29,352	:	:	:
MD	Cantemir	:	:	61,954	:	18,142	:	:	:
MD	Cimislia	:	:	60,069	:	21,925	:	:	:
MD	Edinet	:	:	80,719	:	28,323	:	:	:
MD	Falesti	:	:	91,490	:	32,244	:	:	:
MD	Glodeni	:	:	59,649	:	21,469	:	:	:
MD	Hincesti	:	:	120,176	:	41,232	:	:	:
MD	Leova	:	:	52,834	:	16,575	:	:	:
MD	Nisporeni	:	:	65,581	:	22,654	:	:	:
MD	Ocnita	:	:	53,978	:	18,404	:	:	:
MD	Riscani	:	:	67,929	:	26,978	:	:	:
MD	Taraclia	:	:	43,563	:	13,180	:	:	:
MD	Ungheni	:	:	117,267	:	33,179	:	:	:
MD	Gagauzia	:	:	161,876	:	40,958	:	:	:
MD	Comrat	:	:	:	:	:	:	:	:
UA	Chernivetska oblast	8,094	903,782	:	111.7	:	:	:	:
UA	Ivano-Frankivska oblast	13,894	1,380,770	:	99.4	:	:	:	:
UA	Odeska oblast	33,296	2,387,636	:	71.7	:	:	:	:
UA	Zakarpatska oblast	12,772	1,246,323	:	97.6	:	:	:	:

Source: Eurostat, Nuts 2-Level data. See: http://ec.europa.eu/eurostat/data/database. All data extracted June 2017. National Statistical Offices.

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Table 19: Statistical Data of DRB Nuts 2-Regions – Part 2

		Utilised agricultural area (UAA)			Livestock Units (LSU)			Average area irrigated in the last 3 years
				of holdings <5 ha				
Code	Nuts 2-Region	2010	2013	2013	2010	2013	2013	2010
		ha	ha	%	lsu	lsu	lsu/ha	ha
BG31	Severozapaden	881,670	936,770	2.0	158,340	114,960	0.1	5,650
BG32	Severen tsentralen	806,130	793,430	2.7	193,590	174,000	0.2	2,260
BG33	Severoiztochen	804,550	822,230	2.4	182,480	155,570	0.2	4,990
BG41	Yugozapaden	480,870	554,470	6.8	122,150	117,450	0.2	13,540
CZ06	Jihovýchod	714,590	719,260	0.4	379,300	355,560	0.5	6,290
CZ07	Strední Morava	384,990	393,960	0.3	167,150	169,820	0.4	610
DE11	Stuttgart	464,514	466,810	0.8	:	:	0.9	:
DE13	Freiburg	318,269	324,820	0.8	:	:	0.9	:
DE14	Tübingen	425,837	425,670	0.8	:	:	0.9	:
DE21	Oberbayern	757,719	757,370	0.2	:	:	1.1	:
DE22	Niederbayern	509,176	509,050	0.2	:	:	1.1	:
DE23	Oberpfalz	393,033	393,310	0.2	:	:	1.1	:
DE25	Mittelfranken	328,471	325,810	0.2	:	:	1.1	:
DE27	Schwaben	502,511	505,980	0.2	:	:	1.1	:
HR03	Jadranska Hrvatska	220,380	467,420	9.4	118,830	85,880	0.2	7,580
HR04	Kontinentalna Hrvatska	1,095,630	1,103,790	15.1	901,350	778,140	0.7	7,570
HU10	Közép-Magyarország	259,570	269,810	6.8	112,160	108,500	0.4	7,480
HU21	Közép-Dunántúl	531,170	522,280	3.6	291,010	266,130	0.5	6,660
HU22	Nyugat-Dunántúl	524,370	512,230	4.3	250,790	229,160	0.4	4,470
HU23	Dél-Dunántúl	689,440	679,470	3.9	282,070	265,080	0.4	3,750
HU31	Észak-Magyarország	523,270	544,330	4.6	184,760	161,520	0.3	3,260
HU32	Észak-Alföld	1,051,090	1,023,560	6.6	630,810	579,400	0.6	53,810
HU33	Dél-Alföld	1,107,420	1,104,840	6.3	732,180	649,300	0.6	52,330
AT11	Burgenland	187,890	181,970	3.3	43,650	38,190	0.2	8,850
AT12	Niederösterreich	911,680	908,850	1.7	593,040	577,430	0.6	19,130
AT13	Wien	7,410	8,020	6.1	670	240	0.0	910
AT21	Kärnten	253,570	220,340	5.9	207,360	193,890	0.9	130
AT22	Steiermark	407,260	375,180	8.5	547,370	525,740	1.4	920
AT31	Oberösterreich	529,460	517,350	3.4	768,450	755,320	1.5	460
AT32	Salzburg	195,110	178,390	2.8	141,550	139,140	0.8	50
AT33	Tirol	290,720	259,010	5.9	157,470	154,200	0.6	1,400
AT34	Vorarlberg	95,070	77,780	4.0	57,610	54,930	0.7	40
RO11	Nord-Vest	1,808,350	1,783,180	35.9	769,190	719,730	0.4	260
RO12	Centru	1,627,290	1,693,990	23.2	754,550	717,990	0.4	1,100
RO21	Nord-Est	1,940,160	1,937,080	41.0	1,001,330	962,810	0.5	2,910
RO22	Sud-Est	2,194,370	2,092,500	18.2	800,190	726,580	0.3	113,920
RO31	Sud - Muntenia	2,333,680	2,250,950	25.0	869,440	747,960	0.3	36,440
RO32	Bucuresti - Ilfov	62,450	75,570	16.9	53,140	22,750	0.3	140
RO41	Sud-Vest Oltenia	1,608,410	1,574,200	43.1	625,500	532,730	0.3	8,380
RO42	Vest	1,731,410	1,648,380	15.9	570,840	544,750	0.3	1,640
SI03	Vzhodna Slovenija	343,520	342,480	21.5	378,550	351,110	1.0	700
SI04	Zahodna Slovenija	139,130	143,270	19.8	139,930	136,850	1.0	540
SK01	Bratislavský kraj	75,810	78,640	0.6	26,130	27,110	0.3	5,820
SK02	Západné Slovensko	812,180	817,390	1.1	318,640	313,760	0.4	18,310
SK03	Stredné Slovensko	466,030	465,740	2.3	187,450	153,810	0.3	1,160
SK04	Východné Slovensko	541,480	539,840	1.4	136,110	150,140	0.3	160
CH05	Ostschweiz	216,820	:	:	442,480	:	:	5,660
ME00	Crna Gora	221,300	:	:	118,410	:	:	4,730
RS11	Belgrade	:	136,389	:	:	111,382	0.8	:
RS12	Vojvodina	:	1,608,896	:	:	686,386	0.4	:
RS21	Šumadija i zapadna Srbija	:	1,014,210	:	:	803,843	0.8	:
RS22	Južna i istočna Srbija	:	677,928	:	:	418,277	0.6	:
BA01	Bosnia-Herzegovina	:	:	:	:	:	:	:

BA02	Republic of Srpska	:	:	:	:	:	:	:
BA03	Brčko District of BIH	:	:	:	:	:	:	:
MD	Basarabeasca	17,529	:	:	:	:	:	:
MD	Briceni	60,288	:	:	:	:	:	:
MD	Cahul	90,393	:	:	:	:	:	:
MD	Cantemir	57,038	:	:	:	:	:	:
MD	Cimislia	59,896	:	:	:	:	:	:
MD	Edinet	70,518	:	:	:	:	:	:
MD	Falesti	76,004	:	:	:	:	:	:
MD	Glodeni	53,966	:	:	:	:	:	:
MD	Hincesti	73,570	:	:	:	:	:	:
MD	Leova	49,166	:	:	:	:	:	:
MD	Nisporeni	29,667	:	:	:	:	:	:
MD	Ocnita	42,630	:	:	:	:	:	:
MD	Riscani	72,902	:	:	:	:	:	:
MD	Taraclia	48,062	:	:	:	:	:	:
MD	Ungheni	62,650	:	:	:	:	:	:
MD	Gagauzia	122,636	:	:	:	:	:	:
MD	Comrat	:	:	:	:	:	:	:
UA	Chernivetska oblast	:	:	:	:	:	:	:
UA	Ivano-Frankivska oblast	:	:	:	:	:	:	:
UA	Odeska oblast	:	:	:	:	:	:	:
UA	Zakarpatska oblast	:	:	:	:	:	:	:

Source: Eurostat, Nuts 2-Level data. See: http://ec.europa.eu/eurostat/data/database. All data extracted June 2017. National Statistical Offices.

Table 20: Statistical Data of DRB Nuts 2-Regions – Part 3

		CCI 39 - Water abstraction in agriculture	Average area irrigated in the last 3 years, %-share	Estimated soil erosion by water		Esti-mated soil erosion by water
		2010	2010	2000		2012
Code	Nuts 2-Region	1,000 m3	%	t/ha	2012	t/ha
BG31	Severozapaden	11,464	0.6	3.32	t/ha	2.70
BG32	Severen tsentralen	5,956	0.3	3.85	2.70	2.82
BG33	Severoiztochen	9,213	0.6	3.26	2.82	2.26
BG41	Yugozapaden	23,651	2.8	2.01	2.26	1.83
CZ06	Jihovýchod	2,244	0.9	2.32	1.83	1.76
CZ07	Strední Morava	168	0.2	2.39	1.76	1.75
DE11	Stuttgart	:	1.0	2.65	1.75	1.97
DE13	Freiburg	:	1.0	2.36	1.97	1.98
DE14	Tübingen	:	1.0	2.66	1.98	2.18
DE21	Oberbayern	:	0.5	2.34	2.18	2.08
DE22	Niederbayern	:	0.5	2.91	2.08	2.48
DE23	Oberpfalz	:	0.5	1.72	2.48	1.57
DE25	Mittelfranken	:	0.5	1.59	1.57	1.29
DE27	Schwaben	:	0.5	2.31	1.29	2.05
HR03	Jadranska Hrvatska	16,008	3.4	5.56	2.05	4.83
HR04	Kontinentalna Hrvatska	14,273	0.7	1.64	4.83	1.64
HU10	Közép-Magyarország	2,782	2.9	1.59	1.64	1.45
HU21	Közép-Dunántúl	1,897	1.3	1.97	1.45	1.72
HU22	Nyugat-Dunántúl	1,148	0.9	1.65	1.72	1.50
HU23	Dél-Dunántúl	1,417	0.5	3.43	1.50	3.06
HU31	Észak-Magyarország	446	0.6	2.34	3.06	2.09
HU32	Észak-Alföld	17,804	5.1	0.98	2.09	0.87
HU33	Dél-Alföld	23,413	4.7	0.85	0.87	0.74
AT11	Burgenland (AT)	3,661	4.7	2.26	0.74	1.84
AT12	Niederösterreich	10,829	2.1	2.52	1.84	2.24
AT13	Wien	1,266	12.3	1.17	2.24	1.01
AT21	Kärnten	110	0.1	11.50	1.01	11.67
AT22	Steiermark	909	0.2	5.35	11.67	5.80
AT31	Oberösterreich	320	0.1	3.61	5.80	3.79
AT32	Salzburg	38	0.0	10.37	3.79	10.60
AT33	Tirol	1,082	0.5	16.20	10.60	17.61
AT34	Vorarlberg	101	0.0	9.58	17.61	9.80
RO11	Nord-Vest	200	0.0	3.80	9.80	3.74
RO12	Centru	440	0.1	3.48	3.74	3.29
RO21	Nord-Est	1,333	0.1	4.86	3.29	4.59
RO22	Sud-Est	131,031	5.2	2.41	4.59	2.28
RO31	Sud - Muntenia	57,648	1.6	1.66	2.28	1.52
RO32	Bucuresti - Ilfov	90	0.2	1.13	1.52	1.08
RO41	Sud-Vest Oltenia	12,306	0.5	2.48	1.08	2.36
RO42	Vest	619	0.1	2.23	2.36	2.05
SI03	Vzhodna Slovenija	1,380	0.2	5.74	2.05	5.64
SI04	Zahodna Slovenija	1,264	0.4	10.72	5.64	10.28
SK01	Bratislavský kraj	1,698	7.7	0.87	10.28	0.72
SK02	Západné Slovensko	3,515	2.3	2.22	0.72	1.82
SK03	Stredné Slovensko	210	0.2	2.52	1.82	2.23
SK04	Východné Slovensko	156	0.0	2.79	2.23	2.46
CH05	Ostschweiz	:	2.6	:	2.46	:
ME00	Crna Gora	:	2.1	:	:	:
RS11	Belgrade	:	:	:	:	:

RS12	Vojvodina	:	:	:	:	:
RS21	Šumadija i zapadna Srbija	:	:	:	:	:
RS22	Južna i istočna Srbija	:	:	:	:	:
BA01	Bosnia and Herzegovina	:	:	:	:	:
BA02	Republic of Srpska	:	:	:	:	:
BA03	Brčko District of BIH	:	:	:	:	:
MD	Basarabeasca	:	:	:	:	:
MD	Briceni	:	:	:	:	:
MD	Cahul	:	:	:	:	:
MD	Cantemir	:	:	:	:	:
MD	Cimislia	:	:	:	:	:
MD	Edinet	:	:	:	:	:
MD	Falesti	:	:	:	:	:
MD	Glodeni	:	:	:	:	:
MD	Hincesti	:	:	:	:	:
MD	Leova	:	:	:	:	:
MD	Nisporeni	:	:	:	:	:
MD	Ocnita	:	:	:	:	:
MD	Riscani	:	:	:	:	:
MD	Taraclia	:	:	:	:	:
MD	Ungheni	:	:	:	:	:
MD	Gagauzia	:	:	:	:	:
MD	Comrat	:	:	:	:	:
UA	Chernivetska oblast	:	:	:	:	:
UA	Ivano-Frankivska oblast	:	:	:	:	:
UA	Odeska oblast	:	:	:	:	:
UA	Zakarpatska oblast	:	:	:	:	:
					:	

Source: Eurostat, Nuts 2-Level data. See: http://ec.europa.eu/eurostat/data/database. All data extracted June 2017. National Statistical Offices.

Table 21: Statistical Data of DRB Nuts 2-Regions – Part 4

Code	Nuts 2-Region	Gross domestic product (GDP) at current market prices		Gross value added (GVA) at basic prices		Contribution of Primary Sector to GVA Total
				Total	Primary Sector (Agriculture, forestry and fishing	
		Ø 2002/04	Ø 2012/14	Ø 2012/14	Ø 2012/14	Ø 2012/14
		million €		million €		%
BG31	Severozapaden	1,942	2,999	2,594	323	12.4
BG32	Severen tsentralen	1,926	3,457	2,990	319	10.7
BG33	Severoiztochen	2,162	4,642	4,015	314	7.8
BG41	Yugozapaden	7,479	19,998	17,297	275	1.6
CZ06	Jihovýchod	12,800	23,750	21,355	815	3.8
CZ07	Strední Morava	8,574	15,070	13,551	440	3.3
DE11	Stuttgart	138,561	179,202	160,807	615	0.4
DE13	Freiburg	56,671	73,229	65,712	488	0.7
DE14	Tübingen	50,101	67,016	60,137	448	0.7
DE21	Oberbayern	166,656	223,565	200,617	864	0.4
DE22	Niederbayern	29,878	40,513	36,354	616	1.7
DE23	Oberpfalz	28,031	38,859	34,870	508	1.5
DE25	Mittelfranken	49,792	65,171	58,481	370	0.6
DE27	Schwaben	47,264	62,878	56,424	482	0.9
HR03	Jadranska Hrvatska	9,756	13,851	11,709	309	2.6
HR04	Kontinentalna Hrvatska	21,147	29,616	25,036	1285	5.1
HU10	Közép-Magyarország	34,593	48,699	40,999	297	0.7
HU21	Közép-Dunántúl	7,719	9,864	8,304	479	5.8
HU22	Nyugat-Dunántúl	7,917	10,435	8,785	487	5.5
HU23	Dél-Dunántúl	5,332	6,395	5,384	585	10.9
HU31	Észak-Magyarország	6,278	7,454	6,276	327	5.2
HU32	Észak-Alföld	7,751	9,815	8,263	869	10.5
HU33	Dél-Alföld	7,230	9,179	7,728	925	12.0
AT11	Burgenland (AT)	5,357	7,479	6,658	225	3.4
AT12	Niederösterreich	36,188	50,684	45,121	1232	2.7
AT13	Wien	62,816	82,858	73,763	36	0.0
AT21	Kärnten	13,349	17,843	15,884	324	2.0
AT22	Steiermark	29,522	41,456	36,906	885	2.4
AT31	Oberösterreich	38,560	55,236	49,174	915	1.9
AT32	Salzburg	16,490	23,798	21,186	227	1.1
AT33	Tirol	20,012	28,858	25,690	231	0.9
AT34	Vorarlberg	10,568	15,054	13,402	87	0.7
RO11	Nord-Vest	6,480	16,209	14,282	827	5.8
RO12	Centru	6,508	15,849	13,963	798	5.7
RO21	Nord-Est	6,441	14,548	12,818	1139	8.9
RO22	Sud-Est	6,356	15,923	14,030	1197	8.5
RO31	Sud - Muntenia	6,933	17,687	15,586	1369	8.8
RO32	Bucuresti - Ilfov	11,567	38,139	33,604	161	0.5
RO41	Sud-Vest Oltenia	4,719	10,717	9,441	773	8.2
RO42	Vest	5,337	13,526	11,916	777	6.5
SI03	Vzhodna Slovenija	11,925	16,049	13,871	479	3.5
SI04	Zahodna Slovenija	14,439	20,369	17,605	214	1.2
SK01	Bratislavský kraj	7,636	20,600	18,740	242	1.3
SK02	Západné Slovensko	9,823	23,914	21,755	1137	5.2
SK03	Stredné Slovensko	6,315	14,593	13,275	698	5.3
SK04	Východné Slovensko	6,583	15,166	13,796	603	4.4

CH05	Ostschweiz	:	:	:	:	:
ME00	Crna Gora	:	:	:	:	:
RS11	Belgrade	:	:	:	:	:
RS12	Vojvodina	:	:	:	:	:
RS21	Šumadija i zapadna Srbija	:	:	:	:	:
RS22	Južna i istočna Srbija	:	:	:	:	:
BA01	Bosnia and Herzegovina	:	:	:	:	:
BA02	Republic of Srpska	:	:	:	:	:
BA03	Brčko District of BIH	:	:	:	:	:
MD	Basarabeasca	:	:	:	:	:
MD	Briceni	:	:	:	:	:
MD	Cahul	:	:	:	:	:
MD	Cantemir	:	:	:	:	:
MD	Cimislia	:	:	:	:	:
MD	Edinet	:	:	:	:	:
MD	Falesti	:	:	:	:	:
MD	Glodeni	:	:	:	:	:
MD	Hincesti	:	:	:	:	:
MD	Leova	:	:	:	:	:
MD	Nisporeni	:	:	:	:	:
MD	Ocnita	:	:	:	:	:
MD	Riscani	:	:	:	:	:
MD	Taraclia	:	:	:	:	:
MD	Ungheni	:	:	:	:	:
MD	Gagauzia	:	:	:	:	:
MD	Comrat	:	:	:	:	:
UA	Chernivetska oblast	:	:	:	:	:
UA	Ivano-Frankivska oblast	:	:	:	:	:
UA	Odeska oblast	:	:	:	:	:
UA	Zakarpatska oblast	:	:	:	:	:

Source: Eurostat, Nuts 2-Level data. See: http://ec.europa.eu/eurostat/data/database. All data extracted June 2017. National Statistical Offices.

Table 22: Statistical Data of DRB Nuts 2-Regions – Part 5

Code	Nuts 2-Region	Output of the agricultural 'industry' at basic prices	Crop Output at basic prices	Animal Output at basic prices	Share of Animal Output in Output of the agricultural 'industry'	Animal output per livestock unit (LSU)	Total Labour force directly employed by the holding, annual working unit (AWU)
		Ø 2012/14	Ø 2012/14	Ø 2012/14	Ø 2012/14	Ø 2012/14	2013
			million €		%	€	AWU
BG31	Severozapaden	779	522	142	18.3	1,240	38,360
BG32	Severen tsentralen	962	621	233	24.2	1,340	41,760
BG33	Severoiztochen	945	623	205	21.7	1,320	35,610
BG41	Yugozapaden	281	134	113	40.2	960	55,690
CZ06	Jihovýchod	1,120	654	412	36.8	1,160	26,010
CZ07	Strední Morava	551	329	199	36.0	1,170	12,630
DE11	Stuttgart	1,681	966	623	37.1	:	:
DE13	Freiburg	994	611	299	30.1	:	:
DE14	Tübingen	1,353	573	694	51.3	:	:
DE21	Oberbayern	2,658	1,102	1,362	51.2	:	:
DE22	Niederbayern	2,118	981	1,010	47.7	:	:
DE23	Oberpfalz	1,306	583	628	48.1	:	:
DE25	Mittelfranken	1,111	508	531	47.8	:	:
DE27	Schwaben	1,794	587	1,085	60.5	:	:
HR03	Jadranska Hrvatska	396	279	95	23.9	1,100	36,690
HR04	Kontinentalna Hrvatska	2,136	1,234	754	35.3	970	138,360
HU10	Közép-Magyarország	509	310	163	32.0	1,500	36,170
HU21	Közép-Dunántúl	916	464	375	40.9	1,410	45,420
HU22	Nyugat-Dunántúl	888	502	340	38.3	1,480	43,770
HU23	Dél-Dunántúl	1,147	748	315	27.4	1,190	54,390
HU31	Észak-Magyarország	637	448	151	23.7	940	50,180
HU32	Észak-Alföld	1,724	972	642	37.2	1,110	99,440
HU33	Dél-Alföld	1,932	1,105	684	35.4	1,050	104,340
AT11	Burgenland (AT)	413	330	61	14.7	1,590	6,170
AT12	Niederösterreich	2,271	1,222	831	36.6	1,440	30,660
AT13	Wien	96	92	1	1.0	4,150	2,110
AT21	Kärnten	412	114	248	60.2	1,280	7,530
AT22	Steiermark	1,312	477	706	53.8	1,340	21,440
AT31	Oberösterreich	1,729	557	1,063	61.5	1,410	23,960
AT32	Salzburg	311	67	206	66.2	1,480	7,050
AT33	Tirol	370	80	219	59.1	1,420	9,470
AT34	Vorarlberg	153	30	96	62.6	1,740	2,780
RO11	Nord-Vest	2,014	1,230	563	28.0	780	216,420
RO12	Centru	1,872	1,097	571	30.5	800	156,160
RO21	Nord-Est	2,725	1,715	699	25.7	730	325,690
RO22	Sud-Est	2,708	1,878	561	20.7	770	194,360
RO31	Sud - Muntenia	3,133	2,233	680	21.7	910	279,380
RO32	Bucuresti - Ilfov	208	124	30	14.5	1,320	12,150
RO41	Sud-Vest Oltenia	1,821	1,256	367	20.1	690	251,630
RO42	Vest	1,831	1,212	484	26.4	890	116,840
SI03	Vzhodna Slovenija	:	:	:	:	:	:
SI04	Zahodna Slovenija	:	:	:	:	:	:
SK01	Bratislavský kraj	167	78	60	36.0	2,220	2,580
SK02	Západné Slovensko	1,434	792	511	35.6	1,630	22,040
SK03	Stredné Slovensko	399	140	205	51.4	1,330	14,070
SK04	Východné Slovensko	399	217	152	38.1	1,010	11,910

CH05	Ostschweiz	1,781	582	1,012	56.8	:	:
ME00	Crna Gora	:	:	:	:	:	:
RS11	Belgrade	:	:	:	:	:	:
RS12	Vojvodina	:	:	:	:	:	:
RS21	Šumadija i zapadna Srbija	:	:	:	:	:	:
RS22	Južna i istočna Srbija	:	:	:	:	:	:
BA01	Bosnia and Herzegovina	:	:	:	:	:	:
BA02	Republic of Srpska	:	:	:	:	:	:
BA03	Brčko District of BIH	:	:	:	:	:	:
MD	Basarabeasca	:	:	:	:	:	:
MD	Briceni	:	:	:	:	:	:
MD	Cahul	:	:	:	:	:	:
MD	Cantemir	:	:	:	:	:	:
MD	Cimislia	:	:	:	:	:	:
MD	Edinet	:	:	:	:	:	:
MD	Falesti	:	:	:	:	:	:
MD	Glodeni	:	:	:	:	:	:
MD	Hincesti	:	:	:	:	:	:
MD	Leova	:	:	:	:	:	:
MD	Nisporeni	:	:	:	:	:	:
MD	Ocnita	:	:	:	:	:	:
MD	Riscani	:	:	:	:	:	:
MD	Taraclia	:	:	:	:	:	:
MD	Ungheni	:	:	:	:	:	:
MD	Gagauzia	:	:	:	:	:	:
MD	Comrat	:	:	:	:	:	:
UA	Chernivetska oblast	:	:	:	:	:	:
UA	Ivano-Frankivska oblast	:	:	:	:	:	:
UA	Odeska oblast	:	:	:	:	:	:
UA	Zakarpatska oblast	:	:	:	:	:	:

Source: Eurostat, Nuts 2-Level data. See: http://ec.europa.eu/eurostat/data/database. All data extracted June 2017. National Statistical Offices.

Table 23: Statistical Data of DRB Nuts 2-Regions – Part 6

Code	Nuts 2-Region	GVA Agriculture per AWU	Share of Utilized agricultural area (UAA) in Total area		Output of the agricultural 'industry' at basic prices per ha UAA	Utilised agricultural area (UAA) per annual working unit (AWU)
		Ø 2012/14	2010	2013	Ø 2012/14	2013
		€	%	%	€/ha	ha/AWU
BG31	Severozapaden	10,300	46.3	49.2	880	24
BG32	Severen tsentralen	6,500	55.0	54.1	1190	19
BG33	Severoiztochen	8,500	54.9	56.1	1170	23
BG41	Yugozapaden	3,000	24.0	27.7	580	10
CZ06	Jihovýchod	12,500	51.1	51.4	1570	28
CZ07	Strední Morava	13,600	41.7	42.7	1430	31
DE11	Stuttgart	:	44.0	:	3620	21
DE13	Freiburg	:	34.0	:	3120	21
DE14	Tübingen	:	47.8	:	3180	21
DE21	Oberbayern	:	43.2	:	3510	23
DE22	Niederbayern	:	49.3	:	4160	23
DE23	Oberpfalz	:	40.6	:	3320	23
DE25	Mittelfranken	:	45.3	:	3380	23
DE27	Schwaben	:	50.3	:	3570	23
HR03	Jadranska Hrvatska	6,900	8.9	18.9	1800	13
HR04	Kontinentalna Hrvatska	6,200	34.4	34.6	1950	8
HU10	Közép-Magyarország	5,100	37.5	39.0	1960	7
HU21	Közép-Dunántúl	6,800	47.9	47.1	1720	11
HU22	Nyugat-Dunántúl	6,300	46.3	45.2	1690	12
HU23	Dél-Dunántúl	7,900	48.6	47.9	1660	12
HU31	Észak-Magyarország	5,900	39.0	40.5	1220	11
HU32	Észak-Alföld	6,700	59.3	57.8	1640	10
HU33	Dél-Alföld	7,100	60.4	60.3	1740	11
AT11	Burgenland (AT)	27,600	47.4	45.9	2200	29
AT12	Niederösterreich	30,700	47.5	47.4	2490	30
AT13	Wien	15,200	17.9	19.3	12940	4
AT21	Kärnten	16,800	26.6	23.1	1620	29
AT22	Steiermark	24,500	24.8	22.9	3220	17
AT31	Oberösterreich	28,400	44.2	43.2	3270	22
AT32	Salzburg	17,700	27.3	24.9	1600	25
AT33	Tirol	14,400	23.0	20.5	1270	27
AT34	Vorarlberg	20,700	36.6	29.9	1610	28
RO11	Nord-Vest	4,100	52.9	52.2	1110	8
RO12	Centru	5,100	47.7	49.7	1150	11
RO21	Nord-Est	3,700	52.7	52.6	1400	6
RO22	Sud-Est	5,800	61.4	58.5	1230	11
RO31	Sud - Muntenia	4,700	67.7	65.3	1340	8
RO32	Bucuresti - Ilfov	5,700	34.3	41.5	3320	6
RO41	Sud-Vest Oltenia	3,400	55.1	53.9	1130	6
RO42	Vest	6,400	54.1	51.5	1060	14
SI03	Vzhodna Slovenija	:	27.6	27.5	:	:
SI04	Zahodna Slovenija	:	17.7	18.3	:	:
SK01	Bratislavský kraj	22,600	36.9	38.3	2210	30
SK02	Západné Slovensko	20,400	54.2	54.5	1770	37
SK03	Stredné Slovensko	3,900	28.7	28.6	860	33
SK04	Východné Slovensko	2,500	34.4	34.3	740	45
CH05	Ostschweiz	:	18.8	:	8210	:

ME00	Crna Gora	:	16.0	:	:	:
RS11	Belgrade	:	:	42.2	:	:
RS12	Vojvodina	:	:	74.4	:	:
RS21	Šumadija i zapadna Srbija	:	:	38.3	:	:
RS22	Južna i istočna Srbija	:	:	25.8	:	:
BA01	Bosnia and Herzegovina	:	:	:	:	:
BA02	Republic of Srpska	:	:	:	:	:
BA03	Brčko District of BIH	:	:	:	:	:
MD	Basarabeasca	:	:	:	:	:
MD	Briceni	:	:	:	:	:
MD	Cahul	:	:	:	:	:
MD	Cantemir	:	:	:	:	:
MD	Cimislia	:	:	:	:	:
MD	Edinet	:	:	:	:	:
MD	Falesti	:	:	:	:	:
MD	Glodeni	:	:	:	:	:
MD	Hincesti	:	:	:	:	:
MD	Leova	:	:	:	:	:
MD	Nisporeni	:	:	:	:	:
MD	Ocnita	:	:	:	:	:
MD	Riscani	:	:	:	:	:
MD	Taraclia	:	:	:	:	:
MD	Ungheni	:	:	:	:	:
MD	Gagauzia	:	:	:	:	:
MD	Comrat	:	:	:	:	:
UA	Chernivetska oblast	:	:	:	:	:
UA	Ivano-Frankivska oblast	:	:	:	:	:
UA	Odeska oblast	:	:	:	:	:
UA	Zakarpatska oblast	:	:	:	:	:

Table 24: Detailed overview of agri-environmental programmes in Austria and Slovakia

name of measure(s) in the programme		Austria	Slovakia
1. Payments directly impacting water quality			
1	Land improvement (liming, soil erosion prevention)	X	indirecttly involved in intergrated production in vineyards and orchards
2	Payments for nitrate reduction	X	M10 Art 28
3	Nutrient management plan	X	
4	Maintenance of wetlands and ponds5)	X	
5	Conversion of farmland into wetlands and ponds	X	
6	Shelter belts/Buffer strips	X	M10 Art 28
2. Payments indirectly impacting water quality			
1	Extensive crop production	X	
2	Organic farming	X	M11 Art 29
3	Integrated production wine, fruits and vegetables	X	M10 Art 28
4	Integrated farming	X	
5	Reduced tillage/Mechanical weed control	X	
6	Green manure crops		
7	Green set-aside/Fallows	X	
8	Catch crops, green/winter cover	X	
9	Extensive management of all land	X	indirectly involved in M13
10	Extensive grassland management (pastures/meadows)	X	indirectly involved in M12 (NATURA 2000) and in M13
11	Conversion of arable land into grassland (pastures/meadows)	X	no more supported
12	Grassland/biodiversity/habitat schemes	X	M10 Art 28 / M12 Art 30
13	Maintaining and improving groundcover		
14	Long term set-aside	X	
15	Afforestation		no more supported
16	Converting pasture to perennial vegetation		

yes="X", no=""

		Austria	Slovakia
		Premium per hectare or per farm	
name of measure(s) in the programme		€/ha	€/ha (single payments)
1. Payments directly impacting water quality			
1	Land improvement (liming, soil erosion prevention)	60 to 800	
2	Payments for nitrate reduction	450	25
3	Nutrient management plan	70 to 200	
4	Maintenance of wetlands and ponds5)	450 to 700	
5	Conversion of farmland into wetlands and ponds	450 to 700	
6	Shelter belts/Buffer strips	see Nr. 6	350
2. Payments indirectly impacting water quality			
1	Extensive crop production	40 to 60	
2	Organic farming	70 to 700	96 - 671
3	Integrated production wine, fruits and vegetables	250	ochards 98,3-497; vineyards 367-483; vegetable 221-416
4	Integrated farming	see Nr. 9 and Nr. 10	
5	Reduced tillage/Mechanical weed control	60	
6	Green manure crops		
7	Green set-aside/Fallows	450 to 700	
8	Catch crops, green/winter cover	80 to 200	
9	Extensive management of all land	45 to 450	
10	Extensive grassland management (pastures/meadows)	15 to 45	
11	Conversion of arable land into grassland (pastures/meadows)	450	
12	Grassland/biodiversity/habitat schemes	450	87,33 (M10) / 62,2 (M12)
13	Maintaining and improving groundcover		
14	Long term set-aside	900	
15	Afforestation		
16	Converting pasture to perennial vegetation		

	name of measure(s) in the programme	Austria ha	Slovakia ha (indicative plan)
1. Payments directly impacting water quality		156355	
1	Land improvement (liming, soil erosion prevention)	236	
2	Payments for nitrate reduction	n.a.	70000 ha
3	Nutrient management plan	n.a.	
4	Maintenance of wetlands and ponds5)	n.a.	
5	Conversion of farmland into wetlands and ponds	455	
6	Shelter belts/Buffer strips	see Nr. 6	12000 ha
2. Payments indirectly impacting water quality			
1	Extensive crop production	362808	
2	Organic farming	401709	150000 ha
3	Integrated production wine, fruits and vegetables	16044	3500 ha of ochrards, 10150 ha of vegetable and 7500 ha of vineyards
4	Integrated farming	see Nr. 9 and Nr. 10	
5	Reduced tillage/Mechanical weed control	119401	
6	Green manure crops		
7	Green set-aside/Fallows	251333	
8	Catch crops, green/winter cover	154462	
9	Extensive management of all land	1120784	
10	Extensive grassland management (pastures/meadows)	see Nr. 17	
11	Conversion of arable land into grassland (pastures/meadows)		
12	Grassland/biodiversity/habitat schemes	see Nr. 17	150000 ha / 2665 ha
13	Maintaining and improving groundcover		
14	Long term set-aside	n.a.	
15	Afforestation		

Source: Franz Sinabell, WIFO, Vienna (Austria). Radoslav Bujnovský, Water Research Institute, Bratislava (Slovakia).