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ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

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# Agro-Economic Study for the Danube River Basin

## Country Reports

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**Matej Bedrac, Tomaž Cunder (KIS),**
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Research assistance: Dietmar Weinberger (WIFO)

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### Abstract

This report provides an overview of the state of agriculture in countries and regions of the Danube River Basin. Each chapter deals with one country or a region and describes the state of economic and agri-environmental indicators, current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions, gives an overview of instruments to reduce water pollution, provides evidence on the effectiveness of measures to mitigate pollution. Each country report ends with an outlook at the likely development of the agricultural sector and a synthesis of findings.

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## Table of Contents

## List of Tables

## List of Figures

# 1 Country Report: Austria

Franz Sinabell

## 1.1 Economic and agri-environmental indicators

### *1.1.1 State of agriculture*

The agricultural sector in Austria is small compared to the rest of the economy as measured in its value added share (less than 1%). Its share in employment is much higher (3% of hours worked in the economy). As a consequence farm incomes per person employed are relatively low compared to the rest of the economy. Due to volatilities of prices of outputs and crop yields incomes in agriculture are very volatile. During the last five years incomes in the Austrian agricultural sector declined for four years in a row, only in 2016 a small income increase was observed.

Austrian agriculture is significantly contributing to food supplies of the population. In terms of the overall self-sufficiency ratio approximately 80% of the food consumed in Austria is produced domestically. However, depending on the product under consideration ratios span from 0 (in case of subtropic fruits, coffee and tea) to much over 100% (in case of milk, milk products and beef). The only bulk commodity with a significant import dependence is vegetable oil.

Because of improvements in technical efficiency and technical progress on the one hand and to the very unfavorable income situation structural change is significant. Farm employment has decreased at rates from 1.4% to 2.2% per year during the last decade and there are no signs that this trend is going to be reversed. Many farms in Austria are relatively small and most of them are run by part time farmers. Subsistence farming does not play a role. More recently farming for recreation and lifestyle has become more widespread.

### *1.1.2 State of agri-environmental indicators*

Agricultural crop output measured in tons remained very stable during the last decades apart from yearly fluctuations due to changing weather conditions. Given that the acreage of agricultural land has been declining the stable output is due to increases to productivity. Such increases are not spanning over all products, but are observed mainly in the case of maize, sugar beet, soy bean and rape seed. Yields of cereals are stagnating in most regions.

Most agri-environmental indicators show a favorable trend. This is due to three major factors: the number of livestock has declined between 2005 and 2013 (mainly cattle), chemical inputs become less frequently used and organic farming has become more widely adopted during recent years.

In 2016 the most recent report about nitrates was published (BMLFUW, 2016d). It gives a detailed overview of the current state and trends in nitrate pollution. Figure 1 shows the trend (in mg/l) between two periods for groundwater monitoring sites. Other substances are covered in the water quality report (BMLFUW, 2016c)

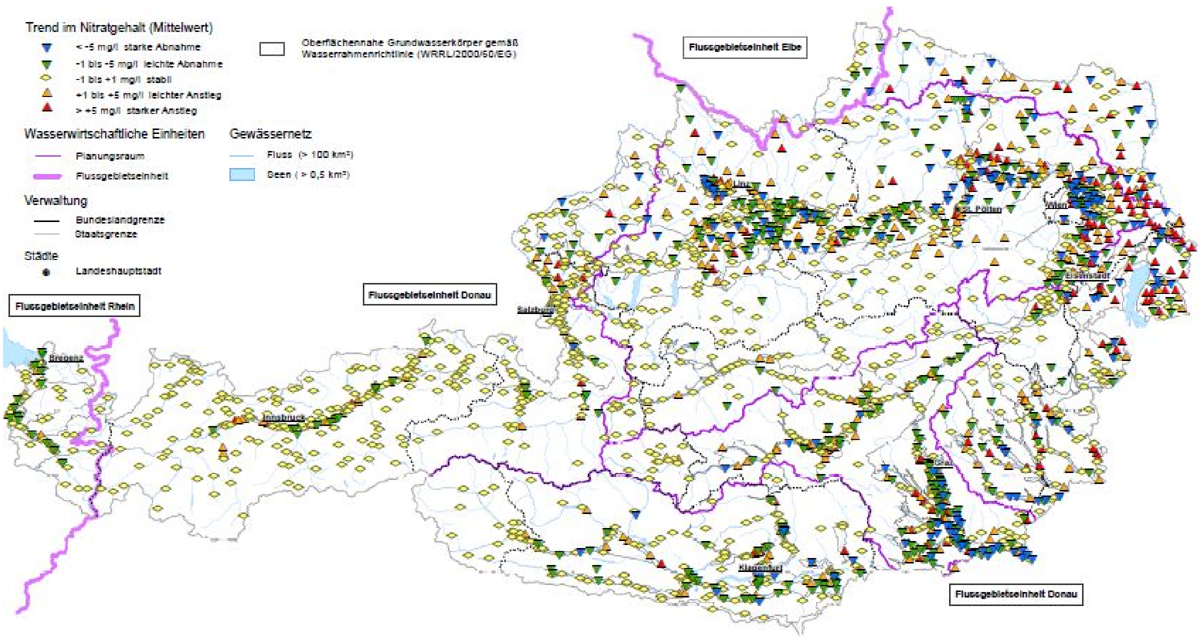


*Figure 1: Nitrate in groundwater: comparison of trend 2007-11 to 2011-15*

Source: BMLFUW (2016d). Map designed by Umweltbundesamt GesmbH.

### *1.1.3 Information gaps*

In Austria a wide range of monitoring system has been established (e.g. surface water and groundwater quality) but potentially polluting sources are not equally well monitored. Agri-environmental policy measures are very important in Austria and significant public funds are made available to reduce negative impacts of agriculture. One aspect of this heavy involvement of policy is that many data are collected which are necessary to govern such programmes. However, administrative information frequently is not used to measure the environmental performance (e.g. farm specific nutrient balances) but is only used to measure compliance with regulations during the course of compliance inspections on the farm.

## 1.2 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *1.2.1 Review of region specific targets relevant for DRB*

Almost the complete territory of Austria is part of the DRB. Only a small region in the north is part of the Elbe catchment and the outmost western part is draining to the Rhein. Because these regions represent only 4% of the Austrian territory and administrative borders cross catchment borders, these two small regions are not separated in the remainder of the text.

Austria is a federal republic and therefore there are three levels of legislation:

1. EU legislation (most importantly the Nitrates Directive, and the Water Framework Directive);
2. national legislation (most important in the context of the Programme of Rural Development and the implementation of EU legislation);
3. Länder specific legislation (most important for the designation of groundwater remediation zones and drinking water protection zones and regulation of agriculture).

DRB specific groundwater targets do not exist in Austria because of two major reasons:

- Referring to the Nitrates Directive (1991) Austria decided to designate the whole territory as a nitrates vulnerable zone and therefore catchment specific regulations are not in place.
- Regulations for groundwater zones with exceeding levels of one or more pollutants are specific for small catchment regions that are part of the DRB and because Länder are responsible for remediation they are Länder specific as well.

Considering this situation it is plausible to say that most of policy measures taken in Austria affect mainly the DRB and only small parts of other European river basins.

### *1.2.2 General agricultural policy*

Austria is part of the EU and therefore the Common Agricultural Policy (CAP) is defining the framework for most policy measures in this field. Compared to the rest of the EU there are three specific noteworthy aspects:[1]

- In general terms Austria is usually implementing the "standard" or "default" variant of regulations among those where country or region specific variants are possible. One outcome of that general approach is that only 3% of payments of the "First Pillar" of CAP are linked to specific outputs. A consequence is that product specific market distortions are very small in Austria.
- Because Austria entered the EU in 1995 the direct payment scheme is different from its Eastern European neighbors. It followed the "historical" approach of farm specific payments in 2005 and is now in the phase of transformation to uniform regional

[1] Financial information is based on BMLFUW 2016 (tables 5.1.4, 5.2.2).

premiums which will be reached in 2020. In 2015 the total of the Basic Premium was 0.4 billion € and the Greening Premium was 0.2 billion €.

- The "Second Pillar" of CAP - the Programme of Rural Development (PRD) - is very important in Austria because the volume of annual transfers is almost 1 bn € per year compared to 0.7 billion € per year from the "First Pillar" of CAP. A considerable share of PRD payments us spent for agri-environmental measures (0.4 billion € or 40% of the PRD volume).

According to the Austrian constitution agriculture is a policy field of Länder. The scope of federal legislation concerning agriculture is therefore relatively small. The way of interaction of the federal governance with farmers is mainly contract based and not regulatory based. In many ways the federal government tries to change behavior of farmers by offering subsidies. As in the case of water management many aspects of agricultural policy are in the responsibility of Länder. An excellent source how governance of agriculture and agri-environmental issues is organized in Austria is Holzer (2015).

### *1.2.3 Agri-Environmental Programmes*

AEP measures that have a directly intended positive effect on groundwater quality are (hectares and transfers in million € in 2015 are given in brackets):

- environmental beneficial practices (1.1 million ha, 64 million €; includes crop rotation specifications; typically 45 €/ha );
- organic farming (0.4 million ha; 97 million €; includes the ban of mineral fertilizer and of most herbicides and pesticides; typically 225 €/ha);
- reduction of chemical inputs(0.38 million ha; 20 million €; similar to organic farming but slightly less restrictive; 40 €/ha in cereal production);
- greening (0.4 million ha; 50 million €; soil cover in winter and permanent cover; 120 to 200 €/ha) - this measure must not be must not be confused with "greening" in the context of direct payments of the first pillar);
- mulch seed, direct seed and strip till (0.12 million ha; 7 million €) and erosion control in fruit, wine and hop production (0.037 million ha; 7 million €; 60 €/ha);
- hose spreading of slurry (slurry injection in soil (1.2 €/$m^3$); slurry injection in soil (1.2 €/$m^3$) together 1.9 million € premiums;
- three specific measures: preventive water protection for groundwater and surface water and leaching soils (0.2 million ha and 21 million €; typically 100 €/ha).

### *1.2.4 Gap analysis*

Most of the measures in Austria are focusing on nitrates in groundwater. The reason is that groundwater is the main source of drinking water and that nitrate is the most important polluting substance. Therefore the awareness of nitrate contaminations is very high. An elaborated monitoring system has been established over the last decades with more than

1,900 groundwater sample stations (BMLFUW, 2016b). During the period 2011-2015 a threshold of 50 mg NO3/l was exceeded in 13.6% of the stations (15.1% during 2007-2011). Over a long period groundwater quality improved. In particular the frequency of samples with residues from herbicides declined. As far as surface water is concerned the share of monitoring stations where chemical and physical status is "less than good" was 18% in 2014 (BMLFUW, 2016c).

In Austria, information about the status of water bodies is excellent. Access to monitoring data for researchers is possible and regular reports describe the status and development. Nevertheless, the causal effects of agricultural practices and the consequences in the environmental medium are not well understood. One reason is that most of the research focuses on small samples or technical case studies and scenario analyses (e.g. BAW and wpa, 2008). Cost-effectiveness analyses focused so far only on (nitrate) balances (Sinabell, et al., 2015) but not on pollutants in the medium.

## 1.3 Overview of instruments to reduce water pollution in each country

### *1.3.1 Measures Observed*

Water protection has a long tradition in Austria. From an historical perspective, drinking water protection had the highest priority, then came the awareness of surface waters. Zones around wells were either bought by municipalities or restrictions on land use were imposed based on Länder-legislation. Starting in the 1960s, huge efforts were made to clean municipal wastewaters and as soon as the polluter pays principle was established in the 1970s agriculture moved into the focus of attention of environmental legislation. Today there is a large spectrum of instruments in place.

#### 1.3.1.1 Training, education and information

The linkage between agriculture and the environment is part of the standard curriculum at agricultural colleges. In Austria anybody can become farmer and operate a farm but there are financial incentives to undergo a formal training for those who operate farms (the setting up a farm premium as part of AEP).

Only people with specified qualifications are allowed to apply certain chemical substances (herbicides and pesticides) on farms. Co-financed by the Austrian AEP educational facilities offer a large range of courses for environmentally friendly farming. Field demonstrations organized in Länder specific programmes complement such courses.

In certain environmentally sensitive zones with high vulnerability, training programmes have been established. Consultants who are funded by government authorities are setting up management plans together with farmers and keep track of nutrient flows on farms.

#### 1.3.1.2 Regulatory instruments

Command and control measures are as important as fiscal measures in Austria. The range of bans and prohibitions is large: many potentially useful chemicals from an agronomic point of view may not be applied, the time when animal manure may be spread is strictly limited, the capacity of slurry tanks is regulated, the equipment used for spreading chemicals must be inspected regularly and records kept on farms are inspected frequently (as part of CAP).

The most important legal source is the Action Programme based on the Nitrates Directive which was most recently updated in 2012 and includes codes of good agricultural practices. Additional legal sources are plant protection acts (of Länder), water protection and water conversation acts (of Länder), and building regulations (of Länder).

#### 1.3.1.3 Fiscal instruments

In Austria there are no taxes on effluents, emissions or potentially harmful inputs of agriculture. Before Austria was part of the EU a tax was levied on mineral fertilizer and seeds of maize. This levy was abandoned in order to avoid discrimination of domestic farmers.

In order to promote environmentally friendly practices subsidies have been the most important instrument apart from regulations. Subsidies have been granted for investments in buildings and infrastructure (sewage pipes, sewage tanks on farms), machinery (slurry tanks with soil injection equipment), emission reducing farming practices, soil sampling, and training. Most of the subsidies are granted via the AEP but Länder governments are providing subsidies as well.

#### 1.3.1.4 Other measures

The environmental criminal law and environmental liability law are relevant additional regulations. In some regions private contracts between farmers and water suppliers exist with the aim to minimize pollution and to compensate farmers for foregone profits.

### *1.3.2 Scale at which the instruments are implemented*

Almost all measures listed above are relevant for the whole territory of Austria. There are two major exeptions:

- as far as water protection and water conservation sites for drinking water are concerned Länder specific regulations apply (water protection contracts between farmers and water suppliers);
- in some regions of Niederösterreich, Steiermark, Burgenland and Oberösterreich supplementary programmes to the Action Programme have been implemented (meausres include: training, soil sampling, consulting, private contracts).

### 1.3.3 Effectiveness of measures

The effectiveness of all these measures listed above is not evaluated regularly. Only in the case of measures financed by the AEP evaluations are necessary, however currently only ex-ante evaluations are available (BAW and WPA 2008). Reports on the effectiveness of selected measures are relatively scarce (see next section).

Apart from measure specific evaluations there are regular reports on the implementation of programmes (e.g. BMLFUW, 2016b), monitoring reports (BMLFUW, 2016c) and progress reports on AEP (BMLFUW, 2016d). According the latest water quality report (BMLFUW, 2016c) there is evidence that measure are effective and that the status of some vulnerable regions improved. Nevertheless, in 2014 there were still 10.5% of monitoring sites with exceeding levels of nitrates (compared to 10.6% in 2000) in groundwater which indicates that further efforts are still necessary.

## 1.4 Evidence from the literature, monitoring reports, evaluation studies

### 1.4.1 Literature review

There are only few studies that provide evidence on the effectiveness of measure to reduce water pollution in Austria. Among the publications screened for this report are Hofreither, et al., 2000; Sinabell, 2009; Heumesser and Morawetz, 2012; Wick, et al., 2012; Sinabell, et al., 2016; Zessner et al., 2014, and Zessner et al., 2017. These studies made efforts to analyze the causal effects of measures in two complementary ways:

- identifying effects of agri-environmental measures on water quality using econometric methods (Hofreither and Pardeller, 1996; Sinabell, 2009; Heumesser and Morawetz, 2012; Wick, et al., 2012);
- evaluating the effectiveness using quantitative computational models (the other studies).

The most important findings of these studies are:

- nutrient balances (either regional or on farms) are good or at least adequate predictors for levels of water pollution depending on the region;
- agri-environmental measures are inducing more environmentally friendly behaviour on farms and are therefore a good complement for command and control measures;
- up to now the gaps in data availability and information are still very big - a consequence is that the effectiveness of single measures can not be identified unambiguously in many cases.

### 1.4.2 Information gaps

In order to evaluate the effectiveness of measures a standard approach in economics is to compare regions where measures are applied with regions where the measures are not applied. Such controls are necessary to identify causal effects. For quantitative empirical analyses important data either do not exist in Austria or are available only at very high cost.

An example is the information on nutrient balances: Only farmers who are enrolled in certain programmes calculate balances on field level. Most other farmers are calculating only farm nutrient balances. In order to obtain such information researchers need to ask farmers to provide it because it is not collected centrally like in many other countries. Detailed information on specific farming practices and results from farm inspections in programme regions can be used for evaluations only for a small not representative number of cases. Because information of non-participants is missing all together, counterfactual empirical studies are not possible.

### *1.4.3 Knowledge gaps*

According to the literature surveyed for this analysis it can be summarized that the physical links between the interaction of agriculture and water quality are well understood. Several quantitative models exist that describe the physical processes (erosion, nutrient charges on different types of soil, etc.) very well (e.g. Zessner et al. 2012, 2014). What is not well understood is the complex nexus between economic incentives (e.g. higher/lower output and fertilizer prices), regulatory interventions (e.g. varying levels of subsidies for certain measures) and the actual consequences on (surface and ground) water quality.

### *1.4.4 Best practice example*

A "best practice example" for Austria is the farmers network project "Boden.Wasser.Schutz Beratung" (soil-water-protection consulting) which is initiated and part financed by the government of Oberösterreich (http://www.bwsb.at/).[2] Similar projects exist in Steiermark and Niederösterreich. The project is managed and run by a group of consultants who are linked to the chamber of agriculture (a representative organization of farmers).

The services provided by a staff of 15 experts for farmers include:

- regular reports in farm management magazines about good practices
- a newsletter with announcements about events and practical information
- a nutrient calculator (LK-Düngerrechner) for single plots and the whole farm
- organized excursion to best practice farms
- updates about agri-environmental programmes
- consulting including economic effectiveness of programmes
- sampling of water quality in wells, nutrient content of manure, mineral content of soils

An important element of the project is that systematic and repeated are conducted. The results are shaping the training programmes and they are also an important means to

[2] A folder in Englisch is available at: http://www.bwsb.at/?+Team+&id=2500%2C1788928%2C%2C%2C

demonstrate farmers the effectiveness of measures and to inform them about the costs of new of modified practices. Field trips and excursions are important parts of the trainings.

The project is organized in the following way: Wasserbauern (water farmers) are the operators of 43 farms and are the leaders of working-teams of farmers who are committed to reduce the environmental impact. Together with their peers they meet regularly to improve their knowledge and to report about progress and new developments. In total there are 54 working teams of farmers who participate in the programme. The consultants financed by the projects are leading these groups together with the specially trained water-farmers.

## 1.5 Future of agriculture in Austria

### *1.5.1 Production trends in Austria*

Future production trends in agriculture were the topic of two recent publications (Mitter et al., 2015 and Sinabell, Schönhart, Schmid, 2015). In the first of these studies the effects of climate change on agriculture were the main topic. In the second one the consequences of climate mitigation policies were investigated. A short summary of the most important findings is the following:

- Based on the assumptions about future prices provided by OECD and FAO Austrian agriculture will continue to specialize on certain livestock activities. Austria has a comparative advantage in milk and beef production due to the large acreages of grassland.
- Current forecasts about future climate conditions indicate that in Alpine regions where grassland is the dominant agricultural land use, plant growth will benefit mainly because of longer growing seasons.
- Milk and beef production will become more competitive compared to other livestock activities like poultry of sheep.
- Due to environmental legislation an expansion of livestock production will be limited. Another reason is that less agricultural land and thus less feed will be available in future due to urban sprawl. The share of maize will increase at the cost of oats and barley.
- Overall environmental impact will decrease if policies are implemented that seem to be necessary to reduce green house gas emissions to lower levels.
- In neither of the scenarios analyzed in these studies, farm incomes will increase significantly. In some scenarios incomes will drop. The underlying assumption is that technical progress in agriculture will remain high which effectively keeps output prices moderate and farm incomes low.

### *1.5.2 Farm structure development in Austria*

Forecasts on farm structure were published in 2016 by Sinabell. The projections are not based on economic scenario analyses or econometric analyses but on trend extrapolations. Therefore the level of uncertainty about the results is relatively high.

Based on the agricultural census in 1999 and 2013 the rates of structural change was 1.3% per annum for farm enterprises and 2.3% per annum for farm labour. In recent years the level of decline of farm labour was slightly smaller mainly because of the high unemployment rate in the economy. Based on such observations the trend projections for farm structure are:

- The number of farms is likely to decline to 133,000 (from 166,000 in 2013); in particular the number of wine producing farms and livestock farms will decline relatively strong.
- There is significant uncertainty about these forecasts because more recently the number of a new type of farms increased. They are recorded to be commodity producing farms but their primary purpose is for leisure activities.
- Agricultural land is likely to decline to 2.3 million ha of which arable land will be 1.33 million ha (in 2013: 2.7 million ha UAA (Utilized Agricultural Area) and 1.36 million ha arable land).
- The number of persons employed in agriculture is likely to decline by 25% until 2025 compared to the level observed in 2013. The expected number of full time equivalent persons in agriculture is 110,000 in 2025 (compared to 159,000 in 2015).

### *1.5.3 Consequences for water related indicators*

The consequences for water related environmental indicators based on the studies cited in the previous sections are:

- Due to climate change mitigation policies it is very likely that the use of mineral fertilizer will be further reduced. This will be mainly triggered by efficiency gains due to better equipment. The assumption is that new technologies will make this possible.
- Due to changes in the farm structure, intensity of production will increase. In 1999 the average number of LU/farm was 19. This number will increase to around 27 LU/farm in 2025. These farms will be more capital intensive with better trained staff and therefore are likely making use of nutrients in a more efficient manner.
- Until 2025 the livestock is likely to decline from 2.4 million LU in 2013 to 2.2 million LU (livestock units) in 2025. The reductions will take place in all Länder, however not in an equal manner. In some municipalities, LU concentration is likely to increase. In such regions it is likely that regulations similar to the Netherlands (exports of manure to deficit regions) will have to become standard practice. The necessary legal instruments are already available.

## 1.6 Synthesis for Austria

### *1.6.1 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.

### *1.6.2 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.

### *1.6.3 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.

### *1.6.4 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.

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# 2 Country Report: Bosnia and Herzegovina

Matej Bedrač, Tomaž Cunder

## 2.1 Economic and agri-environmental indicators

### *2.1.1 State of agriculture*

Bosnia and Herzegovina (BiH) is small European country. It has little more than 50,000 km$^2$ and 3.8 million inhabitants. The agricultural sector in Bosnia and Herzegovina is politically and economically very important. In 2015, the agricultural sector contributed over 7% (838.1 million €) to the total Gross Value Added and around 18% to total employment. In the period 2005-2015, the share of GVA of the agriculture declined from 10.5% in 2005 to 7.6% in 2015. The share of total employment in the agriculture in the period 2006-2015 declined from around 21% in 2006 to around 18% in 2015. Agriculture is still the most important economic activity in rural areas. It's characterized by extensive production and low productivity. There is declining number of rural households active in agricultural production.

Bosnia and Herzegovina is a net importer of agricultural products. Exports of agro-food products have been slowly increasing (in the period 2005-2015, export/import rate increased from 12% in 2005 to 29% in 2015. According to Bajramović (2015) BiH is still net importer of fruits and vegetables, but positive trends are evident in both productions. In the observed period poultry production has been permanently growing until 2012, but a slight decrease was registered in 2013 and 2014. This is one of the few animal production activities in which BH has almost achieved self-sufficiency. BiH has almost reached self-sufficiency in fresh milk and fresh dairy products, but it is still a significant net importer of butter, dairy spreads, cheese and processed cheeses.

Crop production contributes around 63% to the overall Gross Agricultural Output, while livestock production contributes around 37%. The share of crop and livestock output in total Agricultural Goods Output is based on unofficial data of experimental calculations of the Economic Accounts for Agriculture for Bosnia and Herzegovina prepared by Agency for Statistics of Bosnia and Herzegovina for the period 2005-2010.

### *2.1.2 State of agri-environmental indicators*

With the support from the Millennium Development Goals Fund and the United Nations Environment Programme the first State of the Environment Report for Bosnia and Herzegovina was prepared in 2012. The report is a result of a joint effort of over 40 institutions in the country to consolidate and analyze key environmental data in one document (MFTER, 2013).

The main purpose of the report was to present state of the environment through publicly available data and to create a set of environmental indicators that will be used in the future to monitor the state of the environment. The report serves as a background document for decision-makers on the state and trends of the environment, provides a number of targeted policy options and contributes to science-based decision-making and sustainable environmental governance in Bosnia and Herzegovina.

### *2.1.3 Information gaps*

Bosnia and Herzegovina is currently the only European country that doesn't have the basic structural data about agricultural holdings. Farm Structure Survey harmonized with EU regulations are likely to be implemented by 2020.

## 2.2 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *2.2.1 Review of region specific targets relevant for DRB*

Water resources management in BH is territorially divided into two catchment areas: the Danube / Sava River Basin and the Adriatic Sea catchment area. The Danube/Sava river basin covers approximately 75% and the Adriatic Sea catchment area covers approximately 25% of total area of Bosnia and Herzegovina.

BiH is divided into three autonomous territorial units: the Federation of BiH, the Republika Srpska and the Brčko District. Their institutions are fully responsible for managing water resources within these administrative units. State-level institutions are responsible for the implementation of the established BiH policies and the development of international relations.

All administrative units have their specific Water Laws, which are to a great extent already harmonized with the main EU water related directives: the EU "Water Framework Directive" and the EU" Directive on the assessment and management of flood risks." All entities are obliged to prepare River Basin Management Plan for Sava River Basin District whose main goal is to prepare program of measures i for achieving good ecological and chemical status of surface waters and good chemical and quantitative status of groundwater.

According to the existing legislation related to the water sector in BiH, the competent institutions for the preparation of the Sava RBMP are

- the 'Agency for the water area of the Sava River in Sarajevo' in the Federation of BiH,
- the 'Public Institution Vode Srpske' in Bijeljina for the Sava River Basin Management Plan in the Republic of Srpska and
- the Department of Agriculture, Forestry and Water Management of the Brčko District.

There are two by-laws in the Federation of Bosnia and Herzegovina which define nutrient vulnerable zones and monitoring in these zones. None of such zones has been declared in Federation of Bosnia and Herzegovina. The transposition process of the Nitrate Directive is ongoing in Republika Srpska (ISRBC, 2016).

### 2.2.2 General agricultural policy

In the period 2005-2015 total budgetary support for agriculture in Bosnia in Herzegovina decreased from 82 million € to 63 million €. Most of the available funds were devoted for market measures and direct payments (over 90% in 2015), following by structural and rural development measures and general measures related to agriculture (both with 5% in 2015).

Bosnia and Herzegovina doesn't have countrywide strategic plan for agriculture and rural development. According to Bajramović (2017) each administrative unit of Bosnia and Herzegovina (Federation BiH, Republika Srpska, Brčko district) conducts its own agricultural policy and prepares its own strategies and programming documents.

The federation of BiH adopted a mid-term development strategy for the period 2015-2019. The new strategy envisages the implementation of 37 measures within three pillars. Under the 1st pillar there are 10 measures related to market intervention and direct producer support. In the 2nd pillar there are 17 measures related to sector restructuring and rural development while in the 3rd pillar are 10 measures related to general services in agriculture.

The Republika Srpska has adopted a new strategic plan for the development of agriculture and rural areas for the period 2016-2020. The new strategy contains six strategic goals and 16 specific goals that are proposed to be implemented using 52 different measures.

According to the new strategic document in the first pillar measures a reform of direct producer support is envisaged, aiming to reduce the number and type of instruments. The current coupled direct payments disbursed per unit of output (i.e. output subsidies) are planned to be changed to area and animal payments (13), with the exception of milk and wheat. For milk, a transitory period is proposed that will last until 2018, at which point output subsidies will be gradually reduced and animal payments will be introduced simultaneously. The new strategic document also envisages a higher level of support for capital investments for both the crop and livestock sectors.

In the second pillar the importance of support for less favored areas and the introduction of additional area payments for these areas are planned to start in 2018. The strengthening of measures related to general services in agriculture and higher budgetary allocations for their implementation are also features of the new strategic document. Support for agricultural advisory services, improvement of food safety standards, protection of geographical indications and support for producer organizations in the farming sector are just some of the measures of the third pillar that are considered in the new strategic document.

### 2.2.3 Agri-Environmental programmes

According to APM database (2017) Bosnia and Herzegovina in the period 2004-2014, practically didn't implement any agri-environmental measures. The exception are payments for less-favored areas in agriculture in years 2007 and 2008 in a total amount of 1.2 million € and area/animal payments in 2012 in a total amount of 0.1 million €.

### 2.2.4 Gap analysis

Establishing a monitoring network for the quality of groundwater and protection against anthropogenic influence is a priority for water management in Bosnia and Herzegovina. The influence of exploitation on the ecological status of groundwater is considered insignificant for most of the identified groundwater bodies (excluding the cases stated above), the total groundwater exploitation is far lower than the total estimated aquifer capacity.

## 2.3 Overview of instruments to reduce water pollution in each country

### 2.3.1 Measures Observed

Surface water quality monitoring in BiH is under the competence of the Water Agency. Water quality monitoring started in the sixties of the last century and it was stopped during the nineties because of the war crisis. Regular quality monitoring started again in the year 2000, but not on all BiH rivers and not according to the same schedule. On a larger part of the Sava River Basin in BiH, in parts where the river network is highly developed, regular monitoring was re-established in 2007.

According to the State of the Environment report of Bosnia and Herzegovina (2013) surface water quality, of BiH rivers is generally good considering the content of oxygen in water. Only the Bosna river is significantly more polluted than other rivers. According to average values, nitrate concentrations in BiH rivers in the period 2000 – 2008 were not significant which was to great extent the result of slow agricultural and industrial development and very low use of fertilizers and pesticides. The rivers located in regions with highly developed industry, as for example Spreča River, have reported high concentrations of nitrates.

In compliance with the Water Law of the Federation BiH, protected areas have been classified into five groups: the first three are mostly related to the usable value of water, and the remaining two highlight environmental problems, i.e. providing conditions for development of plant and animal aquatic species. According to Art.65 of the Water Law, protected areas are:

- Areas designated for drinking water abstraction;
- Areas designated for protection of economically important aquatic species;
- Surface water bodies designated for recreation, including areas designated for bathing;
- Areas subject to eutrophication and sensitive to nitrates;
- Areas designated for protection of habitats of plant and animal species or aquatic species where maintenance or improvement of water status is an essential prerequisite for their survival and reproduction. (Strategy water management)

In BiH, the use of fertilizers and pesticides is generally lower than elsewhere in Europe. According to the Environmental and Climate Change Assessment report Water pollution is a problem in areas of BiH due to the direct disposal of waste into rivers or very close to watercourses. Approximately 90% of urban and municipal wastewater is released in the ecosystems directly, without treatment.

#### 2.3.1.1 Training, education and information

In Bosnia and Herzegovina there are several educational and research institutions that have ecological issues as a part of the curriculum. Agricultural extension and advisory services have an important role in farmer's education. Advisors use different groups and individual approaches (lectures, seminars, field trips) and media (e.g. internet, leaflets, posters, brochures, mass media). Advisors provide services dealing mainly with agriculture production, processing and marketing, while agri-environmental issues still has to be improved.

#### 2.3.1.2 Regulatory instruments

In 2014 the Federation of BiH adopted a by-law on hazardous substances. Monitoring is performed for 21 hazardous substances due to lack of adequate equipment for other hazardous substances while in Republika Srpska there were no specific activities regarding hazardous substances pollution reduction. Within regular surface water monitoring, in average 30 priority substances from the revised list of substances in Environmental Quality Standards Directive (EQS)14, was monitored per year. Monitoring of priority substances was performed on less than 10% of identified Water Bodies.

#### 2.3.1.3 Fiscal instruments

In the WSS Assessment report (UNDP, 2011) is stated that the most important resources for improvements in the water sector are ensured through "general" and "special" water fees in the Federation of BIH, and "special" water fees in RS. They include fees for water abstraction, water collection and irrigation, water use fees, water protection fees (costs for discharge of wastewater), and fees for extraction of materials from watercourses. Introduction of economic prices of water use is the main precondition for achieving sustainable use of this resource. The price of use should include not only costs of water supply, maintenance and development of infrastructure facilities of the system, but also environmental and resource costs, which basically represents implementation of the "polluter pays" principle.

According to the Environmental performance review (UNECE, 2004) there is no clear information is available on the existence and application of charges for land use in agriculture or revenues from such instruments.

#### 2.3.1.4 Other measures

Beside Laws on water, Laws on environmental protection in the Federation of BiH, the Republika Srpska and the Brčko district are the founding legal acts that define and set out goals, principles, measures, responsibilities, documents, financing and supervision of environmental protection in BiH.

Environment legislation to some degree addresses a need for protection of water through requiring water permits in the process of issuing integrated environmental permits. Prevention of pollution is regulated by the Environmental law trough procedure of environmental impact assessment and integrated environmental permit, but BiH hasn't have documents on a national level. Entity Laws on Environmental Protection include requirements of IPPC Directive, the Seveso II Directive, the Landfill Directive and the Environmental Impact Assessment Directive etc. Agriculture and/or Land legislation is only focused on the protection of agricultural land (Diktas, 2013).

### *2.3.2 Scale at which the instruments are implemented*

The institutions governing the water sector in Bosnia and Herzegovina function at different administrative levels. There are two state ministries dealing with water issues: the Ministry of Foreign Trade and Economic Relations in the Federation of Bosnia and Herzegovina is responsible for the coordination of activities and harmonization of plans between government bodies in the two entities (Federation of Bosnia and Herzegovina and Republika Srpska). In addition, the Ministry of Agriculture, Water Management and Forestry plays a major role in water management. Under the 2006 Water Act, two water agencies were established: the Sava River District Water Agency, for the Danube basin, and the Adriatic Sea District Water Agency.

### *2.3.3 Effectiveness of measures*

There is no evidence in the literature on the effectiveness and cost-effectiveness of the measures listed above on water quality in BiH.

## 2.4 Evidence from the literature, monitoring reports, evaluation studies

### *2.4.1 Literature review*

According to National human development report (2013) agricultural information, training and advice are critical to improving all parts of the agricultural sector and more attention should be given to environmental issues and to agricultural measures for climate change adaptation and mitigation.

In the Environmental and climate change assessment (IFAD, 2012) also recommends the development of a coherent system of agri-environmental indicators to capture the main positive and negative effects of agriculture on the environment and provide valuable information for assessing agriculture policy in terms of its contribution to the preservation of environmental resources on which the future of agriculture and society at large depend.

### 2.4.2 Information gaps

According to the Water management Strategy for the Federation of Bosnia and Herzegovina the continuity in monitoring of water quality was interrupted in 1992. Organized control of surface water quality in the Federation BiH was resumed in 1995, or 2005, depending on river basin district and competent agencies.

### 2.4.3 Knowledge gaps

According to the literature review for this analysis it can be summarized that there is a great discrepancy between the adopted legislation and strategic documents and the actual implementation of the measures in the field of water protection and agriculture. A Farm structure survey is missing and operational agri-environmental monitoring and evaluation systems are not established or working without making results available to the public.

### 2.4.4 Best practice example

A "best practice example" for Bosnia and Herzegovina is the USAID/Sida project –FARMA. The main objective of the project was to provide technical assistance in agricultural sub-sectors through demand driven assistance aimed at improved competitiveness of agricultural products. During the FARMA project a training the trainers programme was organized in the context of the Nitrates Directive.

The project team organized events and study tours, about the importance of Nitrates Directive, which is important in the perspective of meeting the EU and USAID environmental requirements. The purpose of this activity was to develop a critical mass of educators /extension advisers who can train farmers and others on how to implement the EU Nitrates Directive and facilitate its wider adoption on BiH farms. In total, 58 attendees passed this training of trainers programme.

In the FARMA project pf training of trainers programme, personnel from agricultural extension and inspection services was included and informed about Standards of Good Agricultural Practices (GAP) on farms. Training covered four GAP standards: environment, protection of animal and human health, animal welfare, and good agriculture conditions. The purpose of this activity was to develop a critical mass of educators/extension advisers who can train farmers and others, on ways how to minimize adverse environmental impacts from fertilizer and pesticide use in agriculture in line with EU requirements.

The FARMA project organized also training courses for dairy farmers. Farmers were educated about sources of water pollution from agricultural activities, and on the methods for reducing and preventing water pollution from agricultural sources in accordance with the EU Nitrates Directive requirements. FARMA organized a visit for the farmers to a dairy farm, where they were able to observe proper feeding practices, herd management techniques and how the demonstration farm implemented the EU Nitrates Directive requirements in practice. An additional training was held for the employees of the Agricultural Extension Service in Tuzla on about determination of levels of nitrogen in soil and plant leaf.

## 2.5 Future of agriculture in Bosnia and Herzegovina

### *2.5.1 Production trends in Bosnia and Herzegovina*

There is a lack of available studies about future production. Based on to the available data in the period 2005-2015 statistics on average size of the area, heard size and production of main agricultural products were collected (source ....).

- BiH is net importer of cereals. The average area with cereals in the period 2005-2015 remains relatively stable and was around 300 thousand hectares. The area decreased from 321 thousand hectares in 2005 to 299 thousand in 2015. If the current trend will continue the production of wheat will decrease around 25% by 2025 while production of maize will remain stable (around 190 thousand hectares.
- In the period 2005-2008 the total milk production increased from 648 thousand to 758 thousand tons, while in 2015 total milk production 694 thousand tons. The average milk/cow yield in the observed period increased from 2.2 tons /per cow in 2005 to 2.8 tons/per cow in 2015. If the current trend will continue the average production per dairy cow in 2025 will increase to around 3.6 tons per cow.
- The number of pigs substantially decreased in the period 2005-2015 (from 654.000 in 2005 to 564,000 in 2025. If the current trend will continue the number of pigs in 2025 will be around 490,000.
- Production of poultry meat was permanently growing from 2005 to 2011(from 16 thousand to 73 thousand tons), and slight decrease was registered in 2015(nearly 68 thousand tons). The main reasons for a rapid growth of poultry production were development of meat processing industry, orientation to international markets and changes in consumer's habits towards cheaper meat.

### *2.5.2 Farm structure development in Bosnia and Herzegovina*

Forecasts on farm structure were calculated on the basis of available statistical data (Agency for statistics of BiH).

- The total area of the agricultural land in Bosnia and Herzegovina in period 2005-2015 is about 2.2 million has. According to the data, the rate of structural changes was 0.1% per year. If the current trend will continue the total area of agricultural land will remain the same by the year 2025.
- The area of arable land and permanent grassland in the period 2005-2015 remains stable while the area under permanent crops increased around 7% (from 100 thousand to 107 thousand has). If the current trends will continue by 2025 the area under permanent crops will increase to around 115 thousand ha.

- Based on the data from Labour Force Survey in the period 2006-2015 the number of persons employed in agriculture is likely to decline by 13% until 2025 compared to the level observed in 2015. The expected number of persons employed in agriculture, forestry and fishing will be around 130,000 in 2025 (compared to 147,000 in 2015). It is expected that decline of farm labour will be relatively small mainly because of the high unemployment rate in the economy.

There is great uncertainty about these forecasts. The biggest deficiency is the lack data from a Farm Structure Survey. It has to be emphasized that this is the number of employment in the agriculture, forestry, hunting and fishery sector (A), and not form the Farm structure survey. According to our estimates the number of people working on agricultural holdings is substantial higher.

### *2.5.3 Consequences for water related indicators*

Bosnia and Herzegovina is a potential candidate country for accession to European Union. Because of the changes in the farm structure, reform of agricultural policy and technological progress the intensity of agricultural production will likely increase. However, the introduction of agri-environmental measures will counterbalances the impacts of intensification and will have positive effects to the environment and water quality.

## 2.6 Synthesis for Bosnia and Herzegovina

### *2.6.1 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

### *2.6.2 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.

### *2.6.3 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

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# 3 Country Report: Bulgaria

Victor Platon

## 3.1 Introduction

**Landscape, Climate and Water Flow**

Bulgaria has a part of his territory within the Danube River Basin (DRB). The whole territory of Bulgaria is divided in four river basins: Black Sea Basin, West Aegean River Basin, East Aegean River Basin and the Bulgarian Danube River Basin[3] which will be called BDRB.

The Bulgarian Danube River catchment basin comprises 42.5 percent of the territory of the Republic of Bulgaria and totals 46,930 square kilometers, which makes it the largest in Bulgaria. The main water courses in the Bulgarian section of the river basin are the rivers Erma, Nishava, Ogosta, Iskar, Vit, Osam, Yantra, Rousenski Lom and Danube Dobroudja rivers. The Bulgarian rivers account for 3.4 percent of the total runoff of the Danube River. The Danube River Basin District is composed of two basic morphological structural units: the Danube Plain, typical with its lowlands and hilly and plateau like relief, and the Northern slopes of the Balkan mountain chain, which is split into two parts: Fore-Balkan and Main Balkan Chain.

The territory of the Danube River Basin District includes a large number of various protected areas, namely:

- 38 territories, designated for water abstraction intended for human consumption;
- 15 water bodies, designated for recreational and bathing waters;
- the whole Danube River Basin District contains nutrient-sensitive areas and vulnerable zones
- 55 territories are designated for protection of habitats or wet biological species (2 national parks, 4 natural parks, 14 reserves, 3 maintained reserves, 18 protected areas and 14 natural landmarks).

The territory of the BDRB comprises[4] 104 municipalities, with a total number of population amounting to 3.5 million inhabitants by 31.12.2003. The largest city in Bulgaria, the capital Sofia, is located in the BDRB.

This report will be focussed on the BDRB but in some cases, when data are missing, will be taken into account the whole territory of Bulgaria.

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[3] In order to differentiate from the European Danube River Basin (DRB) the Bulgarian district will be named Bulgarian Danube River Basin (BDRB).

[4] Source: Structure of a River Basin Management Plan for the Danube-River-Basin., Sofia (Bulgaria), September 5th, 2007

## 3.2 Economic and agri-enviornmental indicators

### *3.2.1 State of agriculture*

The Utilised Agricultural Area (UAA) is the total area used by a farm, regardless of the type of tenure or whether it is used as a part of common land. Generally, it includes four major components: arable land, permanent grassland and meadow, permanent crops and kitchen gardens.

In Bulgaria, in 2010, the arable land was essentially dedicated to the production of cereals[5] (1.8 million ha) and industrial crops (1.1 million ha). Cereals covered about half of the country's agricultural area and increased by 11% compared with 2003; industrial crops accounted for about 30% of UAA and increased by 37% over this period.

The area of permanent grassland recorded an almost fourfold increase from 107 390 hectares in 2003 to 382,020 hectares in 2010, corresponding to 11% of the Bulgarian UAA. Pasture and meadow was its main component with 313,200 ha, a very large increase from 95 680 ha in 2003 (see Table 7). This equated to 8.7% of the country's agricultural area in 2010.

According to the Agricultural Census 2010, there were 370,220 agricultural holdings in Bulgaria (see Table 3). The number of farms decreased considerably (-44%) in Bulgaria between 2003 and 2010, as about 295,000 farms ceased their activities.

Despite the sharp decline in the number of farms, the Bulgarian utilised agricultural area (UAA) increased by a quarter (+712,480 ha). In 2010 there were 3.6 million ha of UAA, covering 33% of the entire territory of the country.

In Bulgaria, the combined effect of the decrease in the number of holdings and the increase in agricultural land resulted in a growth of the average size of holdings, which more than doubled from 4.4 hectares per farm in 2003 to 9.8 ha in 2010.

The breakdown of agricultural holdings by size band in Table 3 and Table 4 reveals an interesting characteristic of the Bulgarian population of farms: it is dominated by two opposite size classes but in different respects. In 2010, 80% of holdings had between 0 and 2 ha of agricultural land but accounted for only 3% of the UAA. On the other hand, just 1% of holdings[6] were very big with at least 100 hectares of agricultural land, but these made up 82% of the total Bulgarian UAA.

The polarisation of the structure of Bulgarian agriculture is partially due to the process which took place during the 1990s, when state-owned land was returned to the previous owners or their heirs. The resulting ownership changes led to a shift in the agricultural structure, as the division of land into small pieces brought about a high degree of fragmentation on the one hand, and the establishment of large commercial companies on the other hand.

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[5] Source: Eurostat, Agricultural census in Bulgaria, 2012.

[6] Jerzy Banski, "Agriculture of central Europe in the period of economic transformation" available at: http://www.igipz.pan.pl/en/zpz/banski/PDF/28_Agriculture_Central_Europe.pdf

The number of people regularly working on Bulgarian farms dropped by 45% from 1.3 to 0.7 million between 2003 and 2010. Nonetheless, in 2010 the agricultural labour force still represented 22% of the active population, one of the highest proportions recorded among the EU Member States.

In 2010, the Bulgarian livestock population was about[7] 1.2 million livestock units (LSU), a 29% decrease compared with 2003 (-478,670 LSU). Among the other EU-27 countries, the Czech Republic (1.7 million LSU) and Finland (1.1 million LSU) had similar numbers of livestock.

During transition, the amount of water used for irrigation in Bulgaria has sharply declined. In addition, the share of actually irrigated areas to those that can be irrigated is low. Large sections of existing irrigation systems lie abandoned, and the ones still in use are barely maintained. Crops such as wheat and barley have replaced more water-intensive crops, including vegetables, rice and maize. Irrigation, until recently a major water user in Bulgaria, has been drastically affected. Uneven distribution of Bulgaria's natural water resources over time and space makes irrigation necessary to reduce production risk and insures that the common-pool resource retains continuous high economic importance. Yet, the irrigation systems were built to serve large production units during socialism and do not meet the needs of the huge number of small-scale landowners that emerged following the land restitution process. Moreover, facilities have had high costs and water losses (up to 70%). In the meantime, the irrigation infrastructure largely deteriorated.

### *3.2.2 State of agri/environmental indicators*

The total standard output (SO) of Bulgarian agricultural holdings was[8] 2,458 million € in 2010. Among the other EU-27 countries, Finland (3,098 million €) and Slovakia (1,731 million €) recorded the closest values. The standard output is calculated by adding all the standard output values per hectare of crop and per head of livestock of the farms, and in Bulgaria it increased by 6.2% compared with 2007. However, this growth was not seen in all economic size classes of farms, as holdings with less than 8,000 € of SO saw decreases (see Table 3). Almost half of the standard output of Bulgarian farms (42%) came from large holdings, those with an economic size of 250,000 € or more. They had an SO value of about 1,033 million € SO in 2010.

Four out of the six NUTS 2 regions of Bulgaria recorded very similar values in terms of the standard output; the region of Yuzhen tsentralen had the highest share (20%), followed by Yugoiztochen (19%), Severen tsentralen and Severoiztochen (both with 18%). In contrast, the Yugozapaden region recorded the lowest share (7.7%).

As regarding fertilizers, in the period 2002-2013 the quantity of fertilisers used has oscillated. The quantity distributed per ha recorded a minimum of 74.23 kg/ha in 2005 and a maximum of 136.34 in 2013.

[7] Source: Eurostat, Agricultural census in Bulgaria, 2012.

[8] Source: Eurostat, Agricultural census in Bulgaria, 2012.

*Table 1: Use of fertilizers in Bulgaria*

| Year | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | kg/ha | | | | | | |
| Value | 113.77 | 147.33 | 80.85 | 74.23 | 73.94 | 102.01 | 111.24 | 104.60 | 97.05 | 133.08 | 121.79 | 136.34 |

Source: http://www.indexmundi.com/facts/bulgaria/indicator/AG.CON.FERT.ZS

Water used in agriculture has decreased[9] in Bulgaria in the last 5 years (Annex 6). From a consumption of 939.35 million m³ in 2010 to 828.84 million m³ in 2015. This is small decrease in water consumption (6%). In BDRB the decrease was similar as it was at national level (9%).

## 3.3 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *3.3.1 Review of region specific targets relevant for DRB*

Bulgaria is a national state and part of the EU. All environmental acquis was transposed into the national legislation which has a uniform application on the whole territory.

The EU Nitrates Directive was transposed into Bulgarian law system by Ordinance No 2/2000 on the protection of waters against pollution caused by nitrates from agricultural sources. Based on the requirements of this Ordinance, monitoring points suitable for surface and groundwater are selected, and the first assessment of vulnerable areas was carried out in 2004. The first DRBMP, contains measures to reduce pollution of ground and surface waters by applying good agricultural practice, and a program of measures to mitigate and eliminate pollution, caused by nitrates from agricultural sources.

As in other countries, the policy goals in Bulgaria, in respect with the Nitrates Directives are:

- Monitoring of waters polluted or at risk of nitrate pollution;
- Implementation of Codes of Good Agricultural Practice, by farmers.
- Elaboration of Action Programs to be implemented by farmers
- National monitoring and 4 to 4 years reporting on:
    - Nitrate concentration;
    - Eutrophication;
    - Assessing the impact of Action Plans;
    - Review of VHS and Action Programs.

Anyhow, the implementation of Nitrates Directive in Bulgaria faced some problems. In this matter, he European Commission said[10] on September 29 2016 that it was sending Bulgaria reasoned opinions, the second stage of infringement proceedings, asking Sofia to comply with EU regulations concerning water pollution caused by nitrates. Regarding nitrates water pollution, the EC opened the infringement proceeding against Bulgaria in March 2014, after

[9] Bulgarian Yearbook of Statistic., http://www.nsi.bg/en/content/5071/environment

[10] http://sofiaglobe.com/2016/09/29/ec-steps-up-infringement-proceedings-against-bulgaria-on-water-pollution-digital-markets/

identifying a number of shortcomings in the country's Nitrates Action Programme, as required under the EU rules on nitrates. "*Although Bulgaria has now addressed a number of issues following the modification of the Nitrates Action Programme in June 2016, the country still fails to comply with key provisions, such as the land application of fertilisers and the usage limit of 170 kg N/ha/year for livestock manure*," the Commission said.

In Bulgaria, Nitrate Vulnerable Zones (NVZ)[11] cover 34.5 % of the territory and 69% of agricultural areas.

### *3.3.2 Rural Development Programme in Bulgaria (RDP) 2014-2020*

The Bulgarian Rural Development Programme (RDP 2014-2020) was formally adopted by the European Commission on 26 May 2015, outlining Bulgaria's priorities for using 2.9 billion € of public money that is available for the period 2014-2020 (2.4 billion € from the EU budget, including 28 million € transferred from the Bulgarian envelope for CAP direct payments and 0.5 billion € of national funding).

The four biggest RDP measures in budgetary terms (total public funding) are:

- 841 million € allocated for Measure 4: Investments in physical assets
- 626 million € allocated for Measure 7: Basic services and village renewal in rural areas
- 276 million € allocated for Measure 13: Payments in areas facing natural or other specific constraints
- 271 million € allocated for Measure 6: Farm and business development

For our interest is Priority 4: Restoring, preserving and enhancing ecosystems in agriculture and forestry with an allocation of 983.1 million € and Priority 5: Resource efficiency and shift to low carbon and climate resilience economy in agriculture, food and forestry sectors with an allocation of 430.6 million €.

Water related measures are 4B *Water management* (370 million €) which will cover 2.52% of agricultural land under contracts and 5A *Water efficiency* (106 million €) which will cover 49.78% of irrigated land switching to more efficient irrigation systems.

### *3.3.3 Rural Development Programme in Bulgaria (RDP) (2007-2013)*

The Bulgarian RDP 2007-2013 had an allocation of €3.23 billion distributed across 4 axes.

The objectives of the Bulgarian RDP[12] were addressed by 30 Measures. The implementation of the programme started with 23 Measures, which were implemented in the entire programming period 2007-2013, with the exception of Measures 143, sub-measure 2 of 431 and 611, which were implemented until the end of 2009. Measure 214, Agri-environmental payments was implemented for the whole period.

[11] Factsheet on 2014-2020 Rural Development Programme for Bulgaria., EU., 2016

[12] RURAL DEVELOPMENT PROGRAMME (2007-2013)., Bulgaria, February 2011

The Axis 2 - Improving the environment and the countryside was composed two important measures:

- Measure 213: Natura 2000 payments and payments linked to Directive 2000/60/EC (WFD) – agricultural land, with payment up to 108.835 million €, for the period, 2009-2013
- Measure 224: Natura 2000 payments – forests, with payments up to 15.548 million € for the whole period 2009-2013

The Measure 214, Agri-environmental payments has had an allocation of 435.340 million €. The description of the baseline requirements relevant for the design of each particular type of commitment and for calculating the level of support are described in Annex 7 (this was as an attachment to the Measure 214).

The following annual payment rates were defined within the Measure 214 (€/ha/annum):

- Arable crops, including fodder crops:
    - organic – 155 €/ha;
    - in conversion period – 181 €/ha*
- Pasture and meadows:
    - organic – 82 €/ha;
    - in conversion period – 82 €/ha
- Vegetable crops (including cultivated mushrooms and potatoes):
    - organic - 357 €/ha
    - in conversion period -483 €/ha *
- Perennials, orchards and vineyards including essential-oil roses
    - organic – 418 €/ha;
    - in conversion period – 505 €/ha *
- Essential oil and medicinal crops:
    - organic - 267 €/ha;
    - in conversion period – 340 €/ha*
- Payment for one bee family:
    - organic – 11.5 €/family;
    - in conversion period - 11.5 €/family

## 3.4 Overview of economic/regulatory/informational instruments to reduce water pollution

### *3.4.1 Measures observed / implemented / under review / discussed*

Main instruments to reduce water pollution could be found in several legal documents. Only instruments implemented and in force are discussed.

#### 3.4.1.1 Main regulatory framework in Bulgaria

Bulgaria has transposed the whole EU environmental acquis, including Water Framework Directive and Nitrates Directive.

#### 3.4.1.2 Fees for Uses of Water Resources in Bulgaria

In Bulgaria is in place an elaborated economic mechanism for the water management.

An essential element of the financial organization and the economic regulation of the water sector are fees paid by water users and users of water bodies to the state. Fees for the use of the natural resource "*water*" were introduced by the Water Act 1999, in force since 2000. This Act authorizes the Council of Ministers to set out in a Tariff the particular amount of fees for the different kinds of water uses. Fees have to be paid by water users and water body use permit holders.

In 2000 the Council of Ministers adopted a regulation *Tariff on Fees for Water Uses* and/or Permitted Water Bodies Uses, which entered into force in 2001. This tariff provided the method of the annual calculation of the fees due for specific water uses and water bodies.

Fees are payable annually and are uniform in the whole country. The annual amount of fees is determined on the basis of a formula which takes into account the annual volume of abstracted water, the purpose of water use and corrective coefficients. The amount of fees due for water uses (abstraction fees) is determined by:

- the purpose of use of water resources abstracted from water sources,
- the abstracted water volume,
- the category of water used and
- the average Head of Water (Net Pressure) of Hydro Power Plant.

The amendments to Article 194 paragraph 1 item 1 of the Water Act 2006 regulate the payment of the following fees related to water use rights:

**1. Water abstraction fee for:**

- surface waters
- groundwater
- mineral waters

**2. Fee for water body uses for:**

- abstraction of alluvium/driftage sediments from surface water bodies
- aquacultures and related activities
- recreation and water sports

**3. Pollution fees for:**

- discharge of waste waters into surface waters
- disposal of pollutants into groundwater

**4. Concession payment**

The new Water Act 2006 provided a detailed regulation of fees for the resource water (water abstraction fee, fee for use of the water environment and water pollution fee). Principles for the definition of fees are set out and aim at enhancing the water resource protection and complex water uses. They are based on water use permits and a method of fee calculation for each individual case which is additionally laid down in a regulation of the Council of Ministers.

Accumulated funds are used to finance water infrastructure projects. The main part of these funds is invested in projects for urban treatment plants and urban water supply and sewer age networks, for monitoring and scientific researches. A part of the project financing comes from other financing sources such as co-financing by the Ministry of Regional Development and Public Works.

**5. Fees** for water extraction/investment permitting

The new Environment Protection Act 2002 regulates the payment of fees due for the issue of permits and registrations from the Ministry of Environment and Water at rates laid down in the Tariff approved by the Council of Ministers. The rates are specified on the basis of the approximate average costs incurred by the administration in the issue of such permits.

Pursuant to the Environment Protection Act, the Council of Ministers has accepted the Tariff of Fees which are collected by the Ministry of Environment. The administrative fees determined in the last Tariff (2005) were:

- Fee for water use permit - 117 BGN
- Fee for the extension of the terms or the alteration/amendment of the permit – 50 BGN
- Registration fee for the grant of special water use rights – explicit state property with water bodies being public state property – 175 BGN

Fees are not differentiated by river basins and are uniform for the whole country. This fee is 100%-collectable as it is due before services are rendered. The application for a permit for water use will otherwise not be accepted.

Amounts collected from fees are used by the Enterprise for Management of the Environmental Protection Activities to finance the realization of water sector projects. Control of these revenues is not differentiated by types of services or by basin directorates since no sufficient information on such revenues was available in the past years. The expert evaluation based on the number of permits issued (4,384) for the duration of the Water Act (2000 - 2004) shows that the revenues for the whole country were approximately 430 thousand BGN.

*Table 2: The revenues from concession remunerations (in BGN)*

| | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|
| | | | BGN | | | |
| Revenues | 44,757 | 307,261 | 611,724 | 878,725 | 1,090,121 | 1,751,650 |

The size of the one-time concession remuneration is based on the costs as incurred by the state for the grant of the concession and varies from 1000 to 42,500 BGN.

15% of the concession revenues are directed to a special account of the Ministry of Finance, including the revenues from mineral waters. They financially support the administration in the realization of concession-related activities. Amounts of not less than 30% of the concession remunerations go into the budget of the Municipality, on whose territory the respective mineral waters deposits are located. The remaining receipts are directed to the National budget.

The Water Act envisages the grant of special rights of water use in one case only: on mineral water abstraction for bottling purposes.

It seems that the level of fees and charges are low so the goal is to collect money for water use and not to internalize the social cost of water exploitation.

**6. Subsidy**

The Water Act envisages the grant of financial resources from the National Budget for several activities as:

- Activities of the state administration for the enforcement of the provisions of the Water Act,
- Investment in projects of protective measures against harmful impacts on water, the liquidation of eventual subsequence and the maintenance and recovery of forests within the sanitary-hygiene zones and
- Co-financing of projects funded by the EU.

## 3.5 Evidence from the literature, monitoring reports, evaluation studies

### *3.5.1 Evaluation of health hazards in children from regions with nitrate pollution*[13]

The article shows that nitrate pollution of drinking water can be potentially hazardous with health risks for considerable groups of people. Methemoglobin in blood and concentration of nitrates and nitrites in morning saliva, urine, and plasma as sensitive indicators of nitrate accumulation in the body were analysed in 12-14-year-old children living in villages with nitrate pollution of the drinking water. The children were distributed in two experimental groups of 18-21 children each. Nitrates and nitrites were analysed in biological fluids by a modified cadmium-reduction method. Nitrate accumulation in the body was significantly higher in the nitrate pollution exposed children than in the unexposed children which correlated with greater health hazards.

[13] Source: Gatseva PD1, Mardirosian ZH, Popova EJ, Iskrenova ES, Vladeva SV, Pavlova KI. Department of Hygiene and Ecology, Higher Medical Institute, Plovdiv, Bulgaria

### *3.5.2 Nitrate Pollution of the Lesnovska River caused by Filtration of Chemicals by Agricultural Areas*[14]

The nitrate pollution caused by filtration of chemicals from agricultural areas was a subject to a number of studies during the last decade. The main purpose of the study was to specify the river flow (Q, m3/s), nitrate concentrations and conductivity in a part of the Lesnovska River Basin, situated near the Sofia City, the capital of Bulgaria which is in BRDB. Incoming flow (Q, m3/s) by filtration in to the river and evaluation of the contaminated with nitrate water quantity were defined by means of balance methods, based on the results from the precise performed measuring. The main tasks of the study were verification of the mathematical model of the nitrate pollution formation in the river terraces groundwater and to define the contribution of this contamination in to the river. Thus, the effects of fertilizing on agriculture areas and on the river water quality were determinate on the basis of information about the quantity of the nitrate pollution coming from the groundwater and by filtration (Q, m3/s).

### *3.5.3 Institutional Change in Central and Eastern European Agriculture and Environment* [15]

The CEESA Project explored how the requirements of environmental protection and nature conservation have been taken into account during both the transformation of the political and economic institutions of the CEEC agricultural sectors and the preparation for EU accession. Local case studies were conducted in each of the above–mentioned CEECs. The findings were collected and subjected to detailed scrutiny and discussion at the CEESA Policy Learning Workshops (PLWs), which were field–based workshops that took place in the Czech Republic, **Bulgaria** and Poland. The findings have asserted that the building of institutions for sustainable resource management in agriculture will remain a process in transition, even after accession in 2004. In the new Member States, much effort has been put into the task of adopting the acquis communautaire and creating new administrative bodies (as part of the Copenhagen criteria). This observation confirms that building formal institutions at national and subnational levels of society is a task that can involve fewer difficulties than the challenge of building institutions for local resource management. This latter challenge requires that fundamental economic and political reforms be implemented at an early stage in order to create a positive enabling institutional environment for continued reforms at the local level.

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[14] SVETLANA BOZHINOVAGRIGOR VELKOVSKI ., Chemicals as Intentional and Accidental Global Environmental Threats pp 487-491 ., 2006., Springer

[15] Source: Central and Eastern European Sustainable Agriculture ., VOLUME 4 ., Food and Agriculture Organization of the United Nations Humboldt University of Berlin., FAO 2003

### 3.5.4 Good practice example[16]

Wetland Restoration and Pollution Reduction Project - under World Bank-GEF Strategic Partnership for Nutrient Reduction in the Danube River and Black Sea (Bulgaria: Wetland Restoration and Pollution Reduction Project - component of Danube/Black Sea Strategic Partnership: Nutrient Reduction Investment Fund)

INVESTMENT: GEF 7.5 million US-$

TOTAL PROJECTCOST: 13.6 million US$

PROJECT DURATION: 2002–2007

According to the Transboundary Diagnostic Analysis, Bulgaria is responsible for an annual 7,500 tons of nitrogen (N) and 720 tons of phosphorus (P) running into the Danube. Properly functioning wetlands can retain and recycle nutrients and offer cost-effective solutions to abate N and P loads to meet water quality standards.

At the time of appraisal, the cost-effectiveness ratios for the restored wetlands and the best agricultural practices were estimated at USD 1.3 to USD 5 per kg for N and USD 28.9 to USD 46.2 per kg for P (figures from the Implementation Completion Report, June 23, 2009).

NUTRIENTCHALLENGES:

Poor agricultural practices, including inappropriate and over-applications of fertilizers and pesticides, leading to water pollution Soil

Draining and dyking of flood plains and wetlands reducing capacity for water purifcation

Transboundary nutrient pollution loads, flowing into the Danube River and Black Sea basins

Main project objectives were:

To demonstrate and provide for replication of the reduction of transboundary nutrient loads and other agricultural pollution flowing into the Danube River and Black Sea basins.

To ensure the protection of key target threatened species in the protected areas through wetlands restoration and protected areas management programmes.

To provide support to local stakeholders in adopting environmentally friendly economic activities in the two project areas.

Pilot activities:

Restoration of approximately 3,000 ha of former floodplains — Kalimok marsh and Persina marshes — and use of their capacity for nutrient reduction.

Involvement of local stakeholders in decision making — management of Kalimok-Brushlen protected site by non-governmental association of local stakeholders.

Support to the sustainable environmentally friendly use of natural resources around the restored wetlands.

The restauration areas, Kalimok and Persina[17], are situated in the BDRB, near the Danube River (next figure).

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[16] Source: http:// nutrient-bestpractices.iwlearn.org/ nutrientdb/plomino_documents/ 4c79533405a89d8218c4b7cbaeb17798/getfile?filename=lwebulgarialand_draft4.pdf


*Figure 2: Map of the Wetland Restauration and Pollution Reduction Project*

Source: Document of The World Bank, Report No: ICR00001004, IMPLEMENTATION COMPLETION AND RESULTS REPORT (TF-50706 BUL) ON A GLOBAL ENVIRONMENT FACILITY GRANT IN THE AMOUNT OF US$ 7.5 MILLION TO THE REPUBLIC OF BULGARIA FOR A WETLANDS RESTORATION AND POLLUTION REDUCTION PROJECT, June 23, 2009.

## 3.6 The future of agriculture in Bulgaria

### *3.6.1 Vulnerabilities of Bulgarian agriculture*

Climate change will influence mostly vulnerable agricultural areas in Bulgaria as: a) spring agricultural crops, due to the expected precipitation deficit during the warm half-year; b) crops cultivated on infertile soils; c) crops on non-irrigated areas; d) arable lands in south-east Bulgaria where even during the present climate, precipitation quantities are insufficient for normal growth, vegetation and productivity of agricultural crops.

[17] As a fact of interest, in Persina Natural Park is situated the locality Belene where, in 2006, was planned to be built the Belene Nuclear Power Plant. This was an energy project for the construction of a 2000 MW Nuclear Power Plant (NPP) located in the Bulgarian town of Belene on the Danube. The Belene NPP was supposed to become Bulgaria's second NPP after the Kozloduy NPP, located in another Danube town, that was built in the 1970s. In late March 2012, the Bulgarian government of Prime Minister Boyko Borisov and the center-right GERB party terminated the Belene NPP project.

### 3.6.2 Pests and diseases

Generally, in the future climate an increased pest population is expected. Some crop diseases and pests will decrease because of warming and the rainfall deficit during the warm half of the year; however, different kinds of diseases and pests, which currently flourish in the southern regions of the European continent, will appear.

Scenarios on future changes in agriculture largely depend on assumptions about technological development for future agricultural[18] land use in Europe. It has been estimated that changes in the productivity of food crops in Europe over the period 1961–1990 were strongest related to technology development and that effects of climate change were relatively small. For the period till 2080 an increase in crop productivity for Europe has been estimated between 25% and 163%, of which between 20% and 143% is due to technological development and 5-20% is due to climate change and CO2 fertilization. The contribution[19] of climate change just by itself is approximately a minor 1%.

### 3.6.3 Benefits and opportunities for Bulgaria

Initially, owing to warmer temperatures, the decrease in precipitation and the longer growing seasons, there may be an improvement in crop productivity (cereals, oilseeds and sugar beet) in countries such as Bulgaria[20], the Czech Republic, Hungary, Poland and Romania.

From a case study for the northeast region it was concluded that the impact of climate changes on crop yields, measured as variation of gross agricultural output, is positive. It varies between 11% and 23% for the different climate scenarios. Secondly, the impacts of this climate caused crop yield changes on the regional economy are expected to be positive with increases between 2% and 4% in the total output compared to the baseline scenario.

The increase of temperatures at an effective doubling of the CO2 concentration leads to the increase of the agroclimatic thermal potential in Bulgaria - longer growing period and bigger amount of effective temperatures during the same time interval. The precipitation amounts increase or slightly decrease during the potential growing period and decrease in the non-growing period due to the shifting of the dates of sustainable air temperature transition in autumn and spring to the beginning and the end of the winter season. The climate change scenarios derived for Bulgaria were used to evaluate changes in potential and actual crop growing season and grain yield of maize and winter wheat. Under equilibrium 2xCO2, the

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[18] *Future scenarios of European agricultural land use I. Estimating changes in crop productivity* F. Ewerta, *, M.D.A. Rounsevellb , I. Reginsterb, M.J. Metzgera , R. Leemansc., Agriculture, Ecosystems and Environment 107 (2005) 101–116

[19] Land-use and climate change within assessments of biodiversity change: A review

Jacqueline de Chazal, Mark D.A. Rounsevell., Centre for the study of Environmental Change and Sustainability, School of Geosciences, University of Edinburgh, Drummond Street, Edinburgh EH8 9XP, UK

[20] Future Impacts of Climate Change across Europe., CEPS Working Document No. 324/February 2010., Arno Behrens, Anton Georgiev and Maelis Carraro

potential crop growing season was projected to increase by 1-2 months. Hence, a northward shift of productive potential in Bulgaria was evident. This northern shift corresponds to the BDRB.

### *3.6.4 Future changes in land use*

If technology continues to progress at current rates then, in Bulgaria, the area of agricultural land would need to decline substantially. Such declines will not occur if there is a correspondingly large increase in the demand for agricultural goods, or if political decisions are taken either to reduce crop productivity through policies that encourage extensification or to accept widespread overproduction.

Cropland and grassland areas (for the production of food and fibre) may decline by as much as 50% of current areas for some scenarios. Such declines in production areas would result in large parts of Europe becoming surplus to the requirement of food and fibre production. Over the shorter term (up to 2030) changes in agricultural land area may be small.

Although it is difficult to anticipate how this land would be used in the future, it seems that continued urban expansion, recreational areas and natural parks and forest land use would all be likely to take up at least some of the surplus. Furthermore, whilst the substitution of food production by energy production was considered in these scenarios, surplus land would provide further opportunities for the cultivation of bioenergy crops which would create more problems than solving (increase the use of water and fertilizers etc).

### *3.6.5 Likely consequences for water related agri-environmental indicators in DRB*

Due to the growing of quality food and climate change, the agricultural production will intensify its management including irrigation.

The use of more efficient irrigation systems can be expected in Bulgaria because of the need for tighter water management practices to counter increased demand. For orchards and vines, drip-irrigation systems can be used to conserve water. Water losses through seepage and evaporation in canal and flood irrigation systems can be minimized by lining the canals with cement or switching to pipe irrigation systems. The significantly higher costs of production related to irrigation systems will most likely result in shifts to less water-demanding uses in areas where there are higher rates of moisture loss.

The main adaptation measures cover organizational and managerial, financial and economic, and legislative aspects of irrigation and irrigated agriculture and should aim at:

- improvement of management, use and protection of water resources in irrigated agriculture;
- improving the efficiency of the management and use of the existing irrigation facilities and elaboration of the technological and technical facilities for irrigation;

- use of rational and economically sound irrigation regimes for the irrigated crops and elaboration of the technologies for cultivation of crops in the conditions of droughts and water deficit.

## 3.7 Synthesis for Bulgaria

### *3.7.1 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[21] in the Bulgarian agriculture. Some studies[22] 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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[21] 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

[22] 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.

### *3.7.2 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.

### *3.7.3 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.

### *3.7.4 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 neighbouring countries such as Greece, Turkey, and so forth.

## Annex

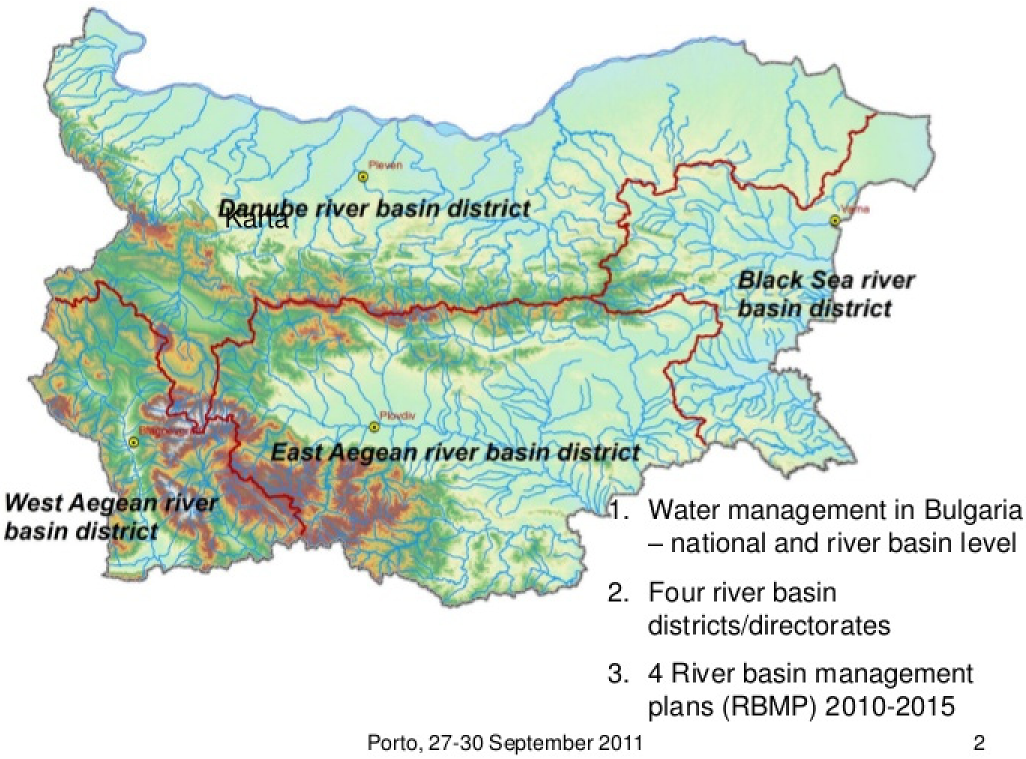


*Figure 3: River basins in Bulgaria*

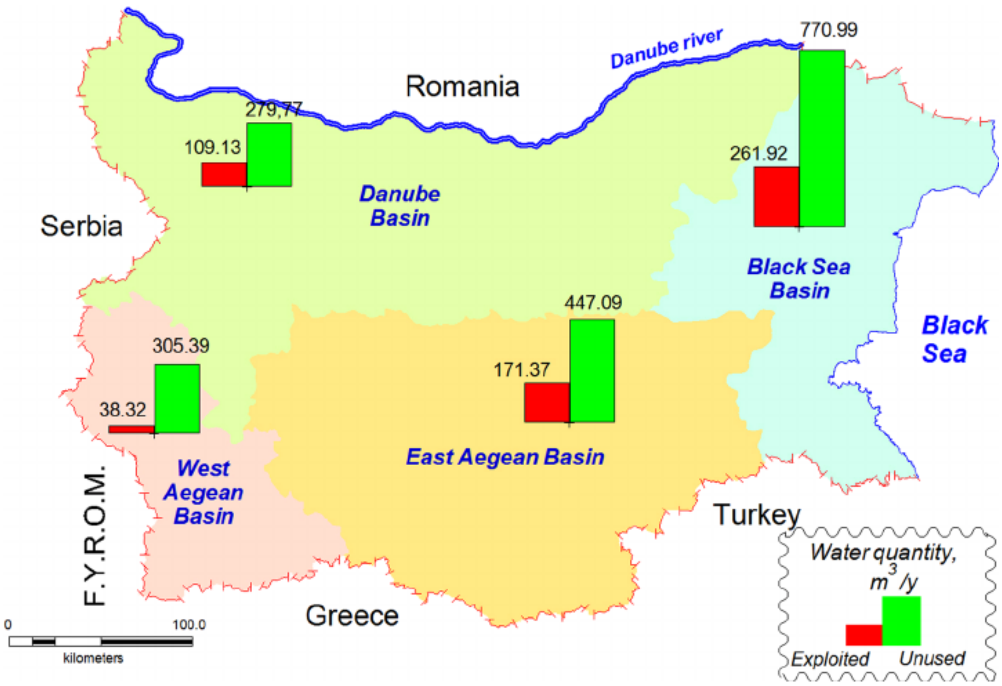


*Figure 4: River basins in Bulgaria – Use of Water*


*Figure 5: Danube River Basin*

Source: ICPDR.

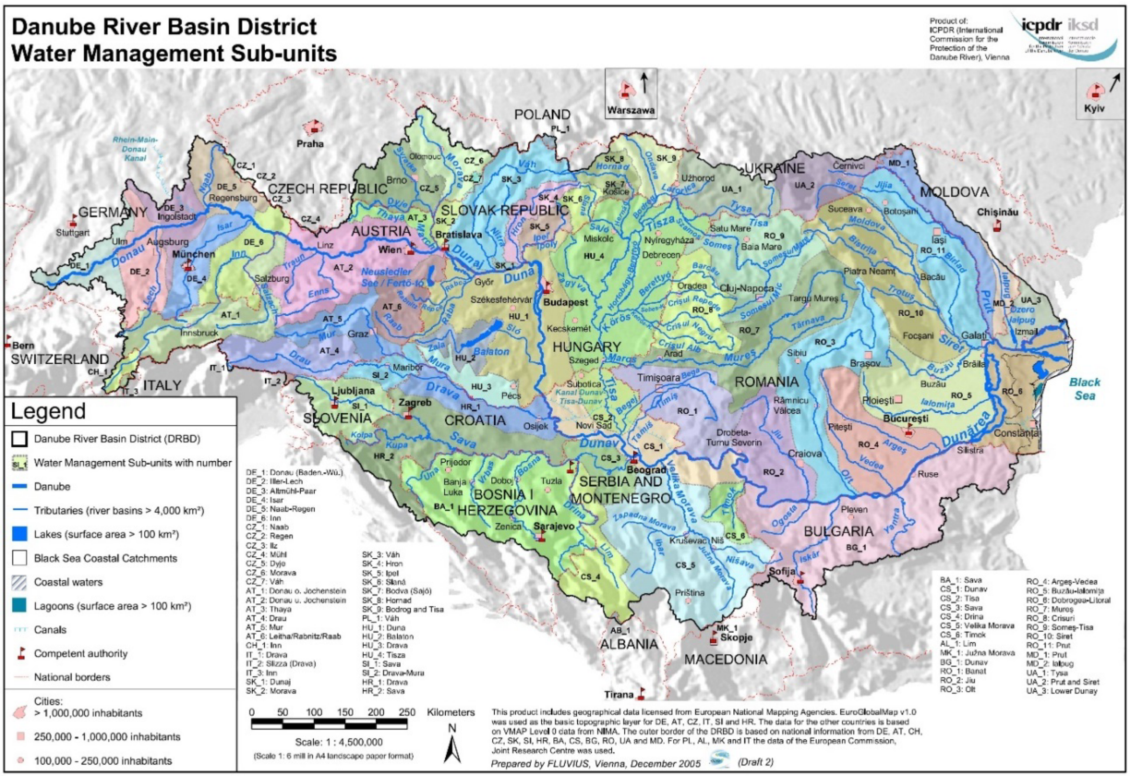


*Figure 6: Danube River Basin District, Water Management Sub-Units*

Source: ICPDR.

*Table 3: Farm Structure, key indicators, Bulgaria, 2003 and 2010*

| Bulgaria | 2003 | 2010* | Change (%) |
|---|---|---|---|
| Number of holdings | 665,550 | 370,220 | -44.4 |
| Total UAA (ha) | 2,904,480 | 3,616,960 | 24.5 |
| Livestock (LSU) | 1,628,140 | 1,149,470 | -29.4 |
| Number of persons working on farms (Regular labour Force) | 1,348,110 | 738,630 | -45.2 |
| Average area per holding (ha) | 4.4 | 9.8 | 123.9 |
| UAA per Inhabitant (ha/person) | 0.37 | 0.48 | 29.2 |

*Figures on common land not included

*Source:* Eurostat (online data codes: ef_ov_kvaa, ef_kvaareg, demo_pjan and FSS 2000 and 2010).

*Table 4: Farm structure, key indicators, by NUTS 2 regions, Bulgaria, 2003 and 2010*

| | | 2003 | 2010* | Change 2010/2003 (%) |
|---|---|---|---|---|
| Number of holdings | Bulgaria | 665 550 | 370 220 | -44.4 |
| | Severozapaden | 119 650 | 51 290 | -57.1 |
| | Severen tsentralen | 88 310 | 43 280 | -51.0 |
| | Severoiztochen | 79 130 | 43 750 | -44.7 |
| | Yugoiztochen | 100 450 | 56 950 | -43.3 |
| | Yugozapaden | 112 880 | 65 510 | -42.0 |
| | Yuzhen tsentralen | 165 130 | 109 450 | -33.7 |
| Total UAA (ha) | Bulgaria | 2 904 480 | 3 616 960 | 24.5 |
| | Severozapaden | 560 030 | 749 520 | 33.8 |
| | Severen tsentralen | 600 310 | 718 170 | 19.6 |
| | Severoiztochen | 702 620 | 738 440 | 5.1 |
| | Yugoiztochen | 581 550 | 731 360 | 25.8 |
| | Yugozapaden | 141 280 | 235 240 | 66.5 |
| | Yuzhen tsentralen | 318 690 | 444 240 | 39.4 |
| Livestock (LSU) | Bulgaria | 1 628 140 | 1 149 470 | -29.4 |
| | Severozapaden | 269 600 | 158 340 | -41.3 |
| | Severen tsentralen | 287 010 | 193 590 | -32.5 |
| | Severoiztochen | 266 360 | 182 480 | -31.5 |
| | Yugoiztochen | 273 510 | 219 220 | -19.8 |
| | Yugozapaden | 187 130 | 122 150 | -34.7 |
| | Yuzhen tsentralen | 344 540 | 273 690 | -20.6 |
| Number of persons working on farms (Regular labour Force) | Bulgaria | 1 348 110 | 738 630 | -45.2 |
| | Severozapaden | 230 800 | 97 270 | -57.9 |
| | Severen tsentralen | 193 500 | 94 080 | -51.4 |
| | Severoiztochen | 166 780 | 89 590 | -46.3 |
| | Yugoiztochen | 195 920 | 110 880 | -43.4 |
| | Yugozapaden | 220 420 | 125 160 | -43.2 |
| | Yuzhen tsentralen | 340 680 | 221 660 | -34.9 |
| Average area per holding (ha) | Bulgaria | 4.4 | 9.8 | 123.9 |
| | Severozapaden | 4.7 | 14.6 | 212.2 |
| | Severen tsentralen | 6.8 | 16.6 | 144.1 |
| | Severoiztochen | 8.9 | 16.9 | 90.1 |
| | Yugoiztochen | 5.8 | 12.8 | 121.8 |
| | Yugozapaden | 1.3 | 3.6 | 186.9 |
| | Yuzhen tsentralen | 1.9 | 4.1 | 110.3 |

**Figures on common land not included*

*Source:* Eurostat (online data codes: ef_ov_kvaa, ef_kvaareg and FSS 2000 and 2010).

*Table 5: Agricultural area size classes, in Bulgaria (2010)*

| Agricultural area size classes | Total number of holdings | | Utilised agricultural area | |
|---|---|---|---|---|
| | number | % | ha | % |
| Total | 370,490 | 100% | 4,475,530 | 100% |
| | number of holdings | % holdings | UAA | % UAA |
| 0 ha | 13 150 | 4% | 0 | 0% |
| >0-<2 ha | 294 960 | 80% | 144 180 | 3% |
| 2-<5 ha | 30 390 | 8% | 90 450 | 2% |
| 5-<10 ha | 10 730 | 3% | 72 700 | 2% |
| 10-<20 ha | 6 820 | 2% | 92 450 | 2% |
| 20-<30 ha | 2 950 | 1% | 70 040 | 2% |
| 30-<50 ha | 3 060 | 1% | 116 180 | 3% |
| 50-<100 ha | 2 930 | 1% | 201 670 | 5% |
| >=100 ha | 5 490 | 1% | 3687 860 | 82% |

*Source:* Eurostat (online data codes: ef_ov_kvaa, ef_kvaareg and FSS 2000 and 2010).

*Table 6: Economic size of the farm by standard output size classes, Bulgaria, 2007 and 2010*

| Standard output | Standard output (SO) of the holding | | change (%) |
|---|---|---|---|
| | 2007 | 2010* | |
| Total | 2 314 429 630 | 2 458 262 780 | 6.2 |
| 0-<2 000 | 263 243 120 | 221 487 460 | -15.9 |
| 2 000-<4 000 | 229 289 220 | 164 064 030 | -28.4 |
| 4 000-<8 000 | 206 328 020 | 144 664 190 | -29.9 |
| 8 000-<15 000 | 134 721 270 | 135 306 870 | 0.4 |
| 15 000-<25 000 | 92 926 840 | 115 887 840 | 24.7 |
| 25 000-<50 000 | 138 907 580 | 164 245 660 | 18.2 |
| 50 000-<100 000 | 160 880 030 | 177 429 170 | 10.3 |
| 100 000-<250 000 | 266 016 950 | 302 467 280 | 13.7 |
| 250 000-<500 000 | 246 656 180 | 326 880 050 | 32.5 |
| >= 500 000 | 575 460 410 | 705 830 240 | 22.7 |

*Figures on common land not included.,

Source: Eurostat, FSS, 2007 and 2010.

*Table 7: Utilised Agricultural Area by land use, Bulgaria, 2003 and 2010**

| | 2003 | | 2010* | | change 2010/2003 (%) |
|---|---|---|---|---|---|
| | Ha | % of UAA | Ha | % of UAA | |
| Land use | 2 904 480 | 100,0 | 3 616 960 | 100.0 | 24.5 |
| Arable land, out of which: | 2 674 910 | 92.1 | 3 124 930 | 86.4 | 16.8 |
| Cereals | 1 609 920 | 55.4 | 1 787 800 | 49.4 | 11.0 |
| Pulses (total) | 16 750 | 0.6 | 8 350 | 0.2 | -50.1 |
| Potatoes | 17 160 | 0.6 | 13 550 | 0.4 | -21.0 |
| Sugar beet | 380 | 0.0 | 40 | 0.0 | -89.5 |
| Fodder roots and brassicas | 1 920 | 0.1 | 140 | 0.0 | -92.7 |
| Industrial crops (total) | 784 840 | 27.0 | 1 076 990 | 29.8 | 37.2 |
| Fresh vegetables, melons, strawberries | 29 730 | 1.0 | 24 470 | 0.7 | -17.7 |
| Flowers and ornamental plants (total) | 150 | 0.0 | 230 | 0.0 | 53.3 |
| Fodder crops | 101 250 | 3.5 | 105 990 | 2.9 | 4.7 |
| Seeds and seedlings | 880 | 0.0 | 530 | 0.0 | -39.8 |
| Other crops on arable land | 0 | 0.0 | 340 | 0.0 | - |
| Fallow land - total (with and w/o subsidies) | 111 940 | 3.9 | 106 490 | 2.9 | -4.9 |
| Kitchen gardens | 21 050 | 0.7 | 10 360 | 0.3 | -50.8 |
| Permanent grassland and meadow | 107 390 | 3.7 | 382 020 | 10.6 | 255.7 |
| Pasture and meadow | 95 680 | 3.3 | 313 200 | 8.7 | 227.3 |
| Rough grazing | 11 710 | 0,4 | 12 770 | 0.4 | 9.1 |
| Permanent grassland and meadow - not used for production, eligible for subsidies | - | - | 56 060 | 1.5 | - |
| Permanent crops | 101 130 | 3.5 | 99 650 | 2.8 | -1.5 |
| Fruit and berry plantations | 31 580 | 1.1 | 45 500 | 1.3 | 44.1 |
| Citrus plantations | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Olive plantations | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Vineyards | 68 490 | 2.4 | 52 340 | 1.4 | -23.6 |
| Nurseries | 950 | 0.0 | 1 330 | 0.0 | 40.0 |
| Other permanent crops | 120 | 0.0 | 470 | 0.0 | 291.7 |
| Permanent crops under glass | 0 | 0.0 | 0 | 0.0 | 0.0 |

**Figures on common land not included*

*Source:* Eurostat (online data codes: ef_lu_ovcropaa and ef_oluaareg).

*Table 8: Water abstraction by River Basin District (RBD), in Bulgaria (2010-2015)*

| River Basin Districts | | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | % | 2015/ 2010 |
|---|---|---|---|---|---|---|---|---|---|
| Bulgaria | Total gross fresh water abstraction[1] | 5960,09 | 6385,10 | 5715,05 | 5468,22 | 5375,56 | 5629,11 | 100% | 94% |
| | Fresh surface water - total gross abstraction | 5403,39 | 5840,35 | 5149,44 | 4910,18 | 4828,72 | 5070,75 | | |
| | of which: Public water supply | 488,32 | 480,35 | 487,62 | 468,15 | 426,94 | 428,45 | | |
| | Self and other supply | 4915,08 | 5360,00 | 4661,83 | 4442,03 | 4401,79 | 4642,30 | | |
| | Fresh groundwater - total gross abstraction | 556,70 | 544,74 | 565,61 | 558,04 | 546,84 | 558,35 | | |
| | of wich: Public water supply | 441,09 | 436,20 | 446,20 | 443,08 | 429,22 | 440,85 | | |
| | Self and other supply | 115,61 | 108,54 | 119,41 | 114,96 | 117,62 | 117,51 | | |
| | Non freshwater sources | 0,34 | 0,35 | 0,54 | 0,52 | 0,44 | 0,38 | | |
| | Water losses, total[2] | 973,01 | 1087,96 | 1154,93 | 992,09 | 864,39 | 907,45 | | |
| Danube | Total gross fresh water abstraction[1] | 3185,86 | 3265,10 | 3014,35 | 2801,06 | 2762,22 | 2896,07 | 51.45% | 91% |
| | Fresh surface water - total gross abstraction | 3006,13 | 3093,39 | 2841,78 | 2634,64 | 2595,44 | 2724,25 | | |
| | of wich: Public water supply | 299,03 | 292,51 | 287,78 | 269,58 | 245,54 | 242,88 | | |
| | Self and other supply | 2707,10 | 2800,88 | 2554,00 | 2365,07 | 2349,90 | 2481,38 | | |
| | Fresh surface water - total gross abstraction | 179,74 | 171,71 | 172,57 | 166,42 | 166,78 | 171,82 | | |
| | of wich: Public water supply | 143,24 | 142,36 | 145,74 | 142,96 | 141,57 | 148,33 | | |
| | Self and other supply | 36,49 | 29,35 | 26,83 | 23,46 | 25,21 | 23,49 | | |
| | Non freshwater sources | - | - | - | - | - | - | | |
| | Water losses, total[2] | 313,02 | 311,31 | 329,93 | 292,27 | 242,48 | 259,81 | | |
| Black Sea | Total gross fresh water abstraction[1] | 631,34 | 690,99 | 531,58 | 398,10 | 435,48 | 303,03 | 5.38% | 48% |
| | Fresh surface water - total gross abstraction | 552,88 | 616,91 | 447,21 | 316,03 | 352,27 | 220,09 | | |
| | of wich: Public water supply | 101,17 | 99,50 | 113,52 | 109,81 | 97,73 | 94,12 | | |
| | Self and other supply | 451,71 | 517,41 | 333,70 | 206,22 | 254,55 | 125,97 | | |
| | Fresh surface water - total gross abstraction | 78,46 | 74,09 | 84,37 | 82,07 | 83,21 | 82,95 | | |
| | of wich: Public water supply | 62,77 | 61,44 | 68,73 | 71,48 | 72,85 | 74,44 | | |
| | Self and other supply | 15,69 | 12,65 | 15,64 | 10,59 | 10,35 | 8,51 | | |
| | Non freshwater sources | 0,34 | 0,35 | 0,54 | 0,52 | 0,44 | 0,38 | | |
| | Water losses, total[2] | 137,65 | 155,41 | 156,28 | 134,56 | 123,31 | 145,55 | | |
| East Aegean | Total gross fresh water abstraction[1] | 2025,10 | 2313,15 | 2050,12 | 2145,36 | 2057,00 | 2297,02 | 40.81% | 113% |
| | Fresh surface water - total gross abstraction | 1761,39 | 2048,55 | 1779,67 | 1878,69 | 1805,30 | 2045,11 | | |
| | of wich: Public water supply | 40,59 | 41,65 | 40,94 | 38,65 | 35,69 | 38,86 | | |
| | Self and other supply | 1720,80 | 2006,90 | 1738,72 | 1840,04 | 1769,61 | 2006,25 | | |
| | Fresh surface water - total gross abstraction | 263,71 | 264,60 | 270,45 | 266,67 | 251,70 | 251,91 | | |
| | of wich: Public water supply | 210,74 | 209,26 | 208,42 | 199,61 | 187,29 | 188,47 | | |
| | Self and other supply | 52,97 | 55,34 | 62,04 | 67,06 | 64,41 | 63,44 | | |
| | Non freshwater sources | - | - | - | - | - | - | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Water losses, total[2] | 476,36 | 573,95 | 620,61 | 510,75 | 450,53 | 449,72 | 7.99% | 94% |
| West Aegean | Total gross fresh water abstraction[1] | 117,79 | 115,85 | 119,01 | 123,71 | 120,87 | 132,98 | | |
| | Fresh surface water - total gross abstraction | 83,00 | 81,50 | 80,78 | 80,82 | 75,71 | 81,31 | | |
| | of wich: Public water supply | 47,53 | 46,69 | 45,37 | 50,12 | 47,98 | 52,60 | | |
| | Self and other supply | 35,47 | 34,81 | 35,41 | 30,70 | 27,72 | 28,71 | | |
| | Fresh surface water - total gross abstraction | 34,79 | 34,35 | 38,23 | 42,89 | 45,16 | 51,68 | | |
| | of wich: Public water supply | 24,34 | 23,14 | 23,32 | 29,03 | 27,52 | 29,60 | | |
| | Self and other supply | 10,45 | 11,21 | 14,91 | 13,86 | 17,64 | 22,08 | | |
| | Non freshwater sources | - | - | - | - | - | - | | |
| | Water losses, total[2] | 45,99 | 47,30 | 48,11 | 54,51 | 48,07 | 52,37 | | |

Note: The quantity is calculated as a sum of water abstracted for water supply and for self-supply of enterprises (without water for hydropower generation). Source of data: is the exhaustive statistical survey on water supply (Irrigation systems and Public water supply /PWS/), and for delf-supply partial statistical survey covering major water users (using over than 36 000 m3 annually). Waters abstracted by households and those used for hydropower generation are not included. The total gross abstraction also includes "returned" water (extracted and taken back to the source without being used).

Water losses (total) reported by water operators include include physical losses at transport, unauthorized consumption, measurement errors, and more. Data are resulting of an estimate using regionalizing factor "Water supplied".

Source: Yearbook of Statistics, Bulgaria, 2016.

*Table 9: Financial allocations of the Bulgarian RDP, by Axes (2007-2013)*

| Axes | Total public contribution € | % |
|---|---|---|
| Axis 1. Improving the competitiveness of the agricultural and forestry sector | 1,214,075,316 | 37.0% |
| Axis 2. Improving the environment and the countryside | 777,394,110 | 23.7% |
| Axis 3. The quality of life in rural areas and the diversification of the rural economy | 905,291,684 | 27.6% |
| Axis 4. LEADER | 76,988,306 | 2.3% |
| Technical assistance | 123,181,289 | 3.8% |
| Complements to direct payments | 181,841,021 | 5.5% |
| Total General | 3,278,771,726 | 100.0% |

Source: Bulgarian RDP 2007-2013, consolidated version, 2011.

*Table 10: Organic Farming Scheme, in Bulgaria, in RDP 2007-2013 (Annex to Measure 214)*

| | |
|---|---|
| Environmental Objectives: | To increase the area of agricultural land and the number of farms managed according to accredited organic farming standards;<br>To encourage the establishment and development of a variety of organic production systems;<br>To encourage more "balanced" organic farming systems based upon crop rotations and the integration of crop and livestock production;<br>To maintain local and regional balances and protect soil and water using the natural resources and energy;<br>To improve rural landscapes by maintaining biodiversity and protecting natural habitats, which also helps to attract and retain population;<br>To increase the availability of seed and propagation materials that are produced according to accredited organic farming standards;<br>Due to prohibition on utilization of fertilizers and synthetic plant protection products organic farming plays a positive role in biodiversity conservation, improves the soil and water quality and contributes to the achievement of a balance in the soil – plants – livestock system. The organic plant growing encourages the use and therefore the conservation of traditional local varieties and breeds; selected because they are more resistant to pests and diseases due to their adaptability to local conditions. This also explains why organic farming has a positive impact on genetic biodiversity in agriculture.<br>Organic apiculture will improve the pollination of wild plants and contribute to the protection of the biodiversity. It will also improve the pollination of fruit-growing crops and their production without using additional quantities of nitrogen containing fertilizers which will lead to preservation of soils. |
| Geographical Scope: | Whole territory of Bulgaria |
| Management Requirements: | *In order to participate in Sub-measure Organic Farming the beneficiary shall undertake the following commitments:*<br>To follow the requirements of Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No. 2092/91 on the whole farmers block (all agricultural parcels in the farmers block should be managed in organic way and/or in conversion or should be set aside and certified. For the set aside areas the farmers will not receive payments.)<br>Sign a contract with a Control body approved by the Bulgarian Ministry of Agriculture and Food for conversion and/or on-going management.<br>To receive a certificate for successful conversion to organic production during the 5 year period for implementation of the measure<br>*In order to participate in Sub-measure Organic Apiculture the beneficiary shall undertake the following commitments:*<br>To follow the requirements of the Council Regulation (EC) 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No. 2092/91<br>Sign a contract with a Control body approved by Bulgarian Minister of Agriculture and Food for conversion and/or on-going management.<br>To receive a certificate for successful conversion to organic production during the 5 year period for implementation of the measure<br>To keep all the bee families in the farm in compliance with organic farming methods. |
| Expected Environmental Impact: | Two implemented targets of the *National Strategy and Action Plan for Development of Organic Farming in Bulgaria* during the period 2007 -2013<br>3% of all Bulgarian food products sold in Bulgaria to be organic by 2013;<br>8% of the whole utilized agriculture land to be under organic management by 2013; |
| Payment Rates: | The methodology for payment calculations is presented in Annex 5 (*Attachment 3 to Measure 214*).<br>The following annual payment rates are defined (EUR/ha/annum):<br>Arable crops, including fodder crops:<br>organic – 155 EUR/ha;<br>in conversion period – 181 EUR/ha*<br>Pasture and meadows:<br>organic – 82 EUR/ha; |

in conversion period – 82 EUR/ha
Vegetable crops (including cultivated mushrooms and potatoes):
organic - 357 EUR/ha
in conversion period -483 EUR/ha *
Perennials, orchards and vineyards including essential-oil roses
organic – 418 EUR/ha;
in conversion period – 505 EUR/ha *
Essential oil and medicinal crops:
- organic - 267 EUR/ha;
in conversion period – 340 EUR/ha*
Payment for one bee family:
- organic – 11.5 EUR/family;
- in conversion period - 11.5 EUR/family
*Payment rates for conversion may be received by the farmers not longer than the standard conversion period for the crop grown according to Council Regulation (EC) 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No. 2092/91

Source: Bulgarian RDP 2007-2013, consolidated version, 2011.

# 4 Country Report: Croatia

Matej Bedrač, Tomaž Cunder

## 4.1 Economic and agri-environmental indicators

### *4.1.1 State of agriculture*

Croatia is small central European country. It covers 56,594 km² and it has 4.4 million of inhabitants. Agricultural land covers around 40% of the total area, while forests cover 36 %. Agriculture plays an important economic role in Croatia. Its share of Gross Value Added of all activities remained between 4.2% in 2007 and 5% in 2012 while in the 2016 was 4%. The Gross Value Added (GVA) of this sector increased from 1,543 million € in 2005, to 2,035 million € in 2008. Since then it has decreases to 1,940 million € in 2016. The share of agriculture in total employment fluctuating, with a decreasing trend from 16.9% in 2005 to 13.7% in 2012 while in 2016 decreased to 7.6%.

Croatia has an unfavourable structure of agricultural holdings with a lot of small family farms According to the farm structure survey 2013 the average size official large average farm size in Croatia is 5.6 ha) and some large state owned agribusinesses. A large majority of family farms are extremely fragmented and the cultivated land is divided in different parcels often located very far from each other. The small parcel size is one reason for a general inefficient agricultural production.

Despite the good climate conditions for growing many varieties, the country suffers from deficit in the agri-food sector. Croatia is currently self-sufficient in the production of only a few products: potatoes, poultry meat, eggs, corn, wine, sugar and wheat. Croatia is neither self-sufficient in beef production (self-sufficiency rate is less than 80%) nor in milk production (approximately 85%). The degree of self-sufficiency in the production of poultry meat in Croatia, between 80 and 90%, is higher than in other types of meat. However, a further decrease is expected and in 2016 domestic production would meet 81.17% of the domestic needs (Meat sector).The lack of self-sufficiency for the majority of agricultural products provides a significant margin for increasing income through higher yields and productivity to fulfill the domestic market needs

The most important crop production in Croatia is production of cereals which comprise around 64% of total arable land. Maize and wheat are the most important commodities in the cereals sector. During the period 2008 to 2012, cereals were produced on an average of 560,000 hectares and production on average totaled to 3.1 million tons.

According to the statistical data, the cereals sector contributes around 20% to the overall Croatian Gross Agricultural Output or 34% to the crop production–. This is a relatively small share compared to the share of arable land that it takes. The main reasons for Croatian cereals productions not being competitive compared to European agriculture are small farms, small scale of production as well as technological problems (e.g. seeds and outdated machinery).

According to data, in 2016 the share of livestock production in the total value of agricultural production was 37.5% which is less than the average in EU 27 countries. The most prominent shortcoming of livestock production is a large number of small unspecialized family farms which have an unfavorable age structure, knowledge level, and technological equipment, in addition to unorganized and difficult market access, all of which impacts their competitiveness and causes their numbers to reduce.

Croatian agro food products are not competitive in international markets, although there are some products with lower prices and positive agro food balance (soft wheat, corn, sugar, tobacco, meat preparations, fish and beverages.

### *4.1.2 State of agri-environmental indicators*

The Environmental Protection Agency prepares an environmental report, which gives the overview on the state of the environment and assesses the effectiveness of the applied environmental protection measures. The main purpose of the report is monitoring the achievement of goals in the field of sustainable development and environmental protection. The report is based on the available environmental data, and provides an assessment of the current state and an assessment of the situation in the following periods. This ensures monitoring of the effectiveness of certain applied environmental policy measures at the national level. The environmental report thus becomes an important tool in environmental policy planning, but also an indication of the necessity of incorporating environmental protection into development and strategic documents from other sectors: agriculture, tourism and energy.

Main findings of the report with respect to water quality indicators are:

The quality of surface waters is much more favorable in the Adriatic water basin. In the Danube river basin especially small rivers have bad status. Quality of groundwater, in terms of quantity and chemical condition can be assessed as good, with the exception of some groundwater water bodies.

According to the data from Hrvatske vode, the average water consumption for irrigation is 1.5 million $m^3$/year, with a significant increase in quantities in 2011 (2.3 million $m^3$/year) and 2012 (2.5 million $m^3$/year).

### *4.1.3 Information gaps*

In Croatia a wide range of monitoring system has been established (e.g. surface water and groundwater quality) but polluting sources from agriculture are not continuously monitored. During the accession period, Croatia has adapted EU legislation and set up mechanisms for monitoring the negative effects of agriculture on the environment. With introduction of agri-environmental policy measures in the programming period 2014-2020 significant public funds are available. A lot of data are collected which are necessary to govern such programmes but monitoring and evaluation system has to be improved. .

## 4.2 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *4.2.1 Review of region specific targets relevant for DRB*

In Croatia, the Danube River drains sixty percent of territory. The fact that the entire Pannonian region drains into the Danube River and its tributaries underscores the significant direct impact of the ongoing agricultural practices in the region on the waters of the Danube. It is estimated that agriculture accounts for 53% of the total nitrogen load in the surface water of the Croatian Danube basin.

The Croatian agricultural sector is characterized by intensive agricultural and livestock production, including, high fertilizer and pesticide applications, narrow crop rotation, lack of mixed cropping, the use of limited number of breeds and varieties, drainage of wetlands and their conversion to arable land, removal of hedges and trees from agricultural lands as well as inadequate manure storage, handling and application. These have resulted in increasing water pollution, lowered agricultural productivity and efficiency, loss of soil fertility, adverse health conditions for the rural communities, and a decrease in species and habitat biodiversity.

Reduction of nutrient run-off into the Danube River from agriculture has been accorded priority status by the government of Croatia and forms an integral part of the country's environmental strategy. The government is a signatory to the Environmental Program for the Danube River Basin and the Danube River Protection Convention and is committed to honoring its international commitments under these documents.

At the end of 2012, the Government of the Republic of Croatia accepted the Decision on Determining Vulnerable Areas in Republic of Croatia. Vulnerable areas are areas with a need to implement enhanced water protection measures to prevent the pollution of nitrates of agricultural origin. Croatia has decided to declare only a part of its territory a vulnerable area. In Croatia it was decided that the most appropriate administrative unit for the designation of vulnerable zones is municipality. Out of a total of 552 municipalities, 75 municipalities are in the vulnerable zones and 235 municipalities are in the potentially vulnerable zones. Certain vulnerable zones cover 52.9% of the territory of Croatia), of which 9% are vulnerable zones and 43.9% potentially vulnerable zones.

### 4.2.1 General agricultural policy

Croatia became a member of the European Union on 1st July 2013. Total budgetary transfers to agriculture increased from 387 million € in 2006 to 582 million € in 2011 while in 2016 they increased to 638 million € due to an increase of rural development measures.

Budgetary transfers for market and direct producer support measures increased from 324 million € in 2006 to 429 million € in 2011 and then declined to 190 million € in 2016.

Budgetary transfers for structural and rural development measures started to increase from 43 million € in 2006 to 448 million € in 2016.

### 4.2.2 Agri-Environmental programmes

Croatia has limited experience of implementing agri-environment measures. In the period 2002 - 2004, were prepared proposals for national and pilot agri environment programmes. The project also set up a national working group for AE consisting of experts from the agricultural sector, nature protection sector, scientific community, NGOs and farming sector, which was effective during the project period but has since been dissolved.

In the period 2007 – 2009, were in the scope of EU financed Project Institutional Capacity Building and Support for Implementation of SAPARD/IPARD Programme in Croatia. The objective was to set-up IPARD pilot schemes for agri-environment and LEADER measures, but the projects didn't result with a national agri-environment administration system which would enable the implementation of agri-environment programs.

In the programming period 2014-2020 Croatia will implement agri-environment-climate measures on 40,500 ha. There will be support for the conversion to, and maintenance of, organic farming on nearly 60,000 ha.

*Table 11: The Agri-environment-climate operations in Rural Development Programme 2014-2020*

| Agri-environment-climate operations: | €/ha or €/LU |
|---|---|
| Tilling and sowing on the terrain with slope for arable annual plants | 141 €/ha |
| Grassing of permanent crops | 331 €/ha |
| Preservation of high nature value grasslands | 102 €/ha |
| Pilot measure for the protection of corncrake (Crex Crex) | 244 €/ha |
| Pilot measure for the protection of butterflies | 274-326 €/ha |
| Establishment of field strips; | 169-346 €/ha |
| Maintaining extensive orchards | 385 €/ha |
| Maintaining extensive olive groves | 804 €/ha |
| Preservation of endangered native and protected breeds of domestic animals | up to 300 €/LU |

## 4.3 Overview of instruments to reduce water pollution in each country

### *4.3.1 Measures Observed*

Water protection monitoring has a long tradition in Croatia. The Report of the State of the Environment (AZO, 2014)) gives a deeper insight on the current situation in waste and water management in Croatia. The problem is that Croatia still does not have an efficient way of reusing the waste. The situation with the water is not much better. There is a significant loss of water in the public sector supply. Regarding water management In the Programing period 2014-2020 (water supply, sewerage and waste water treatment), operations will be financed with the EAFRD in settlements below 2.000 inhabitants and through the cohesion fund in settlements with more than 2.000 inhabitants.

Croatian authorities indicated in 2014 that the monitoring of water status in protected areas is carried out according to the Law on Waters and the Regulation on the Standard of Quality of Waters (Report on the implementation of the Water Framework Directive River Basin Management Plans). In the future, in the Pannonian area, groundwater and surface water quality monitoring will be aligned with the need to monitor the status of water in relation to nitrate pollution from agriculture.

In the first River Basin Management Plan (2013-2015) Croatia defines measures which refer to agricultural pressures on water quality, due to the use of manure and mineral fertilizers as well as pesticides; runoff from livestock grazing is also noted. The measures are divided on technical measures (Reduction/modification of fertilizer and pesticide application, Change to low input farming, Water saving measures), economic instruments (Water pricing, Fertilizer taxation) and non-technical measures which include Implementation and enforcement of existing EU legislation, Technical standards and Environmental permitting and licensing.

Specific measures include:

• The development of "ecological agricultural production" in drinking water protection areas, and construction of storage capacities for manure in these areas;

• Control and reduction of use of nutrients, especially nitrogen;

• The establishment of vulnerable zones and the adoption of an action programme for protection of water from agricultural pollution under the Nitrates Directive;

• Water protection fee on fertilizer producers, depending on the amount of fertilizers placed on the market;

• Establishment of maximum permitted levels of pollution of soil; and

• Issuance of water abstraction permits for irrigation.

The RBMP does not provide information on the cost of these measures. It refers to EU funds as well as state, regional and local budgets and the proceeds from water fees as funding sources for the programme of measures, but does not specify sources of funding for individual measures. The RBMP does not refer to the use of the Rural Development Programme (RDP) to implement measures that contribute to the achievement of the WFD. In the second RBMP were incorporated measures from the RDP.

Croatia has adopted Action Program for the Protection of Water against Pollution Derived from Nitrates of Agricultural Origin which came into force on the day of Croatia's accession to the European Union. In July 2016 (OG 66/16) was adopted second Action Program for the Protection of Water against Pollution Derived from Nitrates of Agricultural Origin. In the programme were described measures and applying conditions of application of fertilizers, general principles of fertilizer use, measures for the storage and management of manure and the period of application. A code of good agricultural practice was passed, which is compulsory within nitrate vulnerable zones and recommended on a voluntary basis in other areas. It regulates fertilizer use and is also part of cross compliance. Bookkeeping is compulsory within nitrate vulnerable zones. Farmers who are receiving funds for agri-environment measures are obliged to attend appropriate lectures. Advisory services give assistance in interpreting rules and implementing best management practice. Soil analysis is compulsory every four years (N, P, K, pH and humus). Fertilizer use is restricted around water courses.

#### 4.3.1.1 Training, education and information

According to the National action programme achieving a lower use of pesticides Croatia establish a system of training on the safe use of pesticides for professional users of pesticides, distributers and advisors. The aim of the training is reducing risks associated with the use of pesticides and to prevent the import, procurement, distribution, sale, advising and use of Plant Protection Products targeted to professional users to persons without the appropriate permit.

#### 4.3.1.2 Regulatory instruments

The first monitoring of water quality began on the Danube River in 1958. Since the 1970s, monitoring has been carried out at the national level. Until 2009, monitoring was performed for the purpose of establishing the general ecological functions of water, monitoring of burdens from point and diffuse sources of pollution and monitoring of water quality on water capture for drinking water. In 2011, the plan for monitoring the quality of surface waters includes testing water quality at 310 measurement stations in watercourses, lakes and reservoirs, and at 75 measurement stations in coastal waters.

In its first generation of RBMPs 2013-2015 Croatia reported the status of 1.231 rivers, 34 lakes, 28 transitional, 22 coastal and 32 groundwater bodies. 61% of natural surface water bodies achieve a good or high ecological status and only 19% of heavily modified or artificial water bodies achieve a good or high ecological potential. 98% of surface water bodies, 98% of heavily modified and artificial water bodies and 88% of groundwater bodies achieve good chemical status 84% of groundwater bodies are in good quantitative status (EC, 2017).

#### 4.3.1.3 Fiscal instruments

According to Croatian authorities, national water pricing policy reflects the principle of cost recovery for water services and the polluter pays and user pays principles: these are incorporated in several pieces of legislation, including the Law on Waters and the Law on Financing of Water Management (EC, 2015).

The most important fee regarding nutrient discharge in Croatia is a water protection fee. The fee is paid for water pollution which is defined as a change in the quality of water that is generated by the introduction, release or disposal of nutrients and other substances into water, energy or other agents, in an amount that changes useful water properties, exacerbates the state of aquatic ecosystems and restricts the intended use of water. This fee has to be paid by all persons who are discharging waste water (including households). Fees are also paid by producers and wholesale companies who sell mineral fertilizers on domestic market.. The funds received from these fees are used to finance water protection activities and to make a fair share of spending on jobs that are characterized by public services. Part of this compensation is used to invest in the construction of new water protection facilities. The funds of collected water protection fee are used on solidarity basis regarding the priorities on the whole territory of Croatia.

#### 4.3.1.4 Other measures

The Environmental Protection Law (O.G. 80/13), O.G. 78/15 Regulation on environmental impact assessment (OG 61/14, O.G. 3/17), Strategy for Sustainable Development of the Republic of Croatia (O.G. 30/09) and Nature Protection Act (O.G 78/15) are relevant additional regulations.

### *4.3.2 Scale at which the instruments are implemented*

The measures listed above are relevant for the whole territory of Croatia.

### *4.3.3 Effectiveness of measures*

The First Croatian RBMP (2013-2015) has some deficiencies that result in uncertainties about the status and effectiveness of Programmes of Measures. In particular there are weaknesses in monitoring, methodologies for status assessment and the link between pressures and Programmes of Measures. Addressing these weaknesses would provide more certainty about the water status. Following Article 10 of the Nitrates Directive, Croatia has submitted in 2016 a report including information pertaining to: codes of good farm practice, designated nitrate vulnerable zones, results of water monitoring and actions programmes (EC, 2017).

## 4.4 Evidence from the literature, monitoring reports, evaluation studies

### *4.4.1 Literature review*

There are numerous scientific and professional projects have been carried out in Croatia dealing with the impact of agriculture on the pollution of surface and groundwater. Most have been done with the aim of solving specific individual problems at the given locations, and the effects of applying different technologies in vegetable production (Romić et al., 1995-2000), the effect of the application different levels of nitrogen fertilization in nitric fertilizer production in Popovača (Mesic and sur., 1996 to date), Josipović et al. (2000 to present) investigated the influence of irrigation and nitrogen fertilization on nitrate leaching from soil in corn and soy production at experimental field of the Osijek Agricultural Institute. Šiminić et al (2000 to present) followed the rinsing of nitrates and active herbicide substances on drained surfaces under cultivation crops on the experimental field in Jelenščak in Popovača and Petošić et al. (2000 to present) in the area of the future Danube - Sava channel are monitoring the state of surface and groundwater with regard to agricultural impacts. In the Varaždin County area, Romić et al. (2011-2013) monitored the impact of different types of plant production on different types of groundwater for flushing nutrients into groundwater.

Bubalo et al (2014) investigated the impact of agricultural production on groundwater vulnerability to Nitrate in Northern Croatia.

### *4.4.2 Knowledge gaps*

According to the literature review for this study it can be concluded that the physical links between the interaction of agriculture and water quality are well understood in Croatia. Croatia is still in the process of full implementation of nitrate directive and monitoring of agri-environmental indicators should be improved.

### *4.4.3 Best practice example*

A best practice example for Croatia is Agricultural Pollution Control Project. The main objective of the Agricultural Pollution Control Project is to significantly increase the use of environmentally friendly agricultural practices by farmers in Croatia's Danube River Basin in order to reduce nutrient discharge from agricultural sources to surface and ground water bodies. This GEF investment has four components and is a pilot activity to be implemented in three selected counties of Croatia: Osječko-Baranjska; Vukovarsko-Srijemska and Varadžinska. The first project component consists of mitigating nutrient loads to water bodies from point-source pollution (manure management) which promotes sustainable manure management practices with the objective of reducing nutrient loads to the surface and ground water bodies. The second component consists of development and promotion of agro-environment measures which will assist with the implementation of the Code of Good Agricultural Practices. The third component consists of a public awareness and replication strategy which will disseminate the benefits of proposed project activities. Finally, the fourth component consists of project management.

The Agricultural Pollution Control Project was the most important educational program for the control of pollution in agriculture, which lasted for three years. Under the project were organized workshops, trips, making of experimental plots, field visits, and other forms of raising public awareness. The money for the implementation of the APCP program was secured by the World Bank in the amount of 2.6 million dollars. The most grants amounted up to 60,000 €, and a total of 50 projects were contracted for which were spent almost 2 million €.

## 4.5 Future of agriculture in Croatia

### *4.5.1 Production trends in Croatia*

There are only a few papers and studies about future production trends in agriculture in Croatia. Rednak et al (2012) assess the impact of introducing the Common Agricultural Policy on Croatian agriculture and on individual production sectors. The scenario analysis is made using a static deterministic model which simulates the changes brought about by the differences in prices and budgetary transfers.

Compared to the base year, the total agricultural budget is estimated to increase by around 40% in the first year after the accession and by almost 70% in the fourth year, after the expiry of the transitional period.

The aggregate prices in agriculture are expected to drop by around 4% after the accession. According to the optimistic scenario, the revenues are expected to slightly increase (by around 1%), and by a pessimistic scenario, revenues could drop substantially (by around 13%). The revenues in crop production are expected to remain at the same level also after the accession. Revenues in livestock production are expected to drop according to all scenarios. The largest drop in revenues is expected in pig and milk production.

Zrakić et al. (2015) prepared paper: Potential impact of EU Common Agriculture Policy on Croatian dairy sector where they  is to analyzed the prospects of Croatian dairy simulated with the help of partial equilibrium model AGMEMOD. Baseline projections for Croatian dairy sector suggest that until 2025 compared to average three years level (2010-2012) raw milk price will drop by 14% in Croatia. Number of dairy cows might decrease by 33 % and cows' milk collected by 13%.

Salajpel and Mahnet (2015) prepared analysis of development potential of pig production in Croatia until 2030. In the period between 2000 and 2012, the number of pigs in Croatia was constantly decreasing, although with some annual fluctuations, and this trend is expected to continue until 2016. The same goes for the degree of self-sufficiency which by the end of 2016 should be slightly above 50%. The lack of domestic production would be compensated by then import of pigs for slaughter and the import of pork and pork products mostly from other EU countries. Without increased number of breeding sows and improvement in technology the production of pig meat will decrease by 10% until 2030.

### *4.5.2 Farm structure development in Croatia*

Based on the agricultural census in 2007 and 2013 the rates of structural change was –2.1% per annum for number of agricultural holdings and –1.2% per annum for farm labour. There is a great uncertainty in these forecasts. The main reason is that the data from Farm Structure Survey 2010 are not entirely comparable with the data of Farm Structure Surveys in 2007 and 2013. Based on such observations the trend projections for farm structure are:

- The number of agricultural holdings will decline to 120,000 (from 157,000 in 2013); the number of holdings with vineyards and holdings with dairy cows and poultry will decline the most.
- The number of persons employed on agricultural holdings is likely to decline by 15% until 2025 compared to the level observed in 2013. The expected number of full time equivalent persons on agricultural holdings is likely to be around 150,000 in 2025 (compared to 175,000 in 2013).
- The consumption of nitrogen from inorganic fertilizers in period 2006-2015 decreased by 30% (from 124,000 tons to 87,000 tons. Because climate change mitigation policies it is very likely that the use of mineral fertilizer will be further reduced.

### *4.5.3 Consequences for water related indicators*

The consequences for water related environmental indicators based on the studies cited in the previous sections are:

- Due to changes in the farm structure, intensity of production will increase. In 2007 the average number of LSU/agricultural holding with livestock was 5.4 and increased to 7 LSU/agricultural holding in 2013. If the current trend will continue the number will increase to around 11 LSU/agricultural holding in 2025.
- Until 2025 the livestock is likely to decline from 864,000 LSU in 2013 to 820,000 LSU in 2025. Therefore the livestock density per hectare is likely to decrease as well.

## 4.6 Synthesis for Croatia

### *4.6.1 Challenges for policy making*

Croatia has done the transposition of the Urban Waste Water Treatment directive in Croatian legislation. Implementation process is financially and organizationally very demanding. It is still on-going and pending deadlines are until the end of 2023.

### *4.6.2 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 goals according 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 fulfillment of the requirements of the Accession Treaty with respect to Urban Waste Water Treatment Directive and Drinking Water Directive.

### *4.6.3 Consequences for policy instruments in place*

Regarding Urban Waste Water Treatment Directive, 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.

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# 5 Country Report: Czech Republic

Ina Meyer

## 5.1 Economic and agri-environmental indicators

### *5.1.1 State of agriculture*

The agricultural sector's share of the gross value added in the Czech Republic was 2.7% on average for the years 2012/14 and remained almost constant with respect to the period 2002/04 (+0.1%point). The contribution of the agricultural sector is rather small compared to the value added created in other economic sectors of the economy, but it is substantially higher with respect to "old" EU Member States such as Austria where the agricultural share in gross value added figures less than 1%. Focusing on the Czech NUTS 2 regions that belong to the Danube River Basin (DRB) management area, namely Jihovýchod (CZ06) and Střední Morava (CZ07), the regional agricultural shares of the value added are even higher, namely at 3.8% in Jihovýchod (ø 2012/14; ø 2002/04 4.3%) and 3.3% in Střední Morava (ø 2012/14; ø 2002/04 3.9%). Both regions show a decreasing relative contribution of the agricultural sector to gross value added, a trend which results from a stronger growth in other economic sectors. In absolute terms, the added value in agriculture increased.

The national agricultural sector employment was at 3.3% in 2014. It is characterized by a decline (measured in annual working units) which mostly took place between 2005 and 2010, the period encompassing the economic and financial crises. While the national agricultural labour force was reduced by 28.9% (2005-2010), or -30.8% (2005-2013) respectively, the relevant NUTS 2 regions of the DRB management area show slightly more pronounced declines (Jihovýchod -33.4% and -33.9% 2005-2013; Střední Morava -35% and -35.7% 2005-2013), with an ongoing decreasing trend. The gross value added per annual working units increased by about 100% on average between the periods 2002/04 and 2012/14 nationwide and for the relevant NUTS 2 regions (Jihovýchod +102%, Střední Morava +103%) which indicates an enormous rise in productivity compared to other regions in the west of Europe.

The total utilized agricultural area amounts to about 3.5 m ha of which 1.1 m ha (~31%) are situated in the DRB management area (Jihovýchod 719,260 ha, Střední Morava 393,960 ha). Agricultural land showed a decrease of 15,000 ha and woodland a rise of 16,000 ha since 1995. The area of land registered as permanent grass land has risen by 71,000 ha (Ministry of Agriculture of the Czech Republic). Half of the agricultural land is considered less favorable for farming but suitable for supporting the creation and maintenance of meadows and pastures.

The size structure of farms in the agricultural sector differs significantly from the average structure in the EU 25, showing a characteristic farm size distribution of a relative high share in small farm holdings of 2-10 ha (CZ 35.9%, DE 17.7%, AT 18.6%) and a relatively high share in large farms of over 100 ha (CZ 11.8%, DE 5%, AT 2.3%, Schulz, 2017). Farms with more than 50 hectares of agricultural land occupy 92.2% of the total area of the farmed agricultural area.

According to the Farm Structure Survey 2013, the core part of the Czech agricultural production is concentrated in the group of large-scale holdings when measured in economic size class (X.-XIV.), which utilize 65% of agricultural land resources and rear 78% of livestock production (in livestock units). The majority of holdings (62%) belong to small size classes (economic size I.-V.) which utilize only 5% of the agricultural area and rear 4% of livestock units.

The most significant types of farming are grazing livestock, field crop production and mixed production. In total, these holdings concentrate 95% of the agricultural land resources. The largest share of the holdings (34%) is formed by specialists grazing livestock, which is characterized by low intensity farming in the less favoured areas. This type of farming consists of specialists in dairy, cattle, sheep, goats and other grazing livestock farming. Evaluation of regional distribution shows that grazing livestock is concentrated mainly in the border areas. Most of the grazing livestock specialists are found in Jihočeský region.

The share of animal-based output in the overall output of the agricultural sector significantly decreased from 46% to 37% on average between the periods 2002/04 and 2012/14 (Jihovýchod from 44.6% to 36.8%, Střední Morava from 46.1% to 36%). This is apparently an opposing trend to neighbouring countries.

The development of organic farming achieved a significant positive trend (see 2.3.2). The concept of sustainable and multifunctional agriculture is taking ground in the Czech Republic addressing the reduction of greenhouse gas emissions and requirements for adaptation measures (Ministry of Environment, 2015).

### *5.1.2 State of agri-environmental indicators*

Agriculture deals no longer with the production of food only, but now engages in important social and environmental functions. Across most European Union Member States agriculture is still an important source of nutrients (and pesticides) pollution into surface and groundwater. Large inputs of nitrogen and phosphorus to water bodies from agricultural production can lead to eutrophication. This causes ecological changes that can result in loss of plant and animal species and have negative impacts on the use of water for human consumption and other purposes. Indicators related to agricultural water pollution include changes in nitrate and phosphate pollution attributed to agricultural sources in surface water, groundwater and marine waters. The European Environment Agency (EEA)[1] makes available indicators on concentrations of phosphate and nitrate in rivers, total phosphorus in lakes and nitrate in groundwater bodies. Nutrient concentrations in rivers and lakes cannot exclusively be attributed to agricultural sources but are the result of nutrient pollution from urban areas and

[1] https://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-freshwater/nutrients-in-freshwater-assessment-published-6 (accessed: September 12, 2017)

industry as well. Groundwater nitrate concentrations, in contrast, primarily reflect the relative proportion and intensity of agricultural activity. According to the EEA-indicators, the nitrate concentration of groundwater in the Czech Republic was on average decreasing from 22.7 mg $NO_3$/l in 2000 to 19.2 mg $NO_3$/l in 2012. In 2012, there was also a high proportion (10%-20%) of groundwater monitoring sites above the Groundwater Quality Standard threshold of 50 mg $NO_3$/l as laid down in the Groundwater Directive (2006/118/EC). The share of agricultural emission in total emission of nitrates and phosphorous in surface water was at 40% for nitrates (year 2000) and 30% for phosphorous (period 2000-09, OECD, 2013).

According to the monitoring in relation with the implementation of the EU Nitrates Directive, concentrations of nitrates in surface and groundwater are being monitored on a regular basis. Table 12 gives an overview of the distribution of average concentrations of nitrates according to the categories stipulated by the European Commission.

*Table 12: No. of sites for different categories of average concentrations of nitrates in surface and groundwater in the Czech Republic, 2004-2006*

| Nitrates concentration | Groundwaters | | Surface waters | |
|---|---|---|---|---|
| mg/l | No of sites | % | No of areas | % |
| 0-24.99 | 303 | 74.3 | 772 | 81.3 |
| 25-39.99 | 33 | 8.1 | 157 | 16.5 |
| 40-49.99 | 14 | 3,4 | 14 | 1.5 |
| ≥50 | 58 | 14.2 | 6 | 0.6 |
| Total | 408 | 100.0 | 949 | 100.0 |

Source: Hrabánková - Martínková, 2010.

The gross nitrogen or phosphorous balance (surplus or deficit) calculates the difference between the nitrogen/phosphorous inputs entering a farming system (i.e. mainly livestock farming manure and fertilizers) and the nitrogen/phosphorous outputs leaving the system (i.e. uptake of nitrogen for crop and pasture production). In the phosphorous balances, the Czech Republic made substantial progress in reducing the surplus between 1990/92 and 2007/09 turning the phosphorous balance even negative in the last observation period (see Table 13). However, the nitrogen balance is still pretty high in surplus and did not show a constant declining trend.

*Table 13: Nitrogen and phosphorous balance volume, 1990-2009*

| | 1990-92 | 1998-2000 | 2007-2009 | 1990-92 to 1998-2000 | 1998-2000 to 2007-09 |
|---|---|---|---|---|---|
| | 1,000 tonnes of nitrogen/phosphorous | | | % change | |
| Nitrogen | 327 | 256 | 282 | -3.0 | 1.1 |
| Phosphorous | 40 | 10 | 1 | -16.3 | -23.6 |
| | kg nitrogen/phosphorous/ha | | | % change | |
| Nitrogen | 79 | 63 | 79 | -2.9 | 2.6 |
| Phosphorous | 10 | 2 | 0 | -16.6 | n.c. |

Source: OECD, 2013.

Since 2010/2011, a gradual increase in the total amount of fertilizers used per hectare of farmland has been observed. In the period 2014/2015, there was an increase of almost 1,200 kg/ha in relation to 2010/2011. This increase was mainly due to the inappropriate structure of crops, i.e. a decrease in areas with perennial forage crops, and an increase in subsidized crops, particularly rape and maize (Ministry of Agriculture - Ministry of the Environment, 2016, Czech Statistical Office, Table 14). The increase in fertilizer use is mainly due to the growth in organic fertilizers. The prevailing type of fertilizer is farmland manure. The use of nitrogen (N) from all fertilizer products per area of croplands (arable and permanent) increased on average for the Czech Republic from 62 kg/ha for the period 2002/04 to 103 kg/ha.[2] Thus, pollution from non-point sources, i.e. agriculture, is growing (EEA, 2016).

*Table 14: Fertilizers used, 2010-2015*

| Fertilizers | | 2010/2011 | 2011/2012 | 2012/2013 | 2013/2014 | 2014/2015 |
|---|---|---|---|---|---|---|
| | | | | kg/ha of UAA | | |
| Mineral fertilizers (nutrients) | total | 108 | 113 | 122 | 127 | 131 |
| of which | nitrogenous | 85 | 88 | 94 | 97 | 99 |
| | phosphoric | 14 | 15 | 17 | 18 | 19 |
| | potassic | 9 | 10 | 11 | 12 | 13 |
| Calcium fertilizers | | 65 | 94 | 111 | 124 | 129 |
| Farmyard manure | total | 5,026 | 4,851 | 4,874 | 4,751 | 4,837 |
| of which | manure | 2,808 | 2,707 | 2,655 | 2,562 | 2,690 |
| | slurry | 1,247 | 1,147 | 1,165 | 1,094 | 1,109 |
| | suds | 662 | 634 | 607 | 600 | 542 |
| | other | 309 | 363 | 447 | 495 | 496 |
| Organic fertilizers | | 363 | 476 | 741 | 1,354 | 1,585 |
| Mineral fertilizer | | 68 | 53 | 53 | 47 | 34 |
| Total | | 5,630 | 5,587 | 5,901 | 6,403 | 6,716 |

Source: Ministry of Agriculture – Ministry of the Environment, 2016, Czech Statistical Office.

Over exploitation of water resources by agriculture may damage ecosystems by reducing water flows below minimum flow levels in rivers, lakes and wetlands which is also detrimental to recreational, fishing and cultural uses of these ecosystems.

Agri-environmental indicators related to agricultural freshwater resources show that the share of agriculture in freshwater withdrawals is 2% on average in the Czech Republic for 2008 to 2010, and hence being much lower than on average in the EU 15 (26%). There is a declining trend in average annual freshwater withdrawal from the agricultural sector of -22% from the period 1990/92 to 1998/2000 but a significant growth of 11.2% from 1998/2000 to 2008/10 (OECD, 2013). The total irrigated area has slightly decreased from 24,000 ha to 19,000 ha (-2%

[2] https://ec.europa.eu/eurostat/web/rural-deveopment/data

per annum) in the period of 1998/2000 to 2008/10; it figures at 17,840 ha in 2013. Much of the decrease in water application rates have largely been driven over the past decade by improvements in irrigation technologies and management practices, but comprehensive data on this issue could not be obtained for the Czech Republic.

Organically farmed land increased to almost 494,000 ha of acreage in 2013, representing 11.7% of all agricultural land (Ministry of Agriculture, 2013). By the end of 2013, there were 3,329 organic farms (ca. 13% of registered agricultural entrepreneurs in the Czech Republic). Growth in the number of organic farmers stagnated. This trend was mainly owed to the fact that applications for inclusion in the "Organic Farming" project within the Agro-Environmental Measures (AEM) were no longer accepted from 2012 (see 2.3.2).

### *5.1.3 1.3 Information Gaps*

Data on water pollution and nutrient (fertilizer) use in agriculture in the Czech regions relevant for the DRB, namely for Jihovýchod and Střední Morava (NUTS 2: CZ06, CZ07, or even at NUTS 3 level), could not be obtained from official statistics and publications. Farm specific nutrient balances for DRB-specific regions were not available either. These data are, however, key to monitor trends in nutrient pollution, to effectively manage the nutrient flows and to judge upon the water quality in the Czech DRB management area. Data on monitoring the water quality was available for nitrates on an average nation-wide basis only (see Table 12), but references to smaller scale geographical regions were missing or were not publicly accessible. Further assessments are needed in that respect.

## 5.2 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *5.2.1 Review of region specific targets relevant for DRB*

In the Czech Republic only two regions of the NUTS 2 classification are part of the Danube River Catchment Basin, namely Jihovýchod and Strední Morava, located in the South-Eastern part and in Central Moravia. There are no specific targets for nutrient discharge for these areas but national environmental goals may apply:

National environmental goals with respect to eutrophication that could also be applied for the Danube River Basin are not determined exactly. But the level of eutrophication is frequently evaluated in various studies on the basis of nutrient concentration or of the P:N-ratio according to Rosendorf et al. (2008) and Hrabánková - Martínková (2010, see Table 1).

National environmental goals with respect to nitrate leaching and designation of nitrates vulnerable zones (NVZs) are similar to the requirements of the Nitrates Directive, namely 50 mg $NO_3$/l (Rosendorf et al., 2011).

Concerning phosphorus application in agriculture, there is no European Directive or any other regulation equivalent to the Nitrates Directive. But phosphorus application by manure is indirectly limited by the Nitrate Directive as manure application in NVZs is restricted by an upper bound. There are no maximum phosphorus application limits or other P restrictions in the Czech Republic as of 2014. However, farmers can have a free soil P measurement and P fertilization recommendation organized by the state agency (not mandatory, Amery – Schoumans, 2014).

### *5.2.2 General agricultural policy*

The Czech Republic is part of the EU and therefore the Common Agricultural Policy (CAP) is defining the framework for most policy measures in this field. The CAP is an important economic driver for farming decisions across the EU and has the potential to advance the water quality in terms of nutrient pollution reduction. The CAP (2014-2020) has three general objectives – viable food production, sustainable management of natural resources and climate action, and balanced territorial development. The CAP is structured as two pillars (Frelih-Larsen et al., 2016): Pillar 1 mainly provides direct payments (including greening payments) to farmers per hectare of land farmed, and Pillar 2 supports Member States' and regions' Rural Development Programs with a wide range of measures to address environmental, social and economic priorities. Horizontal elements of the CAP applicable to both Pillars include cross-compliance rules and a requirement for Member States to provide a Farm Advisory Service (FAS).

Farmers receiving direct payments under Pillar 1 and area-based payments under Pillar 2 must comply with cross-compliance requirements which incorporate "basic standards concerning the environment, climate change, good agricultural and environmental conditions of land, public-health, plant and animal welfare". There are two types of cross-compliance requirements:

- Statutory management Requirements (SMR) are derived from existing regulatory requirements under other EU legislation such as Nitrates, Habitats and Birds Directives
- Standards for Good Agricultural and Environmental Conditions (GAEC) which are defined by individual Member States

Member States must define seven specific GAEC standards under consideration of specific characteristics of the areas in consideration, including soil and climatic conditions. GAEC 1 concerns the establishment of buffer strips along water courses which, apart from contributing to limiting water pollution, can also help to protect the soil along water courses, and GAEC 3 protects the ground water against pollution.

Pillar 1 Greening payments relate to crop diversification, maintenance of permanent grassland and Ecological Focus Areas (EFA). But organic farmers are exempt from all Pillar 1 greening requirements given the recognized environmental benefits of organic farming systems.

### 5.2.3 *Agri-environmental regulations and programs*

#### 5.2.3.1 Nitrates Directive and Action Programs

The main measures aimed at reducing diffuse pollution of waters from agricultural sources are based on the Nitrates Directive 91/676/EEC which has the objective of protecting waters against pollution caused by nitrates from agricultural sources. The Nitrates Directive is an integral part of the Water Framework Directive. The Nitrates Directive requests the identification of water pollution by nitrates from agricultural sources and to determine nitrates vulnerable zones (NVZs). It establishes the implementation of measures reducing leakage of nitrates from agricultural sources into such NVZs, as requested by Action Programs. Action Programs regulate the use and storage of fertilizers and livestock manure, crop rotation and implementation of erosion control measures. In addition to Action Programs, whose measures are mandatory in defined NVZs, binding good agricultural practices must be compiled as preventative measures (Hrabánková - Martínková, 2010).

The Nitrates Directive implementation in the Czech Republic started in 1997, before joining the European Union in 2004. The Nitrate Directive was translated into Czech law by incorporation into the Czech Water Rights in §33 of Act No. 254/2001 Coll.

A broad study mapping diffuse water pollution was prepared as a research and development project of the Ministry of the Environment during 1998 and 2002 (Rosendorf, 2003, Rosendorf et al. 2011). The project focused on the collection of available data on nitrates pollution of surface and groundwater and also on the evaluations and trends in pollution in the period prior to and after the transformation of the socialist system in 1989. Detailed maps were prepared for the vulnerability of the soil and subsoil to infiltration of nitrates into waters, and the evaluation of agricultural management and its impact on pollution of waters in various areas of the Czech Republic was evaluated (Rosendorf et al., 2011).

NVZs represent the areas, where the contamination of ground- and surface water by nitrates has already exceeded or might exceed the limit of nitrate concentration of 50 mg/l. In the first designation in 2003, NVZs were appointed where a connection of water pollution by nitrates with agricultural management could be demonstrated, and also where there was a danger that water pollution would increase unless effective measures were introduced. In some cases NVZs were also designated where there was not enough data and the areas were considered to be generally vulnerable to pollution (especially some groundwater areas, Rosendorf et al., 2011). The list of vulnerable zones was promulgated by the Government Order No. 103/2003 Coll. In these zones, the use and storage of fertilizers and livestock manure, crop rotation and implementation of erosion control measures are requested to be regulated by the so-called Action Program (see 3.1).

NVZs are subject to review. The first review of vulnerable zones was carried out in 2007 (Government Order No. 219/2007 Coll.) and the area of NVZs increased by 3.2% to 31,358 km$^2$ which represent 39.8% of the area of the Czech Republic. Most zones designated as vulnerable in 2003 remained so, and in some even a deterioration was observed. Some vulnerable zones where nitrate concentrations in the groundwater decreased below 25 mg/l were excluded. New areas with much arable land and high amounts of livestock manure became vulnerable, as nitrate concentrations increased to 25-50 mg/l (Hrabánková - Martínková, 2010). The second review (Government Order No. 262/2012 Coll.) in 2011 revised the definition of the „vulnerable areas“, and declared the 3rd Action Program (Ministry of Agriculture – Ministry of the Environment, 2014). NVZs were slightly extended and, mainly based on comments raised by the European Commission, some methods of land use and management were tightened. This refers particularly to the extension of the period when the use of fertilizers is prohibited (Ministry of Agriculture – Ministry of the Environment, 2013). The third revision in 2015 brought a slight increase in NVZs up to 41.9% of the area of the Czech Republic (see Table 15).

Over 25,000 farms are in operation in the NVZs of the Czech Republic of which 80% raise livestock. Each year, approximately 5% of the farms are monitored and consulted under the framework of the Action Program.

*Table 15: Shares of agriculture and NVZ of the Czech Republic, 2003-2015*

| Shares regarding demarcated areas | Designation in 2003 | The first revision in 2007 | The second revision in 2011 | Proposal based on the third revision of 2015 |
|---|---|---|---|---|
| | | | % | |
| Share of NVZ in the area of the Czech Republic | 36,7 | 39,9 | 41,6 | 41,9 |
| Share of agricultural land in NVZ in the total agricultural land in the Czech Republic | 42,5 | 47,7 | 49,0 | 50,2 |
| Share of agricultural land out of the total area of NVZ | 71,0 | 69,3 | 68,4 | 68,4 |
| Share of arable land in total area of NVZ | 57,0 | 58,0 | 54,9 | 53,9 |

Source: Ministry of Agriculture – Ministry of the Environment, 2016.

#### 5.2.3.2 Other Programs

The EU ***rural development program*** (***RDP***, Pillar 2 of the CAP) promotes sustainable rural development in a way that contributes to the development of a more territorially and environmentally balanced, climate friendly and resilient, competitive and innovative agricultural sector (Frelih-Larson, 2016). In contrast to Pillar 1 of the CAP, which is wholly financed by the European Agricultural Guarantee Fund (EAGF), the rural development program (RDPs) is partly funded by the European Agricultural Fund for Rural Development (EAFRD) and co-financed by the Member States’ national or regional authorities.

One measure of funding within this program deals with agri-environmental and climatic issues (measure 10) or with organic farming (measure 11). The measures consists of sub-measures that further address specific objectives.

The ***Operational Programme Environment*** (OPE, 2014-2020) is a national program aiming at the protection and improvement of the quality of the environment as a basic principle for sustainable development. It is managed by the Ministry of the Environment and the State

Environmental Fund (SEF) of the Czech Republic. The SEF receives revenues e.g. from charges for waste water discharges into surface waters and for abstracted groundwater quantities. It administrates three programs broadly encompassing water management (including flood control measures) but has no explicit reference to water pollution from agricultural sources. Projects focusing on the area of water management are also implemented under programs of cross-border cooperation, i.e. regarding the international river basins (Elbe, Oder and Danube River Basins).

In collaboration with non-governmental organizations, the Ministry of Agriculture has prepared an ***Action Plan for the Development of Organic Farming*** in the Czech Republic 2011-2015 which was adopted in December 2010. Main objectives are to achieve a 15% proportion of organic farming by 2015, a 60 % share of Czech organic food in the organic food market, and a 3% share of organic food in the overall food market. The number of organic farms increased from 3 in 1990 to 3,926 farms in 2013 (Ministry of Agriculture, 2013). The acreage of organic farms increased from 480 ha to 493,896 ha (same period). This corresponds to a total of agricultural land under organic farming of below 1% in 1990 and 11.7% in 2013 (Ministry of Agriculture, 2013). The growth in organic farming was particularly strong between 2007 and 2010 but came to a halt in 2012 and 2013. This trend was mainly due to the fact that applications for inclusion in the "Organic Farming" project within the Agro-Environmental Measures (AEM) were no longer accepted from 2012 onwards. However, it is expected that growth in organic farming is being re-driven by the next programming period of the Common Agricultural Policy (2014-2020). Principles applied in organic farming create conditions necessary for achieving higher average carbon content and humus in soil which contributes to climate mitigation. Organic farming may also contribute to adaptation of agriculture to climate change by achieving higher resilience of plants and soils. An important benefit lies in the reduction of nitrate leaching, and retention of N in biomass before the onset of winter (Ministry of Environment, 2015; Meyer – Sinabell, 2011).

### *5.2.4 Gap analysis*

There is a broad portfolio of programs, and their correlated agendas and measures available for application in the agricultural sector. They pursue the aim of nutrient management and to enhance and maintain good water quality. Most of the measures taken in the Czech Republic focus on the reduction of nitrates pollution by designation of NVZs and their measures, and on the development of organic farms which showed a substantial growth pattern. In addition, CAP measures for greening agricultural production may apply. However, detailed data "greening" measures and specific to their geographical application could not be obtained from public sources. Therefore there is no information on the types of measures, nor on the number and extent of agri-environmental measures viable in the DRB management area. However, monitoring of the effectiveness of the Nitrates Directive encompasses the interconnection of existing data and information about water quality and agricultural practice in order to detect critical agricultural activities with detrimental impacts on the water quality in different regions of the Czech Republic (Rosendorf et al., 2011). Region-specific evaluations for the DRB management area may thus be provided in a straightforward way.

## 5.3 Overview of instruments to reduce water pollution in each country

### *5.3.1 Measures Observed*

#### 5.3.1.1 Training, education and information

Measure 1 of the RDP deals with knowledge transfer and information actions. The aim of the measure is to strengthen the knowledge base and to support knowledge transfer in agriculture, food-processing and forestry. To achieve this, support will be provided to life-long learning and vocational training in the agricultural, food and forestry sectors. The measure is divided into training actions and information actions.

Through the national User relation-based Land Use Register information is brought to farmers on measures which the farmer should comply with within the specific land block. Further details on this register and the type of education and information policy is needed.

#### 5.3.1.2 Regulatory instruments

The Action Program of the Nitrates Directive, which is also updated every four years, represents mandatory methods of management in NVZs which are aimed at reducing the risk of nitrogen leaching into surface water and groundwater.

The Action Program is considered the most effective system of measures in the implementation of the Nitrates Directive. The general measures of the Action Program in the Czech Republic include (in compliance with Annex III to the Nitrate Directive):

- Periods of ban of use of certain fertilizers and farmyard manure
- Restriction of fertilizer application with respect to soil and climatic conditions (i.e. maximum nitrogen fertilization limits for the individual crops)
- Maximum limit of 170 kg N/ha/y per farm including manure, organic and organic-mineral fertilizers applied
- Barnyard manure deposit specifications during the period when manuring is prohibited
- Ban on wide-row crop growing on land threatened by erosion
- Restrictions on the use of fertilizers on sloping land
- Maintaining a protection zone near surface water bodies.

The measures included in the Action Program must guarantee that the quantity of farmyard manure together with organic and organic-mineral fertilizers applied in any farming establishment in a NVZ will not exceed on average the limit of 170 kg nitrogen per hectare per year.

The individual measures of the Action Program are specified in several variants and are implemented in agricultural practice according to the soil and climatic conditions occurring in the individual agricultural properties. For the differentiation of the Action Program variants are used, namely 'estimated pedo-ecological units' (EPEU, Rosenfeld et al., 2011)

Adjustments to the Action Program for 2016-2020 should contain the following elements (Ministry of Agriculture – Ministry of the Environment, 2016):

- Extension of the period with ban on fertilizing
- Introducing yield levels for the purpose of differentiating fertilization for various crops
- Adjustment of the period when manure may be deposited in the field
- Adding light soils to areas where manure cannot be deposited

Nevertheless, since 2010, a gradual increase in the total amount of fertilizers used per hectare of farmland has been observed (see 1.2).

The recent programming period (2014-2020) of the Rural Development Program entails the implementation of agro-environmental-climatic activities. The measures aim at maintaining high-quality ecosystems in order to strengthen the higher carbon (C) sequestration potential, and reduce the risk of nitrogen-related (N) emissions together with more extensive farming, thus contributing to mitigation and adaptation to climate change. Management of soils features as a key measure. Agri-environmental measures (RDP) work in synergy with measures implemented under the Operational Programme Environment (2014-2020).

#### 5.3.1.3 Fiscal instruments

The Rural Development Program (2014-2020) provides grants aimed at the renovation, preservation and improvement of eco-systems dependent on agriculture by taking into account in particular agro-environmental measures, investments into competitiveness and innovations in agricultural products (Ministry of Agriculture – Ministry of Environment, 2016). The subsidies from the RDP are co-financed from the European Agricultural Fund for Rural Development (EAFRD) and from the state budget of the Czech Republic. Nearly 3.5 billion € (more than CZK 96 billion) will be made available to the Czech agriculture over the next years. Of that, 2.3 billion € (CZK 62 billion) will come from EU sources and 1.2 billion € (CZK 34 billion) from the Czech budget.

Support for organic farmers has been provided within the RDP Axis II "Improving the environment and the countryside" together with the chapter for "integrated production" summarized under "environment-friendly methods" of the so-called Agri-Environmental Measures (AEM). Within this chapter, organic businesses obtain compensation for economic losses incurred due to the organic farming systems. The payments are provided per hectare of organic land, and are differentiated according to the specific land-use (i.e. crops grown on the land). Equal sums are also paid to organic farmers for land in the so-called conversion period. The level of payment is fixed in Euro for the whole period 2007–2013 as shown in Table 16 (Ministry of Agriculture – Ministry of Environment, 2016).

National subsidies under the measures "Support of technology platforms within the field of Ministry of Agriculture activity" support the Czech Technology Platform for Organic Agriculture (CTPOA). In 2013, the platform's activities were supported by 1,250,000 CZK (Ministry of Agriculture – Ministry of Environment, 2016).

*Table 16: Level of payments as compensation for economic loss incurred from organic farming system (RDP)*

| | in €/ha |
|---|---|
| Arable land | 155,00 |
| Grassland - organic farms with parallel conventional production | 71,00 |
| Grassland - organic farms without parallel conventional production | 89,00 |
| Permanent cultures - intensive orchards, vineyards, hop-fields | 849,00 |
| Permanent cultures - extensive orchards | 510,00 |
| Vegetables and special herbs on arable land | 564,00 |

Source: Ministry of Agriculture, 2016, Czech Statistical Office

### *5.3.2 Effectiveness of measures*

The effectiveness of the measures applied is monitored in the report of water management in the Czech Republic (Ministry of Agriculture - Ministry of Environment, 2016). The report concludes that groundwater pollution in the monitored network did not deteriorate but did not improve either. This monitoring includes all substances for which there are limits set for groundwater pollution (e.g. pesticides, etc.) but does not report results explicitly for nitrate or phosphorous pollution. Measure-specific evaluations could not be found. There is evidence that the area of NVZs has slightly increased which indicates that further efforts are needed in water protection.

## 5.4 Evidence from the literature, monitoring reports, evaluation studies

### *5.4.1 Literature review*

A study by Rosendorf et al. (2011) assesses the effectiveness of the EU Nitrates Directive Action Programs in the Czech Republic. The study concludes that an apparent decrease of nitrate and phosphorous concentrations in a wide range of rivers all over the Czech Republic has been detected since the mid of the 1990s. In groundwater, a decrease in nitrates concentrations was observed more rarely, however. The short period since the first designation of NVZs and the effects from changes in livestock number and sharp decrease of fertilization in the corollary of the 1990s made it difficult to identify direct effects of the Nitrates Action Programs.

A detailed technical description of the networks used for monitoring water quality is also given in the study of Rosenberg et al. (2011). Monitoring not only consists of monitoring sites but also of auditing farming practices (approximately 300 field studies in agricultural businesses in NVZ were conducted), and of modeling nitrate leaching and evaluation of statistical data from agricultural census. Important conclusions from this study are: Nutrient balances are considered to be a suitable tool for assessment of nutrient management in agriculture. A lack of sufficient manure storage capacities was found which resulted in spreading liquid livestock manure on agricultural land at inappropriate times. These developments were explained by the vast territories which involve high distribution costs of manure to agricultural land, a large share of leased farmlands which seem to constitute an obstacle for obtaining building permits for storage capacities, and high investment costs for manure storage facilities. One point of criticism was the lack of funding by state authorities that caused a reduction in the number of water quality monitoring sites (Rosenberg at al., 2011).

The use and efficiency of public support measures with respect to organic farming have been assessed by a study from Sanders et al. (2011). They find that in the Czech Republic, area support measures (payments) for organic farms have a very positive contribution to the organic sector development but were not sufficient to maintain relative competitiveness (around 2006-2008) which, however, did not prevent the share of organic area in total utilized agricultural area (UAA) to increase substantially. This may well indicate that other market and context factors such as consumer demand and the action plan on organic farming have been important drivers in the development of the organic area share. Nevertheless, area payments are considered as a basic requirement for farmers to run their farm viably, and are particularly important in the early phase of organic sector developments and as incentive for new organic farmers to convert their farms. The risk of reduced profitability is considered a major barrier for farmers to convert to organic farming. Therefore, organic market development (i.e. consumer information and organic labelling to foster domestic demand) plays decisive role. Another catalyzer for the development of organic farms is knowledge about organic production and organic production techniques.

The Aquarius project funded by the Czech-Norwegian Research Program[3] assesses cost effective land and agricultural management actions or measures to enhance landscape's retaining water potential and to reduce input of pollutants into waters. Project results concerning the present study objective have not yet been published.

## 4.2 Knowledge gaps

The complex nexus between financial support mechanisms (i.e. payment schemes) and the effectiveness of measures in terms of physical processes and realization of stipulated thresholds e.g. in nitrate and phosphorous concentration in water bodies is difficult to assess and further research is needed in this field. As the DRB management area only concerns the mentioned NUTS2 regions of the Czech Republic, data on measures and their effectiveness needs to be assessed particularly for that geographical region. Data for the Czech Republic on average is not sufficient to judge upon progress in managing the areas relevant for the Danube River.

[3] http://www.ng-aquarius.org/

### *5.4.2 Best practice example*

One best practice example relates to the broad array of small, family farmers across the Czech Republic who supply local people with fresh seasonal food – meat, milk and diary, fruits and vegetables, grains, nuts, wines – and who sustain the rural development. Local food production takes environmental standards into account, and tightens the connection between farmers and people who eat their food. The collection of family farmers was compiled by "Friends of the Earth".[4] They are convinced these farmers are more than just producers of food – they help to preserve nature resources and land. Some examples are given here below:

*Family winery of Richard Stávek*

"Richard Stávek has made a decision to produce authentic wine. This way of producing wine is nothing new, in fact it is based on the traditions and practices of our ancestors, as well as being consistent with the principles of organic farming. Richard, when asked why he started using this method, says: "When I realized what was sprayed on grapes and being adding to the wine, I decided to start producing credible, authentic wines." You can buy not only white, red and rose wines, but also an orange variety. To produce this orange wine, grapes are allowed to lie on their peels to obtain this specific, amber colour. In addition to cultivating vineyards, Richard's family has also orchards, so when they're in season you can taste local apricots, cherries, plums and nuts. Living around the vineyards is also a herd of goats that exists in harmony with the vines, while providing milk for a delicious cheese."

*Koliba at Janovsky pastures*

"While mostly made up of pastures, forests and groves are also part of this farm. Between the villages of Halenkov and Huslenky, there is enough green space for 25 cows and 300 sheep. At an altitude of 670 metres above sea level, herds of horses of various breeds, colours and temperaments run freely around. They are the greatest love of the Kocurek family, who have begun to use organic agriculture because of them. The farm also consists of orchards full of apples, pears and plums and potato fields. In the mountain meadows, which are part of the Beskydy protected area, flowers including gladioli, gnat-flowers and dwarf gentian are flourishing. The best way to support these protected species is let sheep to do the job for you – they are the most experienced landlords with centuries of tradition. The result of such farming is not just local, high-quality meat, fruits and vegetables, but also well managed and protected land."

*František Matoušek's farm*

"The Matoušek family has been farming at their farmhouse at the Czech highlands (called Vysočina) since 1869, and the maternal line of the family landlords extends as far back as 1678. František Matoušek started with organic and vegan agriculture (farming strictly without the use of animal products) in the early nineties. Today, the new orchard is starting to spawn

[4] http://www.foeeurope.org/nourished-by-earth-farming-czech-republic, accessed September 20, 2017.

pears, plums, cherries and apples; many kinds of vegetables (parsley, celery, carrots, potatoes, leeks, onions, garlic, red and white cabbage, lettuce, turnips, radishes, black radish, and corn) and cereals (wheat, spelled, rye bit, barley and oats) thrive here too. The local plant kingdom is also flowering – cornflowers and marigolds in particular. 'Green manure' comes from sunflowers, alfalfa and clover, helping produce the energy for all the other inhabitants of the farm."

## 5.5 Future of agriculture in the Czech Republic

Future agriculture faces multiple challenges. One key driver that will influence the future of agriculture in the Czech Republic is – next to socioeconomic and political drivers - climate change. Projected changes in climatic conditions for the Czech Republic and the northern parts of Austria show that by 2020, the combination of increased air temperature and changes in the amount and distribution of precipitation will lead to a prolonged growing season and significant shifts in the agroclimatic zones in Central Europe (Trnka et al., 2011). In particular, the areas that are currently most productive will be reduced and replaced by warmer but drier conditions. In the same time the higher elevations will most likely experience improvement in their agroclimatic conditions. This effect might be temporary as by 2050, even these areas might experience much drier conditions than observed currently. Both the rate and the scale of the shift are remarkable as by 2020 (assuming upper range of the climate change projections) only 20–38% of evaluated agriculture land will remain in the same agroclimatic zone and by 2050 it might be less than 2% (Trnka et a., 2011). This development requires a change in the crop-mix and climate-adapted crop cultivation.

For many environmental zones, clear signs of deteriorating agroclimatic condition in terms of increased drought stress and shortening of the active growing season were assessed, which in some regions become increasingly squeezed between a cold winter and a hot summer. For most zones the projections show a marked need for adaptive measures to either increasing soil water availability or drought resistance of crops. The study concludes that rainfed agriculture is likely to face more climate-related risks. However, results suggests that there is a risk of increasing number of extremely unfavorable years in many climate zones, which might result in higher interannual yield variability and constitute a challenge for proper crop management (Trnka et al., 2011).

### *5.5.1 Production trends*

The deterioration of soil properties through unsustainable agricultural practices and changing climate conditions could lead to a fall in productivity and devastating effects on ecosystem services in large areas of the Czech Republic. Identifying areas with the highest hazard levels should therefore be a top priority (Trnka et al., 2016).

The key hazards for agricultural land in the Czech Republic include the occurrence of water stress in the topsoil layer during both the first and second half of the growing season, the proportion of fast-drying soils, the risk of erosion and the risk of local floods originating primarily from agricultural land (Trnka et al., 2016).

Trnka et al. (2016) identified typical areas with the highest hazard levels: regions with low precipitation and a high proportion of soils with a degraded or naturally occurring low water-holding capacity, and those with steeper than average slopes and terrain configurations in relatively large catchment areas that have urbanized countryside landscapes located at their lower elevations. The study detected regions where primary attention should be given to reduce the level of the hazards and/or to increase cropping capacity. These regions were found to be concentrated in the southeastern and northwestern lowland areas of the Czech Republic.

In addition, there is an ever growing concern about soil fertility. Damage to soils from modern human activities is increasing and leading to irreversible soil loss due to erosion, local and diffuse contamination and the sealing of soil surfaces which threatens the productivity of soils (EEA, 2006).

### *5.5.2 Farm structure development*

Given a multitude of influencing factors in the fields of socio-economic development, climate change impacts and in policy-related fields (CAP policy and other policies described above), an outlook on the Czech farm structure development is a complex task. Regionalized assessments and scenarios analyses are available from the CAPRI (Common Agricultural Policy Regionalized Impact Modelling System) model.[5] According to this, the nutrient balance of Nitrate will improve for the Czech Republic from an average total surplus of 50.4 kg/ha in 2015 to a surplus of 40.4 kg/ha in 2030. Agricultural income is projected to grow by 109% from 2015 to 2030. In the same period the output of crops [in €] is forecasted to grow by 20.5%, the output of animals by 12.9%.

### *5.5.3 Consequences for water related indicators*

The consequences for water related environmental indicators based on the studies and forecasts cited above in the previous sections will be a reduced pressure of nitrate and phosphorous concentration in water bodies which are related to an overall reduction in fertilizer use. However, these will only manifest with a time-lag. Whether this trend holds for the two NUTS2 regions relevant for the DRB management area needs to be assessed.

Given a potentially growing influence of extreme weather events, in particular droughts, there is a marked need for adaptive measures to either increasing soil water availability, or drought resistance of crops, or irrigation technologies according to BAT.

[5] http://www.capri-model.org/

## 5.6 Synthesis for the Czech Republic

### *5.6.1 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.

### *5.6.2 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.

### *5.6.3 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.

### *5.6.4 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.

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# 6 Country Report: Germany

Franz Sinabell

## 6.1 Economic and agri-environmental indicators

### *6.1.1 State of agriculture in the DRB*

The Danube River Basin (DRB) is covering only part of the German territory. Approximately half of the territory of two German Länder – Bavaria and Baden-Württemberg – are in the DRB. Each of the Länder published very detailed programmes of measures and management plans in accordance to the WFD (StMUV, 2015 and BW, 2015). According to these reports almost 10 million inhabitants live in the German part of the DRB and almost 15% of Germany's territory belongs to the Danube basin (56,302 $km^2$). Baden-Württemberg's share is smaller (8,049 $km^2$). The value added of agriculture, fishery and forestry in the German DRB is 2.8 billion €.

The agricultural sector Bavaria and Baden-Württemberg is small compared to the rest of the economy as measured in its value added share (less than 0.88%). Nevertheless, agriculture is the main user of land an important economic activity, in particular in Bavaria. Further detailed statistics of agriculture in the DRB are not available. In the reminder of the text the figures therefore refer to this sector based on statistics for the whole administrative units. From the overall value added in agriculture of 15 billion € in Germany, 3 billion € were from Bavaria and 1.5 billion € were from Baden-Württemberg in 2015 (StMELF, 2017).

The production structure of agriculture in these two Länder is not balanced. The total value of agricultural sales was 3.2 billion € in Baden-Württemberg and 6.7 billion € in Bavaria. The share of crop products, wine, fruits and vegetables was 45% in Baden-Württemberg and 28% in Bavaria. Apple and wine production is very important in Baden-Württemberg, in Bavaria beef and milk production is predominant (Statistische Ämter des Bundes und der Länder, 2017).

### *6.1.2 State of agri-environmental indicators*

Like in many other highly industrialized countries, most agri-environmental indicators show a favourable trend in Germany. This is the case in Bavaria and Baden-Württemberg as well, but for all agri-environmental indicators, detailed statistics are not available at the Länder level. Referring to pressure indicators, in both Länder the number of livestock units declined between 2005 and 2013. In 2013 there were 1.1 LU/ha UAA in Bavaria and 0.9 LU/ha UAA in Baden-Württemberg.

### *6.1.3 Information gaps*

In Germany a wide range of monitoring system has been established (e.g. surface water and groundwater quality) point sources of water pollution are well identified. Agri-environmental policy measures are more important in Bavaria and Baden-Württemberg than in most other Länder of Germany. One aspect of this heavy involvement of policy is that many data are collected which are necessary to govern such programmes. Compared to other countries in the DRB like Austria, farmers are required to collect environmentally relevant information like nutrient balances at a more detailed level.

## 6.2 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *6.2.1 Governance and review of region specific targets relevant for DRB*

The total territory of Bavaria and Baden-Württemberg is 106,301 km (almost 30% of Germany). Approximately 53% of it is part of the DRB.

Germany is a federal state and therefore there are three levels of legislation:

4. EU legislation (most importantly the Nitrates Directive, and the Water Framework Directive);
5. national legislation (most important in the context of the Programme of Rural Development and the implementation of EU legislation like the Nitrates Directive and the Water Framework Directive);
6. Länder specific legislation (most important for the designation of groundwater remediation zones and drinking water protection zones and regulation of agriculture).

Water related issues are governed by the Federation of German Federal and Länder Water Working Groups (LAWA Bund/Länder-Arbeitsgemeinschaft Wasser) that was formed in 1956 as an association of the ministries responsible for water management and water law in the federal states of the Federal Republic of Germany. The aim of the Federal/Länder Water Working Group is to discuss transnational and joint water management and water law issues, to develop joint solutions and to initiate recommendations for implementation. Current issues in the national, supranational and international field are also taken up, discussed on a broad basis and the results are presented to the respective organisations.[6]

DRB specific groundwater targets and measures are defined in the management plans according to the Water Framework Directive (StMUV, 2015 and BW, 2015).

Referring to the Nitrates Directive (1991), Germany decided to designate the whole territory as a nitrates vulnerable zone and therefore catchment specific regulations are not in place.

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[6] http://www.lawa.de/Ueber-die-LAWA.html (information retrieved 2 Sept 2017).

### 6.2.2 General agricultural policy

Germany is part of the EU and therefore the Common Agricultural Policy (CAP) is defining the framework for most policy measures in this field. Compared to the rest of the EU there are three specific noteworthy aspects:

- In general terms Germany is usually implementing the "standard" or "default" variant of regulations among those where country or region specific variants are possible. One outcome of that general approach is that no payments of the "First Pillar" of CAP are linked to specific outputs. A consequence is that product specific market distortions are very small in Germany.
- The direct payment scheme in Germany is different from its Eastern European neighbours. It started to abandon the "historical" approach of farm specific payments in 2005 and has uniform regional premiums. In 2015 the total of the Basic Premium was 0.22 billion € in Baden-Württemberg, 0.59 billion € in Bavaria; the Greening Premium was 0.12 billion € in Baden-Württemberg and 0.27 billion € in Bavaria and (together 27% of basic premiums and greening premiums in Germany).
- The "Second Pillar" of CAP - the Programme of Rural Development (PRD) - is much more important in Bavaria and Baden-Württemberg than in other Länder of Germany. Baden-Württemberg will use more than 1.8 billion € of public money for the 7-year period 2014-2020 (709 million € from the EU budget). 534 million € will be allocated to measures agri-environmental and climate protection measures (EC, s.a.a). In Bavaria, (EC, s.a.b) 3.5 billion € of public money will be available for the same period (€ 1.5 billion € from the EU budget). For agri-environment-climate measures 600 milllion € are allocated.

According to the German constitution agriculture is a policy area of Länder. The scope of federal legislation concerning agriculture is therefore relatively small with the exception of environmental regulation.

### 6.2.3 Agri-Environmental Programmes

AEP measures are an element of the "Förderprogramm für Agrarumwelt, Klimaschutz und Tierwohl" (FAKT support programme for agri-environment, climate protection and animal welfare) and the Kulturlandschaftsprogramm (KULAP cultural landscape programme) in Bavaria. Both programmes were originally introduced in 1988 and have become complex and targeted policies over the years.

Specific water related measures in FAKT in Baden-Württemberg are (MLR Baden-Württemberg, 2016):

- winter cover crop (100e/ha)
- nitrogen depot fertilizer application with injection (60€/ha)
- precision farming (80 €/ha)

- strip tillage (120 €/ha)
- voluntary farm nutrient balance (20 €/ha up to 180 €/ha per farm)

Specific water related measures in KULAP in Bavaria are:

- single plot management of grassland along water courses and in designated project regions (ban of fertilizer and plant protection substances 350 €/ha );
- measures on arable land include:
  - water protection and erosion prevention practices (920 €/ha on green strips)
  - winter cover (90€/ha when combined with another measure to 120 €/ha)
  - mulch seed and row tillage (70€/ha when combined with another measure to 100 €/ha)
  - strip till and direct seed (120€/ha when combined with another measure to 150 €/ha)
  - ban of input intensive crops in designated sensitive zones (250 €/ha)

In both programmes organic farming practices and the avoidance of chemical-synthetic means of production is supported. Premiums per hectare depend on the efforts and range between 350 €/ha (grassland/arable land) and 1,275 (permanent crops and trees) in Baden-Württemberg and 273 €/ha (grassland/arable land) and 975 €/ha (permanent crops) in Bavaria. These are the rates for maintaining organic practices on the farm. The introduction is supported at higher rates.

### *6.2.4 Gap analysis*

Despite of many efforts and significant financial transfers the chemical status of ground water bodies in the German DRB was "good" only in 76% of the total area (indecated in green in Figure 7). In the rest, the status was "bad", mainly due to high levels of nitrate.

The effectiveness of agri-enrionmental measures is a topic of evaluation reports for the programme or rural development. However, the reports are not very instructive. In the report of the Bavarian programme from 2007-2013 (ART, 2016) only output indicators are listed (how much money was spent for water related measures). With respect effectiveness indicators the report only states "k.A." (no information). The most recent evaluation report for Baden-Württemberg (ifls, art, Unique, 2017) also only reports output indicators and evaluates the effectiveness only in a qualitative manner.

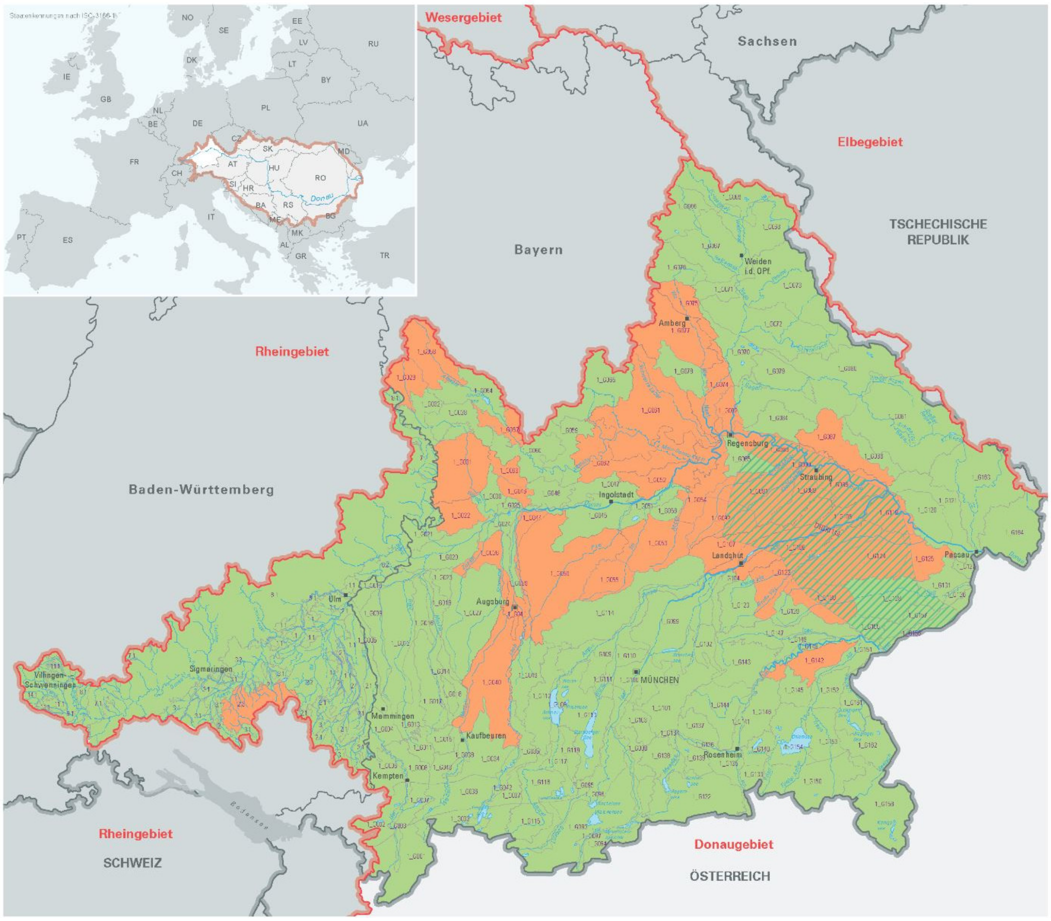


*Figure 7: Chemical status of groundwater in the DRB in Germany*

Source: BWB, 2015, (Flussgebietsgemeinschaft Donau - Karte 7; page 52)

In general, in Germany, information about the status of water bodies is excellent. Access to monitoring data for the general public and researchers is possible and regular reports describe the status and development in a detailed manner. In situations when reports of administrative bodies do not provide sufficiently detailed information, parliamentary questions make additional complementary information available to the public (e.g. Deutscher Bundestag, 2016ab about nitrate content of ground water bodies).

Whereas in many countries causal effects of agricultural practices and the consequences in the environmental medium are not well understood the status of knowledge is better in Germany, in particular in Baden-Württemberg. One reason is, that due to the strong impact on water quality during the second half of the last century, water protection programmes have been put in place over decades now (e.g. SchalVO - see next section). The processes between agricultural practices and mineralized nitrogen compounds in top soil are well understood because hundreds of experiments were made in the past and thousands of samples are taken each year. The processes below the root zone and groundwater tables are not yet equally well understood. This deficit of knowledge is likely one reason why the effectiveness of measures is open to scientific debate.

## 6.3 Overview of instruments to reduce water pollution in each country

### *6.3.1 Measures Observed*

Water protection has a long tradition in Germany. From an historical perspective, drinking water protection had the highest priority, then came the awareness of surface waters. Zones around wells were either bought by municipalities or restrictions on land use were imposed based on Länder-legislation. A century ago investments started to be made in order to clean municipal wastewaters and as soon as the polluter pays principle was established in the 1970s agriculture moved into the focus of attention of environmental legislation. Today there is a broad spectrum of instruments in place at various regional levels.

#### 6.3.1.1 Training, education and information

The linkage between agriculture and the environment is part of the standard curriculum at agricultural colleges. In Germany anybody can become farmer and operate a farm but there are financial incentives to undergo a formal training for those who operate farms (the setting up a farm premium as part of AEP).

Only people with specified qualifications are allowed to apply certain chemical substances (herbizides and pesticides) on farms.

In certain environmentally sensitive zones with high vulnerability, training programmes have been established that are financed by water supply companies and Länder governments. Consultants who are funded by government authorities are setting up management plans together with farmers and keep track of nutrient flows on farms. Such measures are supported in the AEP in Baden-Württemberg.

#### 6.3.1.2 Regulatory instruments

In Germany command and control measures are complementing agri-environmental programs which are voluntary measures. The range of bans and prohibitions is large: many potentially useful chemicals from an agronomy point of views may not be applied, the time when animal manure may be spread is strictly limited, the capacity of slurry tanks is regulated, the equipment used for spreading chemicals must be inspected regularly and records kept on farms are inspected frequently (as part of CAP). This range of measures is very similar to other countries in Europe.

The most important legal source concerning nitrate pollution in the EU is the Action Programme based on the Nitrates Directive. In Germany the "Düngeverordnung" (fertilizer ordinance) is its core element. According to the views of the European Commission which is responsible to check whether EU regulations are fully implemented Germany has not taken sufficient additional measures to effectively address nitrates pollution and revise its relevant legislation to comply with the EU rules on nitrates. An infringement procedure was initiated and in 2016 the case was brought to the European Court (EC, 2016).

A revision of the Düngeverordnung was published in early 2017. An amendment of the Fertilizer Act is necessary because the revised fertilizer ordinance becomes effective (LWK NRW, 2017).

From 2018 onwards, livestock farms with more than 2.5 LU per hectare and more than 30 ha of agricultural land or more than 50 LU must produce a material flow balance; from 2023 this applies to all farms with more than 20 ha of agricultural land or more than 50 LU. Biogas fermentation residues are included in the 170 kg N/ha control.

Administrative data from national authorities can be used for the purpose of supervision (e.g. data from IACs, or certain data, which are available at the approval authorities of the building authorities or environmental enforcement authorities).

The revised regulation establishes a uniform framework throughout Germany, on the basis of which a voluntary quality assurance system for commercial fertilizers. If necessary, the Länder may adopt the specific provisions necessary for this purpose in a legal regulation, provided that Federal authorities do not make use of its authorization to make arrangements. The fine for certain breaches of the Fertilizer Ordinance will be increased to 150,000 €.

#### 6.3.1.3 Fiscal instruments

In Germany there are no taxes on effluents, emissions or potentially harmful inputs of agriculture. In order to promote environmentally friendly practices subsidies have been the most important instrument apart from regulations. Subsidies have been granted for investments in buildings and infrastructure (sewage pipes, sewage tanks on farms), machinery (slurry tanks with soil injection equipment), emission reducing farming practices, soil sampling, and training. Most of the subsidies are granted via the AEP but Länder.

#### 6.3.1.4 Other measures

The environmental criminal law and environmental liability law are relevant additional regulations. In some regions, private contracts between farmers and water suppliers exist with the aim to minimize pollution and to compensate farmers for foregone profits.

### *6.3.2 Scale at which the instruments are implemented*

In Germany, the legislative competence for water resources law is shared among the Federal Government and the Länder. Prior to 2006, the federal government was responsible for the framework legislation. Since then the Federal Government has had the concurrent legislative competence for water resources law. Länder may deviate from the provisions of the Federal

Government. Deviations are not possible in the case of substance or plant-related regulations.

A revised Water Resources Act (Wasserhaushaltsgesetz) entered into force in 2010. The Länder will have to adapt their already existing water laws when they are in conflict with the federal law. All regulations must comply with the relevant EU directives (e.g. the Water Framework Directive, Nitrates Directive). This complex governance structure may be one reason why regulatory differences between Länder are eminent.

### *6.3.3 Effectiveness of measures*

The effectiveness of all these measures listed above is not evaluated regularly in a coherent setting. Only in the case of measures financed by the AEP evaluations are necessary, however currently only ex-ante evaluations are available (ifls, art, Unique, 2016 and ART, 2016). Monitoring programmes are used to measure the environmental status but the reports usually do not identify causal effects of changing practices on environmental indicators.

The effectiveness of measures is depending on many parameters. A very important one is the vulnerability of the environment. Due to its very high variability measures that may be very effective in one place may turn out to be ineffective in another.

In the case of Baden-Württemberg, 5% of the area are very sensitive (maximum tolerable N surplus/ha up to 65kg), in 75% of the area more than 100 kg N/ha are tolerable (N.N., s.a.). In Baden-Württemberg nitrate levels are exceeding the threshold value of 50 mg nitrate/l on 6% of monitoring sites (16% are exceeding 40 mg/l). Residues of plant protection substances are exceeding the threshold value of 0.1µg/l on 10% of sites (more than 0.08 µg/l in 12% of sites).

The status of groundwater quality in Bavaria is reported in the management plan for the implementation of the WFD (StMUV, 2015). In the Bavarian area of the DRB the status of nitrate pollution is "bad" in 19% of 162 water bodies, the status of residues of plant production substances is "bad" in 3% of river basin districts (this figure applies to all substances together). The overall assessment is that 29% of water bodies have to be classified as "bad" (StMUV, 2015, table 4-16).

In the German part of the DRB the chemical status is "good" on 76% of the area and the quantitative status is "good" everywhere (BW, 2016). All the implemented measures together seem to have the intended effect because "overall, the proportion of measuring points, where a decrease of the Nitrate concentrations could be determined [is higher] than the share of the measuring points where increasing nitrate contents are observed" (BMUB and BMEL, 2017). This statement that applies to the whole German territory is not valid for the whole are. Recent monitoring data from Bavaria indicate that water quality is improving not for all categories. The share of samples with very high concentrations (more than 50 mg nitrate/l) was increasing over the years whereas the share of less polluted samples increased (Bayerisches Landesamt für Umwelt, 2017). In Baden-Württemberg the mean nitrate concentration in the groundwater has been decreasing recently. In 2015 lower concentrations of nitrate were observed on 47% of the measuring. However, there was an increase of 44 percent. Overall, the number of heavily polluted areas has been declining (Baden-Württemberg.DE, 2016).

## 6.4 Evidence from the literature, monitoring reports, evaluation studies

### *6.4.1 Literature review*

In Germany and in particular in Baden-Württemberg and Bavaria there are several public research institutes and many university departments that work on water quality related problems. Due to the quality and quantity of these research activities meta-analyses about cost-effective measures in agriculture (see e.g. Osterburg et al., 2007) can derive general recommendations. Many of these studies are reported in the section on the synthesis and are not repeated here.

An important lesson learned from the review of initiative for a water friendly agriculture in Baden-Württemberg and Bavaria is that small groups of farmers who act in a co-ordinated manner with local stakeholders like managers of waterworks are effective arrangements. Well working co-operations are contingent upon a good mix of persons that understand each other well. An important element is that losses for farmers that are due to high sensitivity of locations need to be compensated otherwise environmental friendly practices are not carried out. This and a long term partnership between farmers and water suppliers seem to be the necessary condition for swift, effective and sustainable reduction of emission.

The most important findings of the literature review are:

- nutrient balances (either on farms or on sites) are good or at least adequate predictors for levels of water pollution depending on the region;
- information about the amount of available nitrate in soil is a necessary prerequisite to fine tune management practices to different site characteristics;
- agri-environmental measures are inducing more environmentally friendly behaviour on farms and are therefore a complement for command and control measures, however their cost-effectiveness is not (yet) known;
- the effectiveness of measures depends crucially on the very local conditions and the ways incentives towards more environmentally practices are implemented.

### *6.4.2 Information gaps*

The recently updated fertilizer ordinance makes provision to combine different sources of administrative information in order to obtain a better view on the situation of nitrate pollution in agriculture. These provisions indicate that there is actually a broad range of information sources and data but they are not well integrated. Such a lack of integration is due to legal restrictions concerning the privacy of data and many other reasons. One of these reasons is that the cost-effectiveness of measures is not systematically investigated due to the complexity of the governance structure. Each agri-environmental programme, each co-operation project between farmers and water works established its own way of calculation schemes and incentive structure. The big advantage of such an approach is that many variants of activities are out that try to reach the same goal and those that turn out to be effective are going to survive in the long run. A proper systematic monitoring and evaluation of the cost-effectiveness would contribute to make such efforts more economical.

### *6.4.3 Knowledge gaps*

According to the literature surveyed for this analysis it can be summarized that the physical links between the interaction of agriculture and water quality are well understood. Several quantitative models exist that describe the physical processes (erosion, nutrient charges on different types of soil, etc.) and they are used as instruments in designing management plans (e.g. MONERIS – see http://www.moneris.igb-berlin.de).

What is not yet understood is how economic incentives (e.g. higher/lower output and fertilizer prices), regulatory interventions (e.g. varying levels of subsidies for certain measures) affect the behaviour of farmers. Eventually this behaviour will determine the level of surplus nutrients or crop protection substances. From an economic point of view these are sources of inefficiency. It can be reduced by awareness, better information and the right set of incentives (OECD, 2017).

### *6.4.4 Best practice example*

There is not one "best practice example" in Bavaria, but there are many. A website[7] hosted at the Bavarian Department for the Environmental lists twelve case studies of successful co-operations between farmers and water suppliers. More than 200 Bavarian water suppliers have already concluded voluntary agreements with farmers operating. The most important elements are:

- Such co-operations are voluntary agreements between a water supplier and the farmers operating in its protection and catchment area.
- They offer far-reaching opportunities for the long-term safeguarding and improvement of drinking water quality. They are the best means of remedying nitrate limit value violations.
- Co-operations cannot replace the regulations of protected areas, but are flexibly supplementing them.
- The co-operation compensates farmers for additional agricultural services for groundwater protection that go beyond statutory norms.
- In many cases consultation services are offered to support the farmers.
- The principle of any agreement is the environmental effectiveness.

[7] https://www.lfu.Bavaria.de/wasser/trinkwasserschutzgebiete/kooperation_mit_landwirten/index.htm

- For the development of effective, site-adapted agreements, processing and advice, the use of personnel familiar with agriculture is indispensable.
- There are two different approaches to the contents of the contract; on the one hand, individual activities (e.g. catch crops in the spring) that are rewarded when they are made and on the other hand, the amount of the premium may dependent on the result of the autumn soil examination for N-min.

In Baden-Württemberg SchalVO, a unique ordinance is in place since 1987. The purpose of this it is to protect the waters of public water supplies in water protection areas and areas designated as water conservation areas against the adverse effects of inputs from land use (agricultural, including horticultural, viticultural, forestry and other land use, such as sports facilities). The main purposes are to avoid microbial groundwater contamination, to avoid contamination of groundwater with pesticides and their degradation products and eliminate existing contamination as quickly as possible, to minimize nitrate inputs and to achieve a swift remediation of nitrate-polluted groundwater resources through groundwater-relieving management measures.[8] Financed from the budget of the land farmers in designated areas are supported to carry out monitoring activities (Nmin sampling) and to apply water quality enhancing practices. One element of Baden-Württembergs efforts to reduce water pollution is the Nitrate Information Service (NID). It provides an impact specific total nitrogen fertiliser recommendation and an indication of the height of the first fertiliser dose, in which crop and location dependent parameters were taken into account.

## 6.5 Future of agriculture in Bavaria and Baden-Württemberg

### *6.5.1 Production trends in Germany*

Projection for agricultural production in Germany is made by the Thünen Institute bi-annually. The Thünen-Baseline is built on an integrated model framework. It is not a forecast of the future, but describes expected developments for the next 10 years in the German agricultural sector under given (agricultural) political conditions and assumptions for the development of exogenous influencing factors. The Thünen-Baseline is thus a reference scenario for the analysis of the effects of alternative policies and developments.

According to the most recent Thünen Baseline (Offermann et al., 2016) output prices in Germany are likely to rise. Wheat prices will be supported by export demand and will amount to 210 €/t in 2025. A weakened growth in animal production is expected worldwide and low energy prices. The development of prices for barley, corn and canola will therefore be moderate. In the dairy products segment, the favourable sales prospects on global markets dominate the development in the long term. The milk producer's price at the end of the projection period is therefore just under 38 €/100 kg milk.

[8] http://www.landesrecht-bw.de/

The structural shift in cereal cultivation and the increase in yields mean that cereal production will rise by around 13% until 2025, with only a minimal change in the extent of cultivation. Oilseed cultivation is significantly reduced (-17%) as a result of falling prices, but overall production remains virtually constant due to higher yields. Milk production will be increased to around 37 million tonnes by 2025 due to rising milk prices and the end of the milk quota.

Compared to the base year period 2009 - 2011, the average operating income per employee increases slightly again and is thus above the average level of the last ten years. However, the development of income shows differences between the types of farms. In arable farms, income stabilises at the level of the baseline period, but is somewhat lower than in the 2012/13 and 2013/14 marketing years; dairy farms benefit from a strong increase in average farm-based milk production, with producer prices for milk rising significantly compared to the period 2009-2011. The incomes of dairy farms increase by an average of 35%, which is higher than in all other types of farms. In other feed farms, incomes cannot sustainably break away from the low level (+5 %) despite rising producer prices for beef and veal. The significant decline in real pigmeat prices has a dampening effect on income development in mixed and processing operations.

### *6.5.2 Farm structure development in Baden-Württemberg and Bavaria*

The Thünen-Baseline report (Offermann, et al., 2016) makes no projections concerning the farm structure, only projections on the number of livestock. In both Länder, the number of cattle and an particular dairy cows is likely to increase significantly (in Baden-Württemberg cattle +8.6%, dairy cows +3.6%; in Bavaria cattle +9.8%, dairy cows +5.6%). A downward trend is expected concerning the number of pigs (in Baden-Württemberg live swine -20.4%,; in Bavaria -24.1%). Using these forecasts and calculating the rate of change in terms of LU, it turns out that the authors expect a constant number of livestock units. Therefore a structural change will take place which brings about a shift from pig production towards milk production.

According to the agricultural census in 2000, 2010 and 2013 the annual rates of structural change of the number of farms were between -4.4% (2000 to 2013) and -1.6% (from 2010 to 2010) in Baden-Württemberg. Using these rates to calculate trends until 2025 the number of farms may decline to numbers between 34,000 and 25,000. The annual rates of structural change of the number of farms in Bavaria were between -3.8% (2000 to 2013) and -1.6% (from 2010 to 2010). Using these rates to calculate trends until 2025 the number of farms may decline to numbers between 77,000 and 60,500.

The change of the number of persons employed in agriculture (-1.2% in Baden-Württemberg and -1.6 in Bavaria) is in the short run very similar to the change in the number of farms. In the longer run, the decline of persons employed in agriculture was lower (-1.4% in Baden-Württemberg and -1.9 in Bavaria) compared to the decline of number of farms. If these trends prevail, the amount of labour will be around 55,000 AWU (annual working units) in Baden-Württemberg and 110,000 AWU in Bavaria.

### *6.5.3 Consequences for water related indicators*

At the time when the Thünen Baseline was published (early 2016), the baseline projections did not take into account the possible higher requirements that were under discussion when the projections were made (e. g. in the Fertilizer Ordinance). According to the authors According to the most recent Thünen Baseline (Offermann et al., 2016) such regulations are expected to lead to rising costs, especially in processing plants. Without these effects, the nutrient supply from agricultural fertilizers is projected to increase by around 8% until 2025 due to increased fermentation substrate cultivation, increasing cultivation intensities and an expansion of pig and poultry meat production. In order to meet the higher nutrient requirements resulting from higher yields, an increase in the use of mineral fertilizers of around 8 kg/ha LF is also expected. Nevertheless, according to the model analyses, the sectoral surplus for nitrogen will fall. By 2025, the surplus will decrease by 8% to 64 kg/ha LF by 2011 compared with 2009. Figure 8 shows the regional expected nitrogen balance that is consistent with the projections of production. Atmospheric deposition, inter-regional slurry transport and effects of the new fertilizer ordinance are not accounted for.

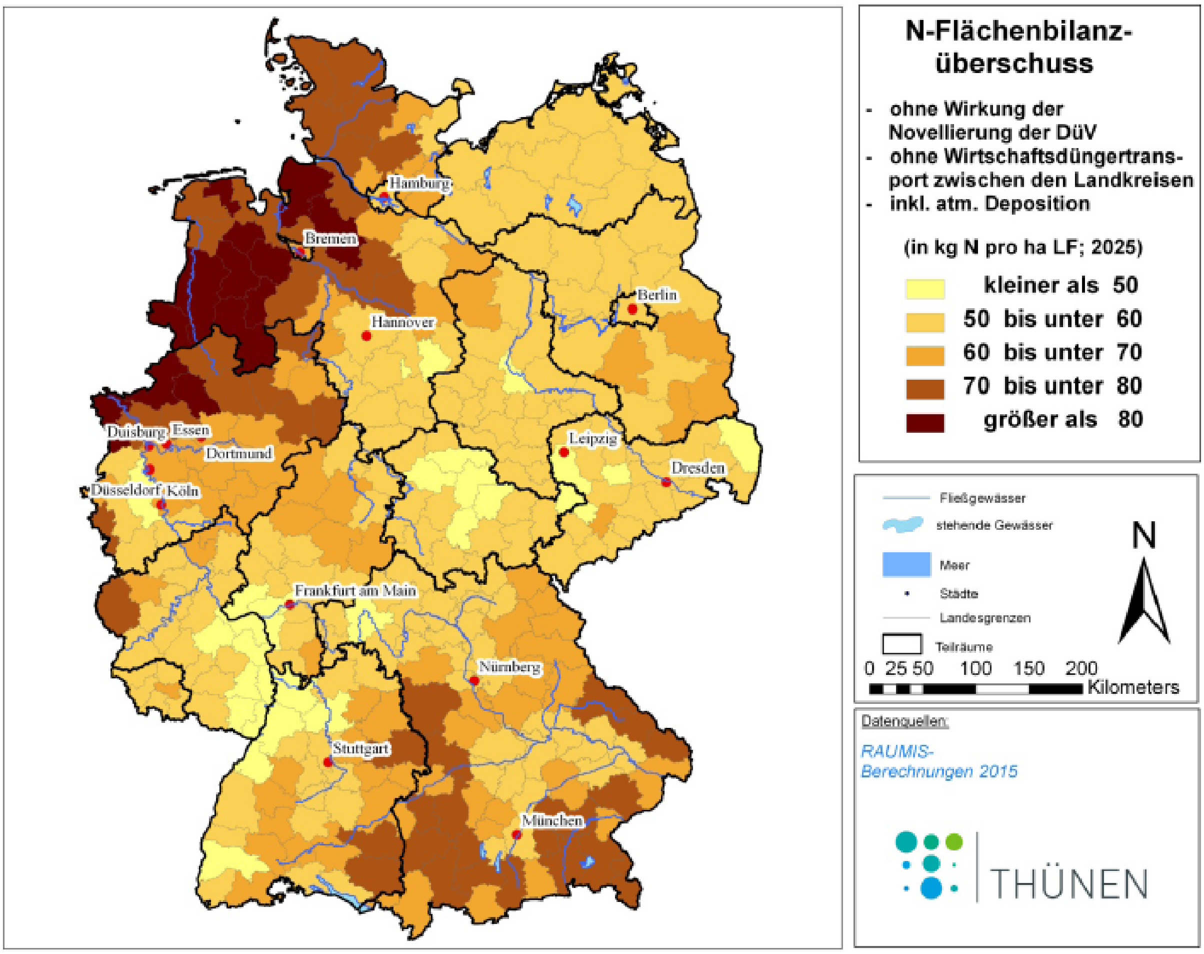


*Figure 8: Projections of agricultural nitrogen surplus in 2025*

Source: Thünen Baseline 2015-2025 (Offermann et al., 2016).

## 6.6 Synthesis for Germany

### *6.6.1 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).

### *6.6.2 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.

### 6.6.3 *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.

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# 7 Country Report: Hungary

Victor Platon

Note: this report was drafted based only on sources in English language found on internet.

## 7.1 Economic and agri-environmental indicators

The whole territory of Hungary is situated in the Danube river basin.

### *7.1.1 State of agriculture in the DRB*

In Hungary, in 2015, the agricultural area[9] was of 5.34 million ha compared with 7.14 million ha in 1960 (a decrease of 1.74 million ha), out of which 76.11% is arable areas, 18.54% is grassland, 3% of gardens and orchards. The remaining 2.05% are orchards and vineyards. The Utilised Agricultural Area (UAA) in Hungary is the total area used by the farm, regardless of the type of tenure or whether it is used as a part of common land. It includes four major components: arable land, permanent grassland and meadow, permanent crops and kitchen gardens.

In Hungary, the agricultural area was mostly taken up by arable land (82.3%). Permanent grassland and meadows covered only 14%, with permanent crops sharing a marginal 3.3% in 2010. Over the period under analysis, the area of permanent grassland and meadow increased by 9.7 % (+57,250 ha), whereas the arable land remained almost stable, only gaining 18,580 hectares (+0.5%).

The ownership of the land in Hungary registered a significant concentration in the period 2000-2010. There were recorded 576,790 agricultural holdings in Hungary in 2010. Compared to 2000 966,920, about 390,000 farms ceased their activities (–40.3%) – far from being a Hungarian peculiarity, this tendency was found to be widespread among the EU-27, although the decrease in Hungary was particularly pronounced.

In Hungary, the utilised agricultural area (UAA) slightly increased over the inter-census period from 2000 to 2010 (+ 57,250 ha): it covered an area of 4.7 million hectares or about half of the entire Hungarian territory in 2010.

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.

In Hungary, following a common trend in EU, the number of people regularly working on the farm decreased over the period under analysis (–21.9%): about 1.5 million people were working on the farms in 2003, whereas only 1.1 million were left in 2010 (Table 20). However,

[9] Source: https://www.ksh.hu/agriculture

the agricultural labour force still represented 27% of the active population[10] in 2010 – one of the highest shares recorded within the EU-27.

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.

### *7.1.2 State of agri-environmental indicators*

As shown in the Table 20, the output of agricultural holdings reached 5,237 million € in 2010. In Hungary, the standard output (SO), which is calculated by summing up the standard output per hectare of crop and per head of livestock of the farms, increased by 12.5% over the 2007-2010 timeframe. An increase was recorded for most classes of farms, with the exception of the smallest one – holdings with less than 2,000 € of SO – whose value actually decreased by 8.6%. On the other side, the highest growth (+44.2%) was recorded by farms with an economic size of 100,000 € to 249,999 €: their value increased from 377 million € in 2007 to 544 million € in 2010.

The biggest size class, agricultural holdings with 500,000 € or more of SO, 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 SO. 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[11] an increase of quantity administered from 61 kg/ha to 103 kg/ha. In 2016 the quantity of fertilizer sold were 554,000 tons compared with 355,000 tons in 2000. Gross input of organic fertilizer (manure) was constant in the analysed period (139,853 tons per year).

Water used in agriculture has decreased in Hungary, from a volume[12] of 215.8 million $m^3$ in 2000 to 192.8 million $m^3$ in 2015.

[10] A value calculated over the active population in the 4th quarter 2010 of the EU Labour force survey (LFS) Population, activity and inactivity - quarterly data

[11] Source: https://www.ksh.hu/docs/eng/xstadat/xstadat_annual/i_omf002.html. The Hungarian Yearbook for Statistics provided data of fertiliser sold and Fertilizer per hectare of agricultural area, kg. Assuming there are no stocks of fertilisers, the whole quantity sold as administered on the land.

[12] Source: https://www.ksh.hu/docs/eng/xstadat/xstadat_annual/i_uw001.html

## 7.2 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *7.2.1 New Hungary" Rural Development Programme (NHRDP), 2007-2013*

One of the most important programmes that has included agricultural policy measures regarding nutrient discharge was the NHRDP. In the period 2007-2013, within NHRDP were allocated[13] a total of 8 billion € with EU co-financing of 80.5%. For our analysis, there are important two axes which include measures regarding environmental protection and preventing nutrient discharge.

The Axis 2 has the measure 214 - Agri-environment payments (1.137 billion €). The measure 214 has supported several actions as:

- To preserve the genetic resources of native and endangered farm animals on farm among „in situ" conditions that are similar to the original traditional breeding and feeding practices.
- Nutrient management based on soil test and planning.
- Improvement of water quality.
- Use of environmentally friendly pesticides.
- Application of certain grazing density (minimum grazing density to 0.3 LU/ha).

Referring to nitrate sensitive areas, NHRDP has several provisions. For instance, the amount of nitrogen from organic manure disposed in an agricultural area on an annual basis must not exceed 170 kg/ha. As well, manure cannot be applied on frozen ground, land filled with water or covered completely with snow. Manure must not be applied in a radius within the protection zone of surface water, source, and wells whose water is used for human consumption or watering animals.

### *7.2.2 Rural Development Programme in Hungary, 2014-2020*

The Rural Development Programme (RDP) for Hungary was formally adopted by the European Commission on 10 August 2015, outlining Hungary's priorities[14] for using the 4.2 billion € of public money that is available for the 7-year period 2014-2020 (3.4 billion € from the EU budget and 740 million € of national co-funding).

The four major RDP 2014-2020 measures, in budgetary terms (total public funding) are:

- 1,425 million € allocated to measure 4 (Investments in physical assets)
- 638 million € allocated to measure 10 (Agro-environment-climate)
- 328 million € allocated to measure 6 (Farm and business development)
- 279 € million allocated to measure 7 (Basic services in rural areas)

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[13] New Hungary Rural Development Programme Budapest March, 2011 Version 7., 537 pages

[14] Factsheet on 2014-2020 Rural Development Programme for Hungary, https://ec.europa.eu/agriculture/sites/agriculture/files/rural-development-2014-2020/country-files/hu/factsheet-hungary_en.pdf

For our analysis Priority 4 is important: Restoring, preserving and enhancing ecosystems in agriculture and forestry with a value of 1.203 billion €. In this priority, there are three components: biodiversity, water management and soil erosion management (Annex 4).

Restoring, preserving and enhancing ecosystems related to agriculture and forestry under this priority Hungary will target interventions on territories with inland water and drought problems and on high nature values areas. Around 11.5% of agricultural land and 6.4% of forests will be under management contracts for supporting biodiversity, to improve water and soil management. Around 26% of the allocated EAFRD funds will be used for area-based payments to farmers for using environment/climate-friendly land management practices, including organic farming, support to areas facing natural constraints and support to areas under Natura 2000 management. Over 111 000 hectares of farmland will receive support to either convert or maintain organic farming.

### *7.2.3 Nutrient Reduction Project in Hungary (2006-2011)*

Between 2006 and 2011, the World Bank gave a loan to the Hungarian Government in order to reduce nutrient load (nitrogen and phosphorus) of the Danube River.

The key development objectives of the Nutrient Reduction Project in Hungary were: 1) to reduce Budapest's discharge of nutrients (nitrogen and phosphorus) into the Danube River, and consequently into the Black Sea; 2) to enhance the nutrient trapping capacity of Gemenc and Beda-Karapancsa wetlands situated in the lower Hungarian part of the Danube River; and 3) to serve as a model for similar nutrient reduction initiatives in Hungary and other Danube basin countries.

The project had 3 components.

- **Component A included a construction of tertiary treatment facilities at the North Budapest wastewater treatment plant (WWTP)**. The cost of the Component A was 26.8 million US$. The main purpose was to decrease the concentration of nitrogen and phosphorous (N&P) in the effluent water. A nitrogen removal technology using activated sludge was installed, and reductions in phosphorous levels were to be achieved by adding ferric chloride to precipitate out the phosphorous.
- **Component B was meant to contribute to wetland restoration works in the Gemenc and Beda -Karapancsa wetlands of the Duna-Dráva National Park** (cost: 6.5 million US$). Eleven restoration works were planned in these two areas of global conservation importance, as evidenced by their status as RAMSAR sites (the UN Convention on Wetlands of International Importance). Both are situated entirely within the Duna-Dráva National Park (DDNP) located along the Danube River downstream from Budapest. This component was also intended to establish a comprehensive Monitoring and Evaluation (M&E) system to document the effectiveness and cost - efficiency of project interventions in terms of retaining N&P concentrations within the wetlands and thereby reducing their outflow into the Danube River. Of particular

interest to both the Bank and the Government was a second project objective to experimentally assess the role of floodplains and wetlands to serve as a cost - effective alternative to more expensive and technologically intensive conventional wastewater treatment plant (WWTP) systems. This was seen as an opportunity to quantify and compare the costs and benefits of actively engineered WWTPs with more passively engineered (i.e. sluices and weirs) natural systems. A third objective was added to ensure that the resulting information would be shared with other countries in the Region so that they might consider implementing similar environmental management interventions in the future.

- Component C: Dissemination activities to foster replication in Hungary and in the other 10 countries of the Danube River water basin (cost: 0.5 million US$). This component was to finance a comprehensive end-of-project impact evaluation and results analysis of the two interventions (tertiary treatment and wetlands restoration), including a cost-benefit analysis. The results of these studies were to be used as the basis for dissemination, replication, and knowledge -sharing activities at a regional workshop, public communication campaigns, and on the project's website and the GEF-funded International Waters (IW) Learn Initiative. There are no measures specific for agriculture in this project.

## 7.3 Overview of economic/regulatory/informational instruments to reduce water pollution

### *7.3.1 Measures observed / implemented / under review / discussed*

In Hungary, there are several charges and fees related to water pollution and consumption/abstraction. The main function of these charges is financial. Charges are often used in association with regulatory instruments as fines. In the past, a significant part of the revenues collected went into the Central Environmental Protection Fund and to the municipalities budget. Lately, all earmarked funds have been integrated into the central budget. In the next table, are exposed main charges for water, in Hungary.

*Table 17: Economic instruments to reduce water pollution in Hungary*

| Instrument | Rate[b] | Remarks[c] |
|---|---|---|
| **Water** | | |
| Water abstraction charge | Households and small-scale industry: 1.15 HUF/$m^3$ (base rate)<br>Large-scale industry: 3.50 HUF/$m^3$ (base rate)<br>Irrigation: 0.5-12 HUF/$m^3$ | Total income: HUF 4.2 billion.<br>For households and industry, charges vary according to the type of water and the region, so that the effective rate ranges from 0.001 HUF/$m^3$ to 10 HUF/$m^3$.<br>Revenue goes to the Water Management Fund. |
| User charge for public water supply | Households: 53-140 HUF/$m^3$<br>Industry: 53-604 HUF/$m^3$ | Payment for service of municipal facilities. From 1995, maximum and minimum user charges have been introduced. |
| User charge for sewerage and sewage treatment | Households: 26.7-163 HUF/$m^3$<br>Industry: 26.7-866 HUF/$m^3$ | Payment for service of municipal plants. From 1995, maximum and minimum user charges have been introduced. |
| Waste water fine[a] | | Total income: HUF 374 million.<br>For municipal and industrial sewage. |
| Sewer fine | | Total income: HUF 761 million.<br>For industrial discharge into the municipal sewerage system.<br>Revenue goes to companies operating sewerage systems. |

Source: Environmental Performance reviews. Hungary, OECD, 2000

At this stage of the research no economic instruments dealing with fertilizers or nitrates were found.

### 7.3.2 Legal instruments to reduce water pollution in Hungary

1. Directive 91/676/EEC (Nitrate Directive) – concerning the protection of waters against pollution by nitrates from agricultural sources, having as objective the reducing of water pollution caused or induced by nitrates from agricultural sources.

The EU Nitrates Directive was transposed in Hungary by the Government Order No. 27/2006 (07.02.) on the protection of waters against nitrate pollution from agricultural sources MARD (Ministry of Agriculture and Rural Development) Order No. 59/2008. (29.04.) on the detailed rules of the action programme necessary for the protection of waters against nitrate pollution from agricultural sources and on the data supply and recording (this defines the rules of "good agricultural practice").

Other legal documents are:

- MARD Order No. 50/2008. (24.04.) on the determination of the system of conditions necessary for the unified territory-based supports and for the sustaining of the "Proper Agricultural and Environmental Status" to be fulfilled in order to be eligible for certain rural development-related supports and that of the rate of changing animals into animal units.
- Government Order No. 220/2004 (21.07.) on the rules of protecting the quality of surface waters;
- Government Order No. 219/2004. (21.07.) on the protection of groundwaters;

- Government Order No. 240/2000. (23.12.) on the designation of surface waters sensitive from the viewpoint of urban wastewater treatment and their catchment areas.

2. NATIONAL PLANT PROTECTION ACTION PLAN[15] - 2012

In accordance with Article 4 of Directive 2009/128/EC of the European Parliament and of the Council establishing a framework for Community action to achieve the sustainable use of pesticides, Member States shall work out and adopt National Action Plans (NAP). In Hungary, the NAP has set up quantitative objectives, measures and timetables to reduce risks and impacts of pesticide use on human health and the environment and to encourage the development and introduction of integrated pest management and of alternative approaches or techniques in order to reduce dependency on and risks posed by the use of plant protection products. The Plan has 21 measures[16] and target areas as: maintenance of plant health safety in Hungary by applying the minimum amount of plant protection products; mitigation of the risks imposed to human health and the environment originating from the use of plant protection products and from pest management programs and keeping the risks at low level by providing risks mitigating measures etc.

In Hungary, all instruments cover the national scale. In the case of Rural Programme 2014-2020, there are official maps that provide information about the regions covered by payments to farmers. As in all EU countries, there are overlapping maps taking into account the measures selected.

It is not possible to estimate the effectiveness of measures in Hungary. A lack of basic data as baseline and measurements after the measures ended has prevented such assessments.

## 7.4 Evidence from the literature, monitoring reports, evaluation studies

### *7.4.1 Health damage due to water pollution in Hungary*[17]

The article showed that the number of the drinking water borne epidemics in Hungary has decreased, but the hazard is not over. The number of epidemics caused by water in swimming pools and spas, however, has not decreased. From 1975-1993, approximately 7500 persons (mainly children) became ill due to contaminated swimming pool water. Recreational waters of lakes and streams have not caused outbreaks up to now (except one case), but, given their bacteriological quality, individual cases of infection might occur. The authors have shown that, from 1976-1993, nitrate contamination of drinking water (mainly

[15] Printed by Easy Solution Kft. H-1108 Budapest, Pára u. 6. ISBN 978-963-08-7463-2

[16] People interested in more details about the measures of the Plan should contact the author of this report at the address: franz.sinabell@wifo.ac.at

[17] MffIALY CSANADY & ELONA STRAUB., National Institute of Hygiene, PO Box 64, H-1966, Budapest, Hungary., Assessing and Managing Health Risks from Drinking Water Contamination: Approaches and Applications., (Proceedings of the Rome Symposium, September 1994). IAHS Publ. no. 233, 1995.

from private wells) led to more than 1700 cases of methemoglobinemia in babies, including 28 fatal cases. The yearly number of cases dropped from about 300 to 20-30 as the result of supplying babies with (usually bottled) drinking water and establishing new water works. In areas supplied by water of high arsenic content (of natural origin) increases in the stillbirth ratio, the number of spontaneous abortions and the occurrence of some illnesses (e. g. hyperkeratosis and hyperpigmentosis) have been observed. In some cases, blue algae (cyanobacterium) water blooms caused allergic symptoms and dermatitis during swimming.

### *7.4.2 Vulnerability and risk evaluation of agricultural nitrogen pollution for Hungary's main aquifer using DRASTIC and GLEAMS models[18].*

The article analyses one important issue related to diffuse pollution. In recent years, the significant improvement in point source depuration (urban and industrial sewage) technologies has highlighted some unsolved problems. These problems are related, in particular, to phosphorus and nitrogen pollution of surface water and groundwater caused by agricultural non-point (diffuse) sources (NPS). Therefore, there is an urgent need to determine the relationship between agriculture and chemical and ecological water quality. This is a worldwide problem, but it is particularly relevant in countries, such as Hungary. This study compares a model showing aquifer intrinsic vulnerability to pollution (using the DRASTIC parameter method; Aller et al. [Aller, L., Truman, B., Leher, J.H., Petty, R.J., 1986. DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings. US NTIS, Springfield, VA.]) with a field-scale model (GLEAMS; Knisel [Knisel, W.G. (Ed.), 1993. GLEAMS—Groudwater Leaching Effects of Agricultural Management Systems, Version 3.10. University of Georgia, Coastal Plain Experimental Station, Tifton, GA.]) developed to evaluate the effects of agricultural management systems within and through the plant root zone. Specifically, GLEAMS software calculates nitrate nitrogen lost by runoff, sediment and leachate.

Groundwater monitoring probes were constructed for the project to measure: (i) nitrate content in monitored wells; (ii) tritium (3H) hydrogen radioisotope, as a tool to estimate the recharge conditions of the shallow groundwater; (iii) nitrogen isotope ratio δ15N, since nitrogen of organic and inorganic origin can easily be distinguished.

The results obtained are satisfactory, above all regarding the DRASTIC evaluation method, which is shown to satisfactorily explain both low and high aquifer vulnerability, and furthermore proves to be a good tool for zoning hydrogeological regions in terms of natural system susceptibility to pollution. The GLEAMS model, however, proves not to be immediately usable for predictions, above all due to the difficulty in finding sufficient data for the input parameters. It remains a good tool, but only after an accurate validation, for decision

[18] Leone A, Ripa MN, Uricchio V, Deák J, Vargay Z.., Journal of Environmental Management., Volume 90, Issue 10, July 2009, Pages 2969-2978

support systems, in the specific case to integrate intrinsic vulnerability, from DRASTIC (or similar methods), with land use nitrate loads from GLEAMS, or similar methods.

The analysis has proved a positive experience to highlight the fundamental points of a decision support system, aimed to mitigate the nitrate risk for groundwater coming from Hungarian agricultural areas.

### *7.4.3 Tisza Case Study on Agriculture and Water Management*[19]

The investigations carried out through the Tisza Analysis Report and the estimation of anticipated effects of implementing the program of measures included in the Integrated Tisza River Basin Management Plan (ITRBMP). The report suggested that across the Tisza basin a high proportion of water bodies will be at risk of failing to meet the Water Framework Directive's 'good status' objectives due to the impact of agriculture. The impacts from agriculture include, above all, the impacts of nutrients, as well as impacts from water abstraction for agricultural uses.

Key conclusions of the report are:

- The countries in the Tisza basin have taken great efforts to adopt, adjust and implement the EU Directives in support of implementing of measures to reduce the pressures from agricultural activities on water resources. The main initiatives are grouped around the WFD, Nitrates Directive and Common Agricultural Policy. There are also other pieces of EU legislation such as Integrated Pollution, Prevention and Control Directive[20] applied for agro-industrial installations, or the Directive concerning the placing of plant protection products on the market which is also contributing to the achievement of the WFD objective and reduction of agricultural pressures on the water resources.
- The role of policies is significant in the river basin management when is discussed the pollution coming from agriculture.
- On the Tisza basin level, basic measures (fulfilling the UWWTD ( Urban Waste Water Treatment Directive) and EU Nitrates Directive) for EU MS and the implementation of the ICPDR Best Agricultural Practices Recommendation for Non-EU MS are the main measures contributing to nutrient reduction.
- The EC Common Agricultural Policy is the single biggest driver influencing agriculture, and the Rural Development Measures implementation should be linked with the WFD to avoid the degradation of water due to agricultural activities.

[19] Source: ICPDR / International Commission for the Protection of the Danube River / www.icpdr.org., Version: final. Date: 26 Oct 2012.

[20] To be replaced by the Industrial Emissions Directive.

### 7.4.4 Impact of Agriculture on Water Pollution in OECD Countries: Recent Trends and Future Prospects[21]

Agricultural pollution of surface water, groundwater and marine waters relates to the contamination of drinking water, and harmful effects on ecosystems and costs for recreational activities, cultural values and commercial fisheries. The paper examines the recent trends and economic costs of agricultural water pollution. Subsequent sections of the paper discuss recent Organisation for Economic Co-operation and Development (OECD) policy experiences in addressing water pollution in agriculture, and the medium outlook for pollution across OECD countries. The final section explores ways forward toward sustainable management of water quality in agriculture.

Agricultural water pollution is a focus of attention for policy-makers in most OECD countries due to the following (the importance of these issues varies within and across countries):

- Reduction in pollution by non-agricultural polluters, which has been more rapid than for agriculture, especially nitrate, phosphorus and pesticide pollution.
- Increase in point pollution from agriculture linked to the intensification of livestock farming, especially in the pig, poultry and dairy sectors.
- Greater public awareness of the damage to aquatic ecosystems from certain agricultural practices.
- Growing concerns related to groundwater and coastal pollution, especially from the leaching of phosphorus and pesticides.
- Uncertainty over the extent and severity of those water pollutants derived from farming that are in general poorly monitored (e.g. pathogens, salts, heavy metals).

### 7.4.5 Good practice example[22]: Sződrákos Creek Program – Phase 2

The Tavirózsa Association, an NGO, implemented a wetlands rehabilitation demonstration project to reduce the nutrient pollution of lakes from a poorly managed sewage system.

The project focused on the 132 square kilometre catchment of Sződrákos Creek northeast of the Budapest agglomeration. The creek runs north through Veresegyház and three lakes, including Malomlake, which was given national protection status in 1985. The water eventually drains into the Danube River above Budapest. Veresegyház, a bedroom community of 15,600 lying 30minutes from Budapest, is one of the fastest growing towns in Hungary, attracting some 500 new residents per year to a new suburb 30minutes from Budapest. It also draws plenty of visitors with attractions such as fishing lakes and wetlands, a beach, a nature trail, an all-year thermal bath and a bear sanctuary.

The main ecological concern in the catchment area was the introduction of foreign grass carp to the lakes, which destroyed natural aquatic and marsh vegetation that used to help absorb nutrient pollution. Because many anglers like to fish in clear open spaces, fishing

[21] Source: Kevin Parris, International Journal of Water Resources Development., ISSN: 0790-0627 (Print) 1360-0648 (Online) Journal homepage: http://www.tandfonline.com/loi/cijw20.

[22] Source: www.tavirozsa-egyesulet.hu

associations continued to stock the lake with reed-eating carp even though the introduction of exogenous fish species is prohibited by law. Other nutrient inputs come from leaching household cesspits and discharge from the local sewage treatment plant. Water quality monitoring by authorities has also been poor.

In 1996, a new sewage treatment plant was built near the lakes to serve Veresegyház and neighbouring villages. Plant capacity was over-used, however, and the concentrations of nutrients discharged from the treatment plant were above permitted levels and leached into the lake system. Bacteria levels increased sharply including toxic cyanobacteria and coliform bacteria.

Project funds were used to purchase water testing equipment to estimate pollution levels, which found very high organic and nutrient counts. Following a baseline environmental assessment in the spring of 2006, a small fenced-off pilot site was created at the southern part of Pamut lake. The grass carp was removed and natural wetland vegetation (rooted and floating native aquatic plant species) with high nutrient removal capacities was collected from the surrounding area and replanted in the pilot site. Water quality monitoring was implemented at the start and end of the project to see if nutrient pollution was reduced. The next step was to test the demonstration site water to prove that quality improved.

The project was financed within the framework Danube Small Grants Program of the UNDP-GEF Danube Regional Project. The value of the project was 4,675 US-$.

## 7.5 The future of agriculture in DRB

### *7.5.1 Production trends in Hungary*

There are few publications in English to give details[23] for future trends in Hungarian agriculture. Based on the papers and articles and some hypothesis developed by OECD, Hungarian agriculture will stay on the course of the last five years having as pillars the next components:

- The country's fertile soil, which is reflected both in yields and in quality of the produced goods.
- large underground fresh water reserves;
- certification system is applied in all areas of agriculture in Hungary;
- higher average production yields than European mid-range;
- high technical standards and plant breeding technologies;
- good qualities in terms of logistics;

In Hungary, the climate condition in the summer will be characterized by rising temperatures so the need for water for irrigation will increase.

Another trend is related to the reduction of the livestock production and increasing the crop production (Figure 10).

[23] Most recent found was the article: *New challenges for Hungarian agriculture* by Gábor Udovecz, József Popp, Norbert Potori, published in Studies in Agricultural Economics No. 108. p. 19-32. (2008)

As Hungary transposed all environmental acquis and continues to implement new pieces of legislation, it is expected that environmental impact of agriculture will continue to decrease so greenhouse gases from agriculture will go down.

### *7.5.2 Farm structure development in Hungary*

In Hungary, the trend has been an ongoing concentration of holdings since the nineties. The number and area of the smallest farms have decreased; those of the larger farms have increased. This is a result of the growing mechanization of individual farms and their need to increase productivity and profitability. Annex 6 shows that there are many farms in the smallest farm-category; however, their area is small. The situation is the reverse for the largest farm categories.

It can be seen in Table 22 that farms that have at least 50 ha have increased from 5650 in 2005 to 6590 in 2013. The big majority of farms, almost 73%, cultivate only about 5 % of the total area.

Most of the small farms are subsistence or semi-subsistence farms. Altogether 7000 holdings, which cultivate 75% of the utilized agricultural area, produce 72% of the standard gross margin. 51% of the 707,000 farms are producing for own consumption, 33% are selling as well, and only 16% produce mainly for selling. The concentration trend is clear: from 641,190 farms in 2005, in 2013 there were only 415,560 farms (-225,630 farms).

### *7.5.3 Consequences for water related indicators*

There are some important consequences for water consumption in Hungary. Due to climate change, mainly in summer, it is very likely that the use of irrigation water will increase but as more efficient irrigation technique will be in place the specific quantity of water per ha may remain constant. As well, an important role will be played by hybrids that are better suited for dray sezon.

As it was said, water used in agriculture for irrigations has decreased in Hungary. From a volume of 215.8 million $m^3$ in 2000 the water consumption has decreased to 192.8 million $m^3$ in 2015 (an average of 148.5 million $m^3$). In this period, was recorded a maximum of 282.3 million $m^3$ in 2013 and a minimum of 55 million $m^3$ in 2010. As we can see the variability of water consumption is high (41.58%). If we extrapolate the water consumption for irrigation in Hungary we end up with a value of 205.8 million $m^3$ in 2019 (on average). The upper confidence limit is 420 million $m^3$ and the lower confidence limit is 8.5 million $m^3$. This spread is due to high variability of water consumption for irrigation, in Hungary.

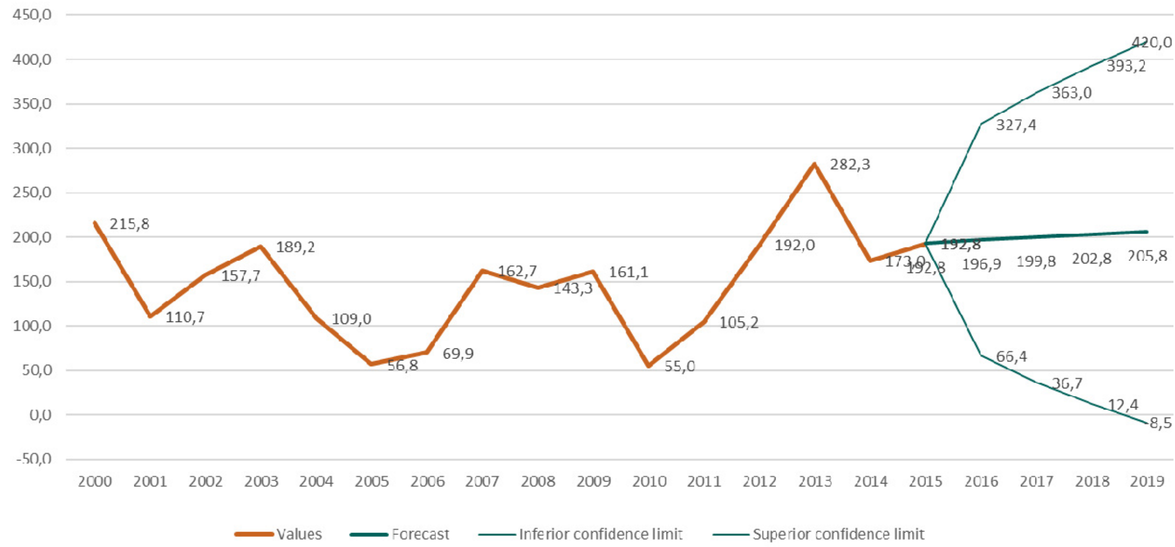


*Figure 9: Forecast of water consumption for irrigation, in Hungary (Million m³)*

Source: extrapolation of the data from: https://www.ksh.hu/agriculture.

## 7.6 Synthesis for 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).

## Annex

*Table 18: Farm structure, key indicators for Hungary*

| Hungary | 2000 | 2010* | Change (%) |
|---|---|---|---|
| Number of holdings | 966 920 | 576 790 | -40.3 |
| Total UAA (ha) | 4 555 110 | 4 612 360 | 1.3 |
| Livestock (LSU) | 3 097 540 | 2 483 790 | -19.8 |
| Number of persons working on farms (Regular labour Force)** | 1 464 670 | 1 143 480 | -21.9 |
| Average area per holding (ha) | 4.7 | 8.0 | 69.7 |
| UAA per Inhabitant (ha/person) | 0.45 | 0.46 | 3.4 |

**Figures on common land not included*

*** For values on labour force reference years are 2003 and 2010*

Source: Eurostat, Online data [ef_kvaareg], [ef_ov_kvaa] and [demo_pjan].

*Table 19: Farm structure, key indicators, by NUTS 2 regions, Hungary, 2000 and 2010*

| | | 2000 | 2010 | Change 2010/2000 (%) |
|---|---|---|---|---|
| Number of holdings | Hungary | 966,920 | 576,790 | -40.3 |
| | Közép-Magyarország | 81,910 | 46,320 | -43.5 |
| | Közép-Dunántúl | 90,860 | 52,560 | -42.2 |
| | Nyugat-Dunántúl | 101,870 | 61,110 | -40.0 |
| | Dél-Dunántúl | 124,240 | 74,960 | -39.7 |
| | Észak-Magyarország | 135,640 | 73,560 | -45.8 |
| | Észak-Alföld | 221,740 | 143,910 | -35.1 |
| | Dél-Alföld | 210,640 | 124,370 | -41.0 |
| Total UAA (ha) | Hungary | 4,555,110 | 4,612,360 | 1.3 |
| | Közép-Magyarország | 314,340 | 251,900 | -19.9 |
| | Közép-Dunántúl | 528,470 | 524,420 | -0.8 |
| | Nyugat-Dunántúl | 502,480 | 515,230 | 2.5 |
| | Dél-Dunántúl | 687,490 | 683,540 | -0.6 |
| | Észak-Magyarország | 485,270 | 513,520 | 5.8 |
| | Észak-Alföld | 976,080 | 1,041,260 | 6.7 |
| | Dél-Alföld | 1,060,980 | 1,082,500 | 2.0 |
| Livestock (LSU) | Hungary | 3,097,540 | 2,483,790 | -19.8 |
| | Közép-Magyarország | 164,090 | 112,160 | -31.6 |
| | Közép-Dunántúl | 442,840 | 291,010 | -34.3 |
| | Nyugat-Dunántúl | 347,440 | 250,790 | -27.8 |
| | Dél-Dunántúl | 406,890 | 282,070 | -30.7 |
| | Észak-Magyarország | 238,790 | 184,760 | -22.6 |
| | Észak-Alföld | 672,540 | 630,810 | -6.2 |
| | Dél-Alföld | 824,950 | 732,180 | -11.2 |
| **Number of persons working on farms (Regular labour Force) | Hungary | 1,464,670 | 1,143,480 | -21.9 |
| | Közép-Magyarország | 108,780 | 86,030 | -20.9 |
| | Közép-Dunántúl | 145,450 | 109,620 | -24.6 |
| | Nyugat-Dunántúl | 160,510 | 128,050 | -20.2 |
| | Dél-Dunántúl | 200,200 | 151,540 | -24.3 |
| | Észak-Magyarország | 204,320 | 146,800 | -28.2 |
| | Észak-Alföld | 330,790 | 283,430 | -14.3 |
| | Dél-Alföld | 314,620 | 238,010 | -24.,4 |
| Average area per holding (ha) | Hungary | 4.7 | 8.0 | 69.7 |
| | Közép-Magyarország | 3.8 | 5.4 | 41.7 |
| | Közép-Dunántúl | 5.8 | 10.,0 | 71.5 |
| | Dél-Dunántúl | 5.5 | 9.1 | 64.8 |
| | Észak-Magyarország | 3.6 | 7.0 | 95.1 |
| | Észak-Alföld | 4.4 | 7.2 | 64.4 |
| | Dél-Alföld | 5.0 | 8.7 | 72.8 |

**Figures on common land not included*

*** For values on labour force reference years are 2003 and 2010*

Source: Eurostat (online data codes: ef_ov_kvaa, ef_kvaareg and FSS 2000 and 2010).

*Table 20: Farm structure, key indicators, by NUTS 2 regions, Hungary, 2000 and 2010*

| Standard output | Standard output (SO) of the holding 2007 | 2010 | 2010 |
|---|---|---|---|
| | € | | % |
| Total | 4,655,291,510 | 5,236,814,250 | 12.5 |
| 0-<2 000 | 299,147,420 | 273,472,450 | -8.6 |
| 2 000-<4 000 | 203,873,080 | 251,558,170 | 23.4 |
| 4 000-<8 000 | 236,484,460 | 259,276,470 | 9.6 |
| 8 000-<15 000 | 246,815,300 | 275,445,420 | 11.6 |
| 15 000-<25 000 | 224,322,800 | 249,498,710 | 11.2 |
| 25 000-<50 000 | 321,287,510 | 365,702,320 | 13.8 |
| 50 000-<100 000 | 329,153,510 | 412,319,660 | 25.3 |
| 100 000-<250 000 | 377,072,790 | 543,866,350 | 44.2 |
| 250 000-<500 000 | 264,413,380 | 370,585,000 | 40.2 |
| >= 500 000 | 2,152,721,250 | 2,235,089,690 | 3.8 |

**Figures on common land not included*

Source: Eurostat, FSS, 2007 and 2010.

*Table 21: Financial allocations of Hungarian NRP, for Priority 4 (2014-2020)*

| **Priority 4: Restoring, preserving and enhancing ecosystems in agriculture and forestry[2]** | | **1 203 443 811** | **28.83** |
|---|---|---|---|
| 4A Biodiversity<br>11.79% of agricultural and 5.08% of forestry under contracts | 01 knowledge | 14 306 962 | 0.34 |
| | 02 advisory | 10 039 464 | 0.24 |
| | 04 investments | 19 008 620 | 0.46 |
| 4B Water management<br>3.57% of agricultural and 0.59% of forestry land under contracts | 08 forests | 6 472 009 | 0.16 |
| | 10 AEC | 638 200 527 | 15.29 |
| | 11 organic farming | 207 598 705 | 4.97 |
| | 12 NAT-WFD | 165 725 129 | 3.97 |
| 4C Soil erosion and management<br>8.39% of agricultural and 0.77% of forestry land under contracts | 13 ANC | 76 208 075 | 1.83 |
| | 15 forest-environment | 51 691 200 | 1.24 |
| | 16 co-operation | 14 193 120 | 0.34 |

Source: Hungarian NRD 2014-2020.

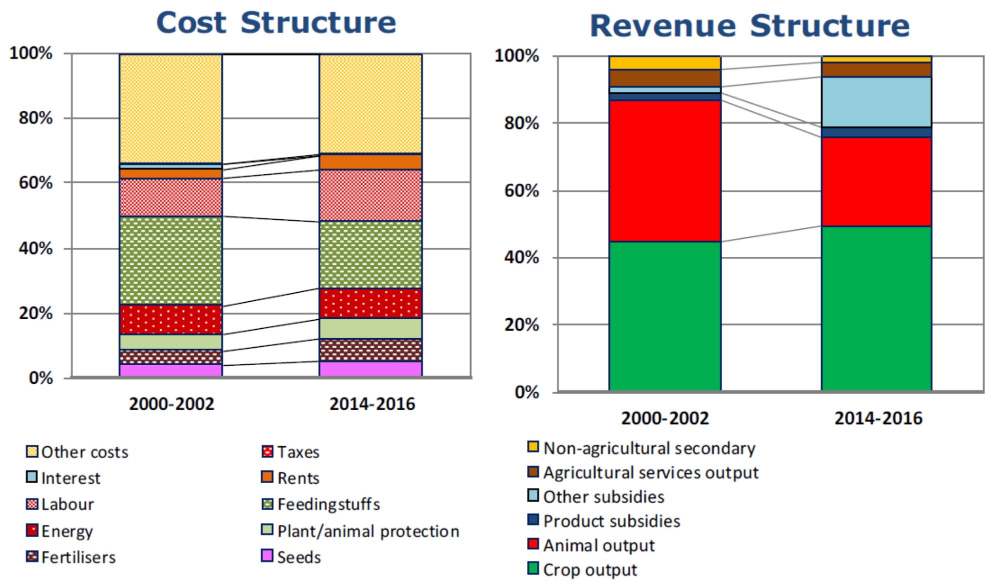


*Figure 10: Cost and revenue structure in Hungarian Agriculture*

Source: Eurostat. Updated: March 2017.

*Table 22: Form structures in Hungarian Agriculture (2005, 2013)*

| Holdings | | 2005 | | 2013 | |
|---|---|---|---|---|---|
| | | Total | % | Total | % |
| By UAA (*) | < 5 ha | 641,190 | 89.7% | 415,560 | 84.6% |
| | 5-10 ha | 28,960 | 4.1% | 25,550 | 5.2% |
| | 10-20 ha | 18,990 | 2.7% | 20,160 | 4.1% |
| | 20-30 ha | 7,570 | 1.1% | 8,350 | 1.7% |
| | 30-50 ha | 6,400 | 0.9% | 7,490 | 1.5% |
| | 50-100 ha | 5,650 | 0.8% | 6,590 | 1.3% |
| | > 100 ha | 6,040 | 0.8% | 7,640 | 1.6% |
| By economic size (**) | < 4 000 € | 602,520 | 84.3% | 388,350 | 79.0% |
| | < 8 000 € | 52,580 | 7.4% | 37,780 | 7.7% |
| | < 15 000 € | 27,770 | 3.9% | 24,980 | 5.1% |
| | < 25 000 € | 12,990 | 1.8% | 14,340 | 2.9% |
| | < 50 000 € | 9,870 | 1.4% | 12,090 | 2.5% |
| | < 100 000 € | 4,460 | 0.6% | 6,680 | 1.4% |
| | < 250 000 € | 2,550 | 0.4% | 4,430 | 0.9% |
| | < 500 000 € | 830 | 0.1% | 1,260 | 0.3% |
| | =/> 500 000 € | 1,220 | 0.2% | 1,430 | 0.3% |
| By LSU (***) | 0 | 217,900 | 30.5% | 186,160 | 37.9% |
| | 0-5 | 460,780 | 64.5% | 281,320 | 57.3% |
| | 5-10 | 20,120 | 2.8% | 11,080 | 2.3% |
| | 10-15 | 5,800 | 0.8% | 3,610 | 0.7% |
| | 15-20 | 2,680 | 0.4% | 1,860 | 0.4% |
| | 20-50 | 4,290 | 0.6% | 3,820 | 0.8% |
| | 50-100 | 1,210 | 0.2% | 1,410 | 0.3% |
| | 100-500 | 1,350 | 0.2% | 1,410 | 0.3% |
| | > 500 | 660 | 0.1% | 650 | 0.1% |
| By age of holder | < 35 years | 55,470 | 7.8% | 30,170 | 6.1% |
| | 35-44 years | 105,910 | 14.8% | 73,160 | 14.9% |
| | 45-54 years | 185,690 | 26.0% | 95,540 | 19.4% |
| | 55-64 years | 173,270 | 24.2% | 143,690 | 29.2% |
| | > 64 years | 194,450 | 27.2% | 148,780 | 30.3% |
| **Total** | | **714,790** | **100** | **491,330** | **100** |
| UAA in 1 000 ha | | 4,267 | | 4,657 | |
| UAA (ha) per holding | | 6.0 | | 9.5 | |

Source: Eurostat, Farm Structure Survey 2005 and 2013. Updated: January 2017.

(*) UAA = Utilised agricultural area.

(**) Economic size: The standard output of an agricultural product (crop or livestock), abbreviated as SO, is the average monetary value of the agricultural output at farm-gate price, in euro per hectare or per head of livestock.
There is a regional SO coefficient for each product, as an average value over a reference period (5 years, except for the SO 2004 coefficient calculated using the average of 3 years). The sum of all the SO per hectare of crop and per head of livestock in a farm is a measure of its overall economic size, expressed in euro.

(***) LSU = Livestock units. A LSU is equivalent to a dairy cow. The number of animals (heads) is converted into LSU using a set of coefficients reflecting the feed requirements of the different animal categories.

# 8 Country Report: Moldova

Victor Platon

## 8.1 Introduction

Moldova is situated in the South-Eastern part of Europe. At North, East and South it is neighboring with Ukraine, at West – with Romania. The area is equal to 33.8 thousand km². From North to South it has 350 km, while from West to East – 150 km.

Minimum altitude is 1.0 m placed on the north of the village Palanca in valley of the river Nistru. Maximum altitude is 428.2 m placed on the Balanesti hill. The climate of Moldova is temperate-continental, influenced by Atlantic air masses coming from West, Mediterranean – from South-West and Continental – from North-East.

Average annual temperature constitutes 10.5°C - 12.1°C. Annual precipitations decrease from North-West to South-East, from 466 mm to 382 mm. The highest quantity of precipitations is recorded for Codru – ancient oak forest, situated mostly in the central part of the country.

Moldovan rivers are a part of the Black Sea basin. The main rivers are Nistru and Prut, which have their spring in Carpati Mountains. Moldova has the entrance to Danube, on a small portion of land in the South of the country.

The soil of the Republic of Moldova is characterized first and foremost by hilly plains with fertile chernozems and productive agricultural lands.

In Republic Moldova there are two river basins: Prut river basin (which includes the Danube sub-basin and Black-Sea sub-basin) and Nistru river basin which are transborder water sources, inland rivers and natural and manmade reservoirs. The biggest surface water source is the Nistru River having a total annual discharge of circa 10.7 km³. The second biggest river is Prut, with an average annual discharge of circa 2.9 km³. All other inland rivers flowing on the territory of the country have an average annual discharge of circa 1.22 km³. The basin of the Nistru River with its tributaries occupies circa 67% of the country's territory, and of the Prut River circa 24%. The waters of the Nistru and Prut rivers are considered to be relatively clean to moderately polluted. The waters of small rivers are medium to highly polluted. Circa 44% of the population does not have access to safe drinking water sources. At present all towns and municipalities and over 65% of rural settlements have centralized drinking water supply systems. Only 50% of this type of systems is in satisfactory technical condition. The rest needs significant capital repairs or rather reconstruction.

Between 2000 and 2011, direct water abstraction[24] from Prut River water resources remained relatively constant at 7.8 million m³ per year on average (6.18 million m³ in 2011 and 15.04

[24] Source: RIVER BASIN MANAGEMENT PLAN FOR PRUT PILOT BASIN IN THE TERRITORIES OF UKRAINE AND MOLDOVA., Environmental Protection of International River Basins (EPIRB), Contract No 2011/279-666., Prepared by Institute of

million m³ in 2000). Water abstraction served, in order of importance: communal needs – 39.4%, agriculture needs – 21.5%, irrigation needs – 17.9%, industry needs – 14.8%, and fisheries – 6.4% of the total use of Prut River water resources.

In the Prut River basin, there are 122 water supply systems with combined length of 1,475.7 km, and 103 operational water pipelines. On average, 3.48 m³ per year of water is transported per capita in the basin, and 15.9 m³ per year in the countryside.

Wastewater discharge to the Prut River network is 12.2 million m³ per year. Of which 4.6 million m³ are discharged directly into the Prut (yearly average), only 19.6% of which treated. Across the Prut network, treated waters are on average 16.4% of the total discharge, and conditionally treated waters – 59%. In addition, all treatment facilities are obsolete. They have been in operation for over 25–30 years and do not meet current technological requirements.

On the whole, the volume of water used for irrigation is insignificant in the central part of the Prut basin (Hincesti and Nisporeni districts) and especially in the south (Leova and Cahul districts). Compared to regions in the north of the basin, these areas have greater demand for irrigation; however, the existing surface water resources sources and irrigation systems here are insufficient.

Agricultural pollution factors, such as use of fertilizers, livestock breeding, and excessive grazing of pasture, are diffuse (non-point, disperse) sources of pollution, which exert pressure on the quality of ground and surface waters in the Prut basin. In the last 20 years, the amount of mineral fertilisers used in agriculture has decreased over 10 times and reached 1960s levels. This decrease is due to: lack of mineral fertilizer production in Moldova, lack of government subsidies for agricultural producers, and high prices of mineral fertilizers. Conceivably, as mineral fertilizer use has decreased, so has the pressure from chemicals on the quality of water in Prut River. The largest use of fertilizers, especially mineral fertilizers, is registered in the northern part of Prut basin – Briceni, Edinet, and Falesti districts. This can be explained with the number of agricultural farms here, the high level of mechanization in agricultural production, and the predominance of grain and industrial crops in the area crop structure. The use of organic fertilizers is minimal, due to absence of large livestock farms following the 1990s collapse of cooperatives.

The area of pastures in the Prut basin is 1,302.4 km² or 16% of the basin area. This is much higher than the country average (10.6%). A special indicator “conditional animal” (animal unit = 1 cow = 1 horse = 3 sheep) has been used to determine pasture availability and the corresponding environmental load from animal grazing. The advisable indicator value is 1 ha per “conditional animal” (source: V. Surd, I. Bold, 2005). Based on 2011 livestock inventory – 78,000 cows, 17,000 horses and 237,000 sheep/goats – the indicator “conditional animals” for the Prut River basin is 174,000. In other words, there are 0.75 ha of pastures available in the

Ecology and Geography, Academy of Science of Moldova (Moldova), Ukrainian Center of Environmental and Water Projects, Academy of Sciences (Ukraine), March 2013.

Prut basin for every cow, every horse and every three sheep/goats. Consequently the livestock density is 1.3 'conditional animals' per hectare.

This is 0.25 ha less than the advisable value, but 0.2 ha more than the country average. The indicator shows growing trend, due to increase in the area of pastures and decrease in the number of animals. Only 22 of all rural communities in the Prut basin, mostly in the Middle Prut Plain, have sufficient pastures (at least 1 ha per "conditional animal"). Even here, some pastures are heavily degraded as a result of excessive grazing. The lowest indicators for pasture support are registered in the Tigheci Hills, the Lower Prut plains, and Codri Hills – below 0.3. Such low pasture support leads to extreme degradation of pastures. The issue is even more pressing in the south of the Prut basin, where the number of animals (especially sheep) is much higher. Additional degradation of pastures comes from: pollution with discharges from cattle farms, straightening of small riverbeds and consequent decline of the water table, and construction of embankments and other hydraulic engineering structures.

Economic development of the area started in the early 19th century. Its largest impact on the ecological state of the basin was observed in the mid–19th century, when tilled fields and deforested lands expanded in area, and especially in the second half of the 20th century, when large cooperative farms and livestock breeding complexes were established, introducing excessive use of fertilizers and pesticides. Despite the significant reduction in water consumption and the amount of chemicals used in agriculture in recent years, the condition of water bodies in the basin remains disturbed.

*Table 23: Fertilizers used in Prut Basin, Republic Moldova, 2009/2010*

| | Mineral fertilizers | | | | Organic fertilizers | | | |
|---|---|---|---|---|---|---|---|---|
| | Total (t) | | Average (kg/ha crops) | | Total (t) | | Average (kg/ha crops) | |
| | 2009 | 2010 | 2009 | 2010 | 2009 | 2010 | 2009 | 2010 |
| Basin-wide | 7,014 | 9,407 | 26.3 | 31.2 | – | – | – | – |
| Briceni | 1,386 | 3,000 | 63.3 | 93.3 | – | – | – | – |
| Edinet | 912 | 1110 | 32.1 | 45.2 | – | – | – | – |
| Falesti | 1003 | 1079 | 31.7 | 33.3 | 14 | – | 0.00 | – |
| Glodeni | 416 | 502 | 15.5 | 18.5 | – | – | – | – |
| Oknitsa | 868 | 842 | 42.4 | 41.1 | – | – | – | – |
| Riscani | 608 | 856 | 16.3 | 22.9 | 330 | 2,616 | 0.01 | 0.07 |
| Hincesti | 206 | 161 | 11.9 | 9.4 | 235 | 116 | 0.01 | 0.01 |
| Nisporeni | 15 | 17 | 26.2 | 25.5 | – | – | – | – |
| Ungheni | 571 | 555 | 31.4 | 27.9 | – | – | – | – |
| Cahul | 450 | 514 | 12.6 | 15.1 | 4,000 | 1 | 0.11 | – |
| Cantemir | 368 | 383 | 17.3 | 17.5 | – | – | – | – |
| Leova | 211 | 388 | 14.6 | 25.1 | – | – | – | – |

Source: RIVER BASIN MANAGEMENT PLAN FOR PRUT PILOT BASIN IN THE TERRITORIES OF UKRAINE AND MOLDOVA. Environmental Protection of International River Basins (EPIRB), Contract No 2011/279-666., Prepared by Institute of Ecology and Geography, Academy of Science of Moldova (Moldova), Ukrainian Center of Environmental and Water Projects, Academy of Sciences (Ukraine), March 2013.

The quality of surface waters in the Prut refers to class II – "clean," or in most cases, class III – "moderately polluted." Key water and environmental problems in the Prut basin are:

1. Devastating rainfall floods, which form in the Ukrainian Carpathians, result in flooding of considerable part of floodplains. Long-term data analyses show doubling of the expected frequency of floods in the basin in the last 40 years.

2. Intensive development of slopes leads of a range of geodynamic processes, most significantly landslide and rockfall (talus) processes.

3. Monitoring results indicate serious pollution of basin waters in Moldova with organic chemicals. These originate from both point sources of pollution (insufficiently treated and untreated wastewater discharges in rural localities) and diffuse sources of pollution (unauthorized dumps/landfills for solid industrial and domestic wastes, runoffs from transportation, fertilizer use in agriculture, etc.).

4. The analysis of hydrochemical monitoring during 2005-2012 indicates a significant increase in the level of surface water pollution at low river flow rates.

5. Results from hydrobiological monitoring show that the quality of waters in the Prut remains at the same level from year to year, without major changes.

6. The most polluted part of Prut River is the section downstream of the Jijia River (Romania) inflow near Valea Mare (Ungheni District). Pressures from hydraulic engineering structures and infrastructure, drainage and intensive use of floodplain lands in agriculture have resulted in disruption of the hydrological regime and the living environment of many valuable species of animals and plants.

## 8.2 Economic and agri-environmental indicators

### *8.2.1 State of agriculture*

The population of the Prut basin is 798,700 inhabitants[25] or 22.4% of the total population of the Republic of Moldova. The surface of the basin is a typical agrarian region, where the share of the population in rural areas accounts for 74% of the total population. During the last 20 years, the population of the region has been reduced by about 50,000 people. Within the river basin there are 447 villages and 15 towns.

Agriculture is a traditional economic sector in Moldova. The agro-industrial sector accounts for over a third of the total country GDP and employs about 40% of the active working population. Agricultural products comprise over 13% of the total country exports. The main agricultural exports include cereals (primarily wheat), fruit (apples, grapes, etc.) and sunflower seeds.

In terms of land use, the Prut River basin area is typical agrarian (Figure 12). Farmland represents 76.8% of the area – 3% higher than the average for Moldova. Tilled fields occupy over half of the basin area (52.5%); these are used mainly for cereals and industrial crops.

[25] Source: DRAFT PLANUL DE MANAGEMENT AL BAZINULUI HIDROGRAFIC PRUT 2016 – 2021, Elaborat de Institutul de Ecologie și Geografie al Academiei de Științe a Moldovei Chișinău, 2015.

Tilled fields occupy slightly larger areas in the north of the basin (57% mean north of Ungheni) and slightly smaller areas in the middle course of the Prut (north of Leova) – within Codri Hills, where the terrain is more dissected. Irrigated areas are used for vegetable-growing. Perennial plantations occupy 8.3% of the basin area, almost half of which in the river's middle course within Codri Hills. Here, dissected terrain and south-facing slopes are favorable for vinery. Garden areas decrease toward the basin south. Pastures spread uniformly and cover over 16% of the total basin area. Generally, pastures occupy meadows in the river floodplains.

The functional structure of land use in the basin alters from north to south. The northern and southern parts of the basin are mainly arable lands and with vast pastures. Perennial plantations and forests dominate the central part of the basin within Codri Hills.

Consolidation of woodlands (especially in Tigheci Hills) and vineries should help prevent degradation of lands and enhance productivity of some farmlands. Consolidation of tilled fields in higher areas should be avoided.

At present, in Moldova there are 78 irrigation systems[26] and 131,700 ha of land equipped for irrigation. In the Prut basin, there are 33 irrigation systems and 51,481 ha of land equipped for irrigation. All existing irrigation systems are managed by the Water Agency Apele Moldovei (MOE). Irrigation systems are old with high water losses. Due to hilly terrain, the irrigation systems are limited.

### *8.2.2 State of agri-environmental indicators*

The Republic of Moldova is a country exporting net agro-food products, whose agriculture generates almost half of the country's export revenues, but the agro-food balance is declining. It is obvious that agriculture has reached a positive trade balance over the last decade, while Moldova's total trade deficit has become alarming since it has increased tenfold from 300 million US$ in 2000 to 3 billion US$ in 2010. Exports of agri-food products, consisting primarily of low-value, unprocessed raw materials, increased threefold between 2000 and 2012, while the import of agri-food products, headed by processed products, increased seven-fold, leading to unbalance of the agro-food balance, as well as to the deterioration of the trade conditions.

Republic Moldova signed a Free Trade Agreement with EU. As well, is important the export of agricultural products to Russia and to the Economic Eurasiatic Association (Russia, Belarus, Kazahstan).

National demand of agriculture products is greater, primarily due to remittances, and is more sophisticated as consumers are looking for diversified products with increased added value. Analyzing the structure of agri-food imports, it becomes obvious that the most popular

[26] Source: RIVER BASIN MANAGEMENT PLAN FOR PRUT PILOT BASIN IN THE TERRITORIES OF UKRAINE AND MOLDOVA, Environmental Protection of International River Basins (EPIRB). Contract No 2011/279-666., Prepared by Institute of Ecology and Geography, Academy of Science of Moldova (Moldova), Ukrainian Center of Environmental and Water Projects, Academy of Sciences (Ukraine), March 2013.

imported products are relatively high value: tobacco, fresh fruit and vegetables off-season, alcoholic beverages. However, domestic supply is not prepared to respond to these changes in demand for some reason as limited processing capacities, vulnerable base production climate, and fragmented value chains.

The agricultural sector of the Republic of Moldova is dominated by agricultural production, while the livestock sector plays a smaller but stable role in production, suggesting a potentially low level of competitiveness. Crop production constituted 60-70% of the total agricultural production in 2001-2012 in the Republic of Moldova, being largely represented by raw material exported in bulk to CIS and EU. It is also noticed that the share of the zootechnical sector has increased in the years of drought (especially in 2009 and 2012), due to the mass slaughter of animals in times of crisis. Agricultural services used to represent around 2% of total (Annex 3).

From a regional perspective, Moldovan farmers get the lowest prices for their products. A regional comparison of the main crops (apples, grapes, tomatoes, wheat) indicates that prices for Moldovan products are among the smallest of all analyzed products. The price gap between products appears to be even more significant if we compare the averages of the Eastern European countries with those of the New EU Member States and the EU15.

Regarding livestock, over 52 percent of the Prut basin is covered by arable land, used for growing grains and crops for feedstock. There has been a dramatic slump in animal farming in recent years due to the absence of subsidies and frequent droughts. Numbers of pigs and poultry do not differ greatly by region, but there tend to be more sheep and goats towards the south and more cattle in the north, according to the extent and quality of natural pastures.

In the Prut basin in the Republic of Moldova there are 742 landfills for the disposal of solid domestic waste, covering an area of 529 ha, and seven storage facilities for obsolete pesticides and chemical fertilizers. There are many unauthorized landfills and dumpsites for solid industrial and domestic waste, and a vast amount of mining waste, particularly in the north of the basin.

There is a shortage of modern treatment facilities, although 15 new landfills were constructed.

Anyhow, agricultural land is an insignificant source of water pollution in Moldova due to the small volume of chemical fertilizers used in agriculture, with the exception of the north, where it can exceed 90 kg/ha[27].

[27] Source: Prut River Basin, KEY WATER ISSUES., http://www.blacksea-riverbasins.net/en/pilot-basins/prut-basin.

## 8.3 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *8.3.1 Support measures for Agriculture (2017-2021)*

In Moldova, agricultural producers receive some support. There are eligible producers' groups which have made the investment corresponding to the fields of action of each financial support measure are eligible for subsidy and which they are based on a business plan.

The supports granted to farmers are mainly for investment and have very few connections with nitrates reductions.

In 2015, were only financed fruits, no funds were directed for crops on extensive surfaces. For example, apples received[28] about 8 eurocents per kg, the same share is also for technical varieties of grapes, because wine has lost its traditional market and there emerged the need to help the producers, and for prunes there are 4 eurocents per kg. The minimum eligible area in this case is 0.33 ha.

Increased subsidies are given only to cooperatives or groups. There is a separate program only for producer groups with post-harvest, processing, market entry, etc. That is why at least 5 producers that are associated are considered a group. Any investment made by the group is funded 50% from the state budget, with a limit of 350,000 € per group.

The main measures for 2017 are:

*MEASURE 1*. Investment in agricultural holdings for restructuring and adaptation to European Union standards;

*MEASURE 2*. Investment in processing and marketing agricultural products;

*SUB-MEASURE 2.2*. Stimulate investment to purchase irrigation equipment;

The amount of support granted is calculated in the form of compensation for the equipment and the equipment procured with the production year beginning two years preceding the subsidy in proportion to:

- 50% of the cost of new drip / microspeed irrigation systems and installed, maximum 1 million lei / beneficiary;
- 40% of the cost of sprinkler irrigation / mobile irrigation systems, maximum 800 000 lei / beneficiary;
- 50% of the cost of the pumping station, the fermenter station, the geomembrane, the geotextile for water capture, maximum 1 million lei / beneficiary;
- 50% of the cost of the equipment forming the supply and / or distribution networks, maximum 2.5 Mio. lei / beneficiary.

*MEASURE 3*. Preparing for the implementation of the actions related to the environment and the rural space;

[28] MĂSURILE DE SPRIJIN AFERENTE REGULAMENTULUI DE SUBVENȚIONARE 2017-2021. http://aipa.gov.md/ro/content/materiale-de-informare-0

*MEASURE 4*. Improve and develop rural infrastructure;

*MEASURE 5*. Consultancy and training service;

The total amount of subsidy granted to farmers, in 2017, is around 1 million €.

## 8.4 Overview of economic/regulatory/informational instruments to reduce water pollution

### *8.4.1 Measures observed / implemented / under review / discussed*

#### 8.4.1.1 Legal instruments to reduce water pollution in Republic Moldova

Law No. 272 from 23.12.2011 (Water Law) has partially included parts of several EU Directives.

This law, partially harmonized with Council directives: no. 91/271 / EEC of 21 May 1991 on the treatment of urban waste water and 91/676 EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources, Directives of the European Parliament and of the Council: 2000/60 / EC of 23 October 2000 establishing a framework for Community action in the field of water resources; no. 2006/7 / EC of 15 February 2006 concerning the management of bathing water quality; no. 2007/60 / EC of 23 October 2007 on the assessment and management of flood risks; no. 2008/105 / EC of 16 December 2008 on environmental quality standards in the field of water creates the legal framework necessary for the management, protection and use of waters.

Other laws and regulations are:

- Law no. 113 of 18.05.2012 on establishing the principles and general requirements of food safety legislation;
- Law no. 228 of 23.09.2010 on plant protection and phytosanitary quarantine;
- Law no. 257 of 27.07.2006 on the organization and functioning of agricultural and agri-food products markets;
- Law no. 115 of 09.06.2005 on organic agro-food production;
- Law no. 78 of 18.03.2004 on foodstuffs;
- The Law of Wine and Wine no. 57 fin 10.03.2006;
- Law no. 412 of 27.05.1999 on animal husbandry;
- Law no. 728 of 06.02.1996 on fruit growing.

### *8.4.2 Economic instruments for water extraction and consumption*

In the Republic of Moldova, the tax system for water use is regulated by Title VIII of the Tax Code14. According to the Law on Natural Resources[29], payments for the use of natural resources reflect the beneficiary's monetary compensation of public spending on

[29] Law no. 1102 of 06.02.1997 on natural resources. In: Monitorul Oficial no. 40 of 19.06.1997.

exploration, conservation and restoration of water resources. When water is used according to regulations, payment is included in the cost of the manufacturing and outcome service, but in case of irregularly usage, the payment is charged from beneficiary's net income after income tax payment. Taxes for water consumption are applied to primary users, who collect surface water or groundwater, for the purpose of their production activities, work and provision services. Water tax is calculated by the payer on the basis of used water volume, according to the meter or in accordance with water consumption norms. Taxes for water consumption are transferred to the local budget, being used mostly for current financial assistance to essential local public works and services. As a result, the economic and environmental effect of the application of these taxes is reduced. Due to the small rates, not connected to the inflation rate, it is an acute lack of funds for efficient operation and modernization of water supply systems and improving the ecological and medical status of water sources.

The current mechanism of fees for water consumption is focused only on getting the fiscal effects (which is small in absolute terms). As a consequence, the economic and environmental effects are insignificant. That tax rates need to be adjusted to the inflation rate and to the cost of maintenance and restoration of water sources.

According to recent changes, water tax is levied at the following rates: a) for 1 $m^3$ of water extracted is made a payment to water fund – 0.3 MDL; b) for each 1 $m^3$ of extracted bottling intended natural mineral water – 16 MDL; c) for every 10 m 3 of water used for hydropower stations – 0.06 MDL (Table 25).

## 8.5 Evidence from the literature, monitoring reports, evaluation studies

### *8.5.1 Literature review*

The Report "*Analysis of pressures and impacts on water bodies and assessment of water bodies at risk of failing the environmental objectives in the Prut River basin*"[30] was realized within the Contract for combining Moldovan part of the Prut RBMP with the Ukrainian part for producing an integrated transboundary River Basin Management Plan of the Prut Basin within the limits of Ukraine and Moldova.

The conclusions of the study mentioned that, from political point of view, it is considered as fundamental the integration of policies into national law, such as wastewater treatment, decrease of nitrate concentration, integrated prevention and control of pollution, Republic of Moldova. In this respect, Republic Moldova is at the initial stage of adaptation of the regulatory framework and the provisions the Water Framework Directive, at the end of 2013 being approved regulations on prevention of water pollution from agricultural activities,

[30] Component B – Development of an integrated transboundary RBMP of the Prut Basin within the limits of Ukraine and Moldova, Prepared by Institute of Ecology and Geography, Academy of Science of Moldova, Chișinău, October 2014.

gathering, treatment and discharge requirements of wastewater into the sewerage system and / or water bodies for urban and rural localities and conditions of wastewater discharge in water bodies, Government decisions for the regulations on Environmental Quality requirements of surface waters (11/12/2013) and groundwater (November 20, 2013).

Of the 83 surface water bodies, most of them have been declared "at risk". This is due, firstly, to a very high degree of lands used for agriculture (76.8). Thus, 52.5% of the basin area is used as cultivated lands, which is the main source of diffuse pollution by nitrates. The multiannual plantations (8.3%) are the significant source of pollution with pesticides, and pastures (16%) a source of pollution with organic waste. Other sources of pollution with organic and chemical waste (in this case point sources) is represent by individual households and zootechnical complex (mostly in the river meadows located). Tractors mechanized parks and PECO stations are the significant polluters of petroleum products.

Currently, wastewater discharged into the Prut river basin, including those discharged by treatment stations are not properly treated, having a strong potential for pollution of surface waters and, partially, of the groundwater, especially of the phreatic waters horizon, widely used in rural areas. The activities of wastewater treatment stations, often, do not respect the environmental conditions including, pollution prevention and control. A serious problem is the lack of sewage networks and treatment stations in most settlements. Thus, in 447 settlements existing in the basin area, 245 waste water discharge points were identified. Of these, to 123 points the monitoring on the volume of water discharged is carried out, including to 47 points a wastewater treatment (especially biological one) is done. The problem of treatment stations is very acute. Most of the biological wastewater treatments stations work at very low indexes, require reconstruction with technological modernization of treatment stages, especially biological wastewater treatment stations from Cahul district, Corneşti and Valea Mare in Ungheni district, etc.

Thus, achieving the environmental objectives for river water bodies - good and very good ecological status, will be very difficult, both the short term (until 2021) and medium term (until 2027).

The whole spectrum of pollutants of the Water Framework Directive list is not being monitored. The frequency of sample collection and their number are insufficient for a complete characterization of groundwater and, primarily, temporal and spatial dynamics of their status. Despite of insufficient data, necessary to assess the quality state of groundwater according to the Water Framework Directive, the identified groundwater bodies are in a much more favourable situation, and are attributed to the good ecological status. Groundwater remains a priority alternative in supplying the population with drinking water.

### *8.5.2 Best practice example*

The “Agricultural Pollution Control Project”

The Agricultural Pollution Control Project was a WB project with the aim to increase significantly the use of environmentally friendly agricultural practices by farmers and agro-industry in Moldova in order to reduce nutrient discharge from agricultural sources to the Danube River and Black Sea. The project had four components. The first component had two subcomponents. It intended to promote mitigation measures for reducing nutrient loads in water bodies. This component provided grants to entrepreneurs and enterprises under the Rural Investment and Services Project (RISP) for investing in environmentally sustainable agricultural practices; and trains rural advisory service providers in several nutrient reduction practices, including crop nutrient management, conservation tillage practices, crop rotation and tree planting of buffer strips etc. The first component also promoted improving watershed management practices, particularly manure management practices, environmentally-friendly agricultural practices, shrub and tree planting, wetland restoration and sustainable management practices, and the monitoring of soil, water quality, and environmental impacts. The second component was intended to strengthen national policy, regulatory enforcement and national capacity. The third component had supported public information campaigns and a replication strategy. The fourth component financed project management and evaluation.

The project has the objectives:

• Project Global Environmental Objective is to reduce the discharge of nutrients into the Danube River and Black Sea through integrated land and water management.

• The overall project development objective is to increase significantly the use of mitigation measures by agro-industry and farmers and thereby reduce nutrient (N&P) discharge from agricultural sources in Moldova to the Danube River and Black Sea.

Specific objectives:

• Promote the adoption of mitigating measures by farmers and agro-industry for reducing the nutrient loads entering the water bodies – these measures would include better management of household and livestock wastes in the villages, crop nutrient management, planting of buffer strips and conservation tillage, as well as dealing with wastewaters from agro-processing units;

• Strengthen national policy, regulatory enforcement and institutional capacity for agricultural nutrient pollution control and organic farming;

• Promote a broad public awareness campaign and replication strategy.

Project interventions by component:

• COMPONENT 1: Promotion of Mitigation Measures for Reducing Nutrient Load in Water Bodies

(a) Activities under RISP; including:

Grants to Support the Credit Line of RISP;

Training of ACSA Service Providers.

(b) Promotion of Watershed Management Practices, including:

Manure Management Practices;

Promotion of Environment-Friendly Agricultural Practices;
Shrub and Tree Planting;
Wetland Restoration and Promotion of Sustainable Management Practices;
Monitoring Soil, Water Quality and Environmental Impacts.
• COMPONENT 2: Strengthening of National Policy and Regulatory Capacity
Support to MENR for Work on Application of the Nitrates Directive;
Support to MENR for Work on Application of the Nitrates Directive;
Recommendations for joint activity of MENR and MAFI.
• COMPONENT 3: Public Awareness and Replication Strategy
Public Awareness Campaign to Support Project Actions and Promote the Replicability of Project Activities at Local Level;
Public Awareness Activities and Replication Strategy at National Level;
Public Awareness Activities and Replication Strategy at National and Regional Level
• COMPONENT 4: Project Implementation Unit

*Table 24: Use of funds by components (WB/GEF project in Republic of Moldova)*

| Project Activities | Planned (USD) | Used (USD) | Status (%) |
|---|---|---|---|
| **1. Promotion of Mitigation Measures for reducing nutrient load in the water body** | **4,072,700.000** | **2,272,250.32** | **55.8** |
| a) Promotion of Environmentally-Friendly Agricultural Practices | 161,000 | 98,136.48 | 61.0 |
| b) Monitoring soil, water quality and environmental impact | 275,600.000 | 64,456.86 | 23.4 |
| c) Sub-grants for activities under RISP | 2,090,100.000 | 1,323,512.83 | 63.3 |
| d) Training of rural advisory services | 102,800.000 | 31,598.24 | 30.7 |
| e) Manure management practices | 1,256,100.000 | 665,520.86 | 52.9 |
| e) Shrub and tree planting | 134,500.000 | 62,413.39 | 46.4 |
| f) Wetland restoration and promotion of sustainable management practices | 52,600.000 | 26,611.66 | 50.6 |
| **2. Strengthening national policy and regulatory capacity** | **72,400.000** | **20,631.69** | **28.5** |
| **3. Public awareness and replication strategy** | **277,500.000** | **128,769.24** | **46.4** |
| **4. Project management and evaluation** | **419,900.000** | **254,907.06** | **60.7** |
| **Total;** | **4,842,500.000** | **2,676,558.31** | **55.3** |

Source: http://projects.worldbank.org/P075995/agricultural-pollution-control-gef-project?lang=en

## 8.6 Future of agriculture in the Republic Moldova

### *8.6.1 Trends in agriculture*

There are few publications to give some details for future trends[31] regarding agriculture in Republic Moldova. Based on the papers and articles and some hypothesis developed by WB and IMF, Moldavian agriculture will continue past trends.

In 2017, the Ministry of Economy[32] relies on a recovery of the agricultural sector after 2015, unfavorable for agricultural production. Thus, for the year 2016 was foreseen to increase in real terms the volume of agricultural production by 8% compared to the level of 2015 and compared to the previous forecast of 7%.

The increase in the volume of agricultural products will have a positive effect on the activity in the industrial sector. However, building on the current domestic and external context, industrial output will increase by 2% compared to 2015.

Time series of averaged crop yields in Moldova emphasize an increasing trend from 1962 to 1981 due to intensive agriculture, and a decreasing trend from 1985 to 2012 due to drought, heat stress, evapotranspiration intensification, reduced soil fertility, and sharp economic changes and free market forces. Stagnating cereal yields in eastern European countries have been attributed to lower yields under higher frequency of droughts, heat stress, and the short duration of the grain-filling period, but changes in management may also have played a role. In almost all eastern European countries, crop yields also dropped as a result of sudden decrease of nitrogenous fertilization after 1990 due to shortage of funds.

The agricultural production over 1991-2008 was characterized by fluctuations, with the best performance reported in 1993, 1997, 2004 and 2008, and with poor results – respectively in 1992, 1994, 1996, 1998, 2003 and 2007, in most cases being caused by unfavorable climate conditions (severe droughts in 2003 and 2007). In 2007 irrigation was available on 32,400 ha of the agricultural plantations, or 88.9% less than in 1990 (291,600 ha).

### *8.6.2 Soil degradation*

Generally, Moldova has favorable climate conditions and relief, mainly in Centre and North. The country's soils have a high level of fertility in the northern region and a medium level of fertility in the central and southern regions. However, natural calamities such as droughts, late spring frosts, hail, and floods frequently have a destructive impact on harvests. Furthermore, many land parcels are losing their natural fertility and require rehabilitation. If the soil protection issue is ignored and soil deterioration proceeds due to continued use of outdated farming techniques and a failure to adopt practices that protect against destructive effects

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[31] Strategia de Dezvoltare a Agriculturii și Mediului Rural din Moldova 2014 – 2020, 3 iunie 2013.

[32] Magazine Economist, Wednesday, 24 August 2016. Online available at: http://www.eco.md/index.php/economie/macroeconomie/item/4747-ministerul-economiei-a-%C3%AEmbun%C4%83t%C4%83%C5%A3it-prognoza-privind-cre%C5%9Fterea-economic%C4%83.

of changing climate, agricultural productivity can be expected to face further serious declines.

Additional costs are required to eliminate the consequences of soil degradation and to restore the initial productivity levels of the affected soils. The principal factors that affect soil quality in the Republic of Moldova and that present the potential risks in view of climate change include:

- erosion (caused by the surface water as well as underground water);
- landslides;
- drift soil silting;
- primary and secondary soil compaction;
- deep tillage of soil;
- loss of the humus layer on un-eroded arable soils;
- salinization;
- degradation due to non-compliance with the irrigation techniques;
- biological degradation;
- degradation caused by certain social-economical aspects of the economy in transit.

Over 65 per cent of fertile soils are affected by erosion, landslide and other processes. These destructive factors diminish the land areas that can be irrigated.

### *8.6.3 Future productivity*

Due to climate change the reduction in productivity of the winter wheat by the year 2039 may increase from 14.28% to 17.79% (depending on climate model used) with respect to 1961-1990. In comparison with 1961-1990, by 2069 year the crop productivity may decrease, in dependence of the assessed model, from 23.35% to 33.99 %. By 2099, the productivity of winter wheat may decrease from 38.13% to 53.59% (depending on climate model used. Other studies confirm these results. For instance, wheat yield reductions have been projected of 25% in 2010-2039, 45% in 2040-2069 and 75% in 2070-2099 compared with 1960-1990.

The sharp decline in the productivity of winter wheat can be explained by a shift of vegetation phases in a more unfavorable period due to temperature increase. The critical period for jointing at winter wheat will take place in dry conditions, which will impact a sharp decrease in the productivity.

For crops such as sunflower, which is relatively drought-resistant, more favorable climate conditions are projected during the growing season than for winter wheat.

For sugar beet by 2039, when assessing the combined effect of temperature and humidity during the growing season, a decrease in productivity is expected by 6.12% - 6.58% under the all climatic models assessed. In 2099, productivity for sugar beet is expected to decrease by 19.40 - 39.04% (depending on climate model used).

Without adaptation measures, by 2099 a significant drop in the productivity for winter wheat (38.13 - 53.59%) and sugar beet (19.40 - 39.04%), a medium drop in the productivity for grain maize (20.07 - 29.77%), and a slight reduction in the productivity at sunflower (by 1.41%) is projected.

If no alternative economic occupations are provided, these trends will drive more rural families into poverty and further encourage the depopulation of rural areas.

### *8.6.4 $CO_2$ fertilization*[33]

Some future trends associated with climate change could be positive for agriculture, such as a higher concentration of $CO_2$ in the atmosphere, an increase in the duration of warm temperatures, an increase in solar radiation and an increase in the sum of active temperatures. These trends may accelerate plants' growth, lengthen the periods of vegetation, and increase the yields of the plants. For instance, it has been shown that doubling the concentration of $CO_2$ can increase the yields of wheat by about 28% (a phenomenon known as the so-called $CO_2$ fertilization).

However, the leading experts in Moldova believe that overall balance of the climate change effects projected for the next 100 years is not favorable for Moldovan agriculture. $CO_2$ fertilization will not compensate completely for the losses in wheat production due to the projected increase in temperatures and reduction in amount of precipitations, but it is likely to offset the losses in corn production.

### *8.6.5 Consequences for water related indicators*

There are some important consequences for water consumption in Republic Moldova. Due to climate change, mainly in summer, it is very likely that the use of water will increase but as more efficient irrigation technique could not be implemented without significant investment the water consumption will not change much due to the fact that infrastructure to deliver water will be missing .

**Passive adaptation** is the result the natural evolution of traditional practice. This type of adaptation can be recommended in the southern part of the Republic Moldova, which is traditionally confronted with a deficit of water and a poor quality of aquatic resources, because of their practices and the way of life have evolved under the conditions of water insufficiency. But, the long - term impact of adaptation is quite questionable. As an eloquent example[34], it can be reproduced the current situation in the South East of Moldova. Uninsulated water tanks of villages are exhausted due to their capacity lower recovery and

[33] 2009/2010 National Human Development REPORT, UNDP, Climate Change in Moldova Socio-Economic Impact and Policy Options for Adaptation, page 86.

[34] Sursa: Sîrodoev I.G., Knight C.G., 2008: Vulnerability to Water Scarcity in Moldova: Likely Threats for Future Development. (Vulnerabilitatea față de deficitul de apă din Moldova: Amenințări probabile pentru dezvoltarea viitoare) Present environment and sustainable development 2: 7-15.

overexploitation; people do not get water to them in order wet vegetable gardens, actively cultivated traditionally. The solution was found by accessing the upper tank (not insulated) with a pipe and pumping water in the deep-water reservoir (isolated). As a result, water tank exhaustion rate has increased, but so far there is still sufficient water for irrigation for vegetables. In farming practices and in people's way of life nothing has changed; simply the rate of exhaustion of the non-isolated water reservoirs grew.

Passive adaptation will increase water reserves that are not exploited in normal circumstances.

**Active Adaptation** (Planned, Deliberative and proactive) intends to intervene directly in the life of humans. The action is more water-efficient but it is associated with high costs and requiring significant investment. It leads to better results in the long run but it is more effective if it is done under the conditions of passing over a certain threshold. In relation to the effect of probable changes associated with society, is worth highlighting socially active adaptation, as the most radical, because they require changes, sometimes fundamental, of traditional occupations of people. It's about, for example, about the introduction of agricultural crops new or new agricultural technologies, which people do not know them, or the relocation of an enterprise due to limitations of water usage. The vulnerability of the population increases, both from the cause of global environmental changes as well as from the cause of policy measures, especially when they apply with the anticipation of future conditions, which are not yet obvious to the local population. In addition to direct financial costs, this approach creates tension among the inhabitants, generates emotional effects, and if we turn these indirect costs in financial terms, we get total and higher costs than originally planned. But from a longer-term perspective, if this tactic is done in the right way, it promises the best results.

Active adaptation is riskier and diffuse in implementation, however, it is more recommended in the regions vulnerable. In order to be effective this type of adaptation, the approach is particularly important to all aspects of everyday life of people.

The best (but not the fastest) way of doing so to apply such a policy is to start with education and going through all aspects associated with water in everyday life of people and of their economic activity. Introducing the active adaptation across the designated regions, especially in regions with vulnerabilities, will lead to an increase in the effectiveness of water policies, will eliminates an important brake on economic development of Moldova and will contribute to consolidation the basis for the sustainable development of the country.

The anticipated impact of some water resources in decrease, which is likely to take place in the near future. This development will lead to a differentiation in three type zones, depending on human and economic activity in the affected regions:

1. Areas traditionally affected by deficiency of water. In these territories, Climate Changes will put pressure on the current economic activities; however, the shortage of water will not be a new thing for regions and its inhabitants;

2. Areas with vulnerable populations, predominantly rural. This includes, in particular, the South region, which already is faced with a deficit of water and a deepening of the water reserves in the reservoirs uninsulated due to overexploitation;
3. Central Moldova. This region of the country is exposed to a complex impact of some diminishing water resources in both rural and urban areas.

In any case, the most vulnerable areas to water shortage are in the south of Republic Moldova (Figure 15).

## 8.7 Synthesis for 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.

## Annex

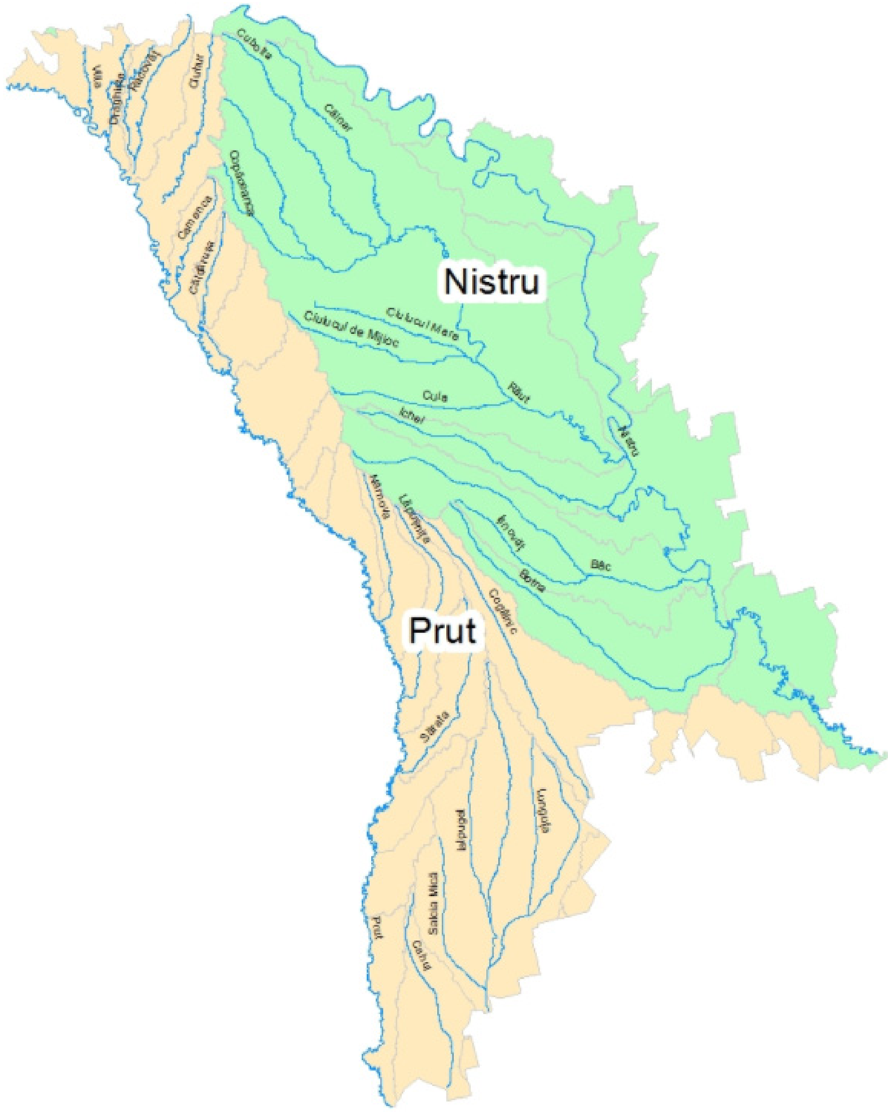


*Figure 11: River basins in Republic Moldova*

Source: http://www.apelemoldovei.gov.md/pageview.php?l=ro&idc=134&id=439.

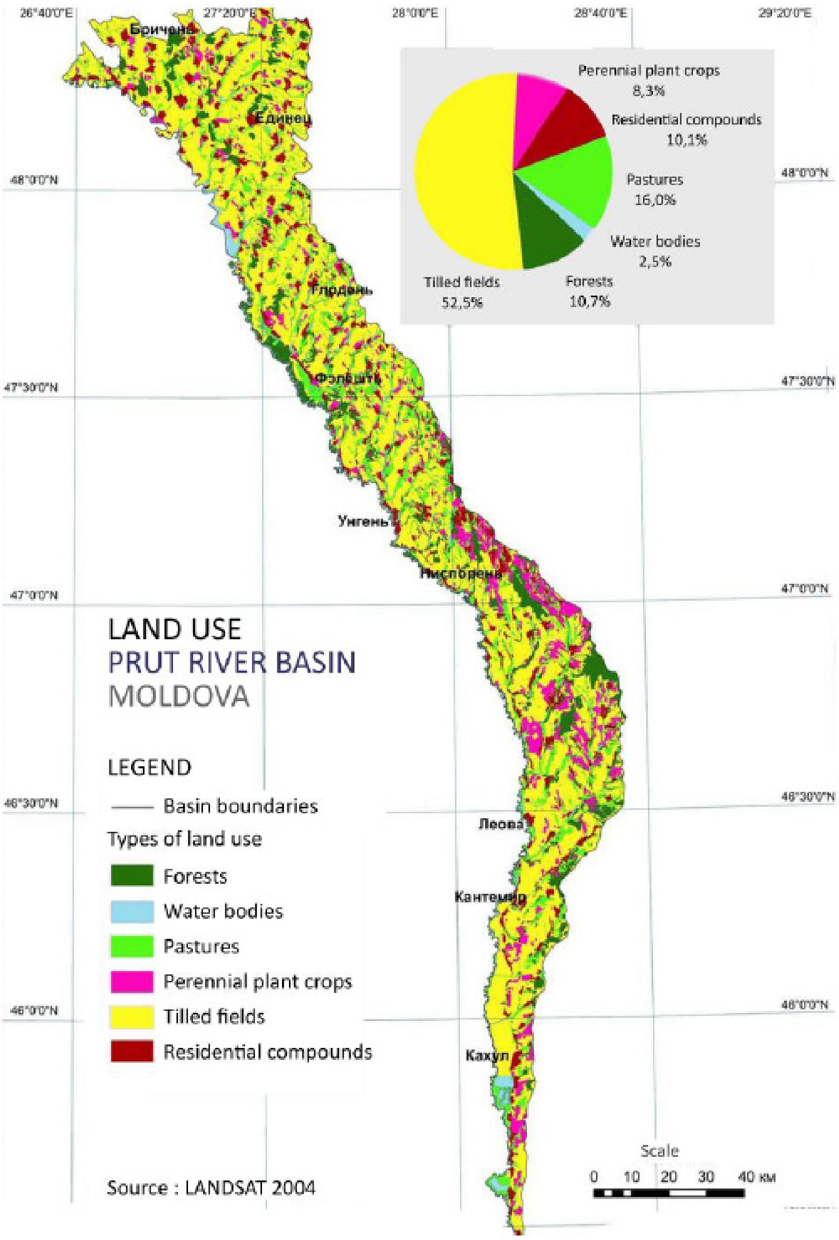


*Figure 12: Land use in Prut Basin, Republic Moldova*

Source: RIVER BASIN MANAGEMENT PLAN FOR PRUT PILOT BASIN IN THE TERRITORIES OF UKRAINE AND MOLDOVA., Environmental Protection of International River Basins (EPIRB), Contract No 2011/279-666., Prepared by Institute of Ecology and Geography, Academy of Science of Moldova (Moldova), Ukrainian Center of Environmental and Water Projects, Academy of Sciences (Ukraine), March 2013.

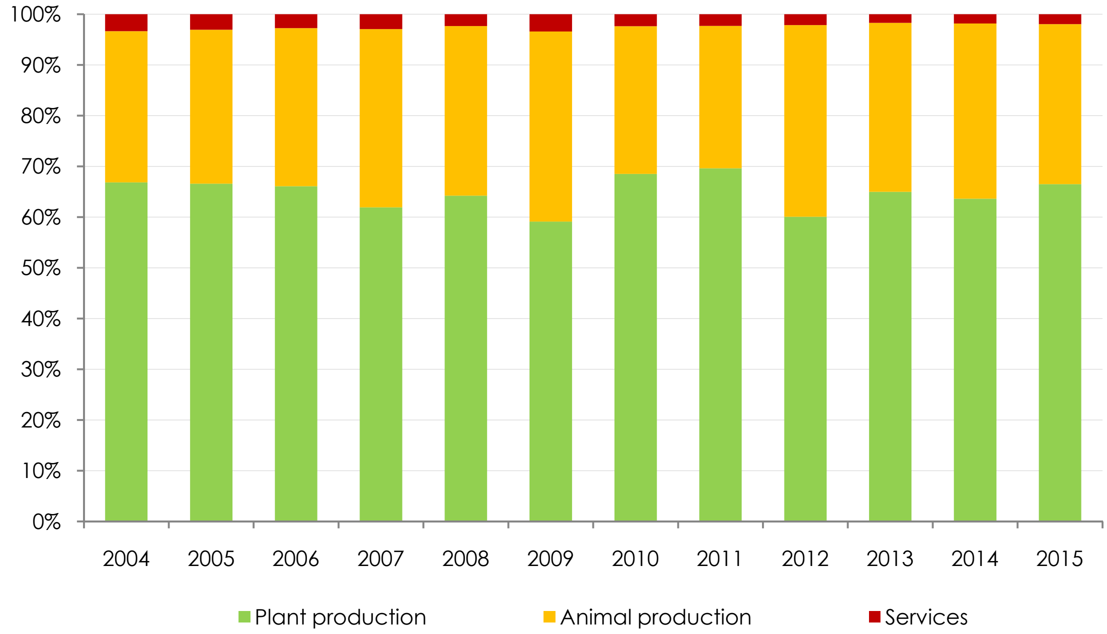


*Figure 13: Agricultural production in Republic Moldova (2001-2012) (%)*

Source: National Bureau of Statistics of the Republic of Moldova, Statistical Yearbooks of the Republic of Moldova, 2016. http://www.statistica.md/pageview.php?l=en&idc=263&id=2193

*Table 25: Tax quotas for water consumption, Republic Moldova*

| Usage Purpose | Years | | | |
|---|---|---|---|---|
| | 1996-2002 | 2003-2005 | 2006-2007 | 2008-present |
| For every 1 m³ of water extracted from the water fund, in MDL | 0.18 | 0.5 | 0.5 | 0,3 |
| For water bottling, mineral and healing water production, in MDL | 10%[1]<br>1.8 | 5<br>8[2] | 8 | 16 |
| For irrigation, in MDL for each 1 m³ | 0.09 | 0.1 | 0.1 | 0.3 |
| For hydro-power stations, in MDL for each 10 m³ | 0.05 | 0.03 | 0.03 | 0.06 |
| For cooling technological equipment of power plants, in MDL for each 1 m³ | 0.06 | – | – | – |

Source: ECONOMIC ANALYSIS OF WATER SUPPLY AND SEWERAGE SERVICES IN THE PRUT RIVER BASIN IN THE LIMITS OF REPUBLIC OF MOLDOVA. Prepared by Institute of Ecology and Geography, Academy of Science of Moldova February 2015. –[1]) Conform anexei respective a Legii Bugetului de Stat, în anul 1999 nu au fost prevăzute astfel de taxe; –[2]) Pentru anii 2004-2005.

*Table 26: Total water abstraction and consumption from the Prut river basin within the territory of the Republic of Moldova for the period from 1990 to 2014, Mio. m³*

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| | | | | Mio. m³ | | | | |
| Total abstraction | 29.71 | 25.17 | 28.02 | 24.00 | 24.12 | 24.24 | 21.44 | 20.17 |
| Total consumption | 22.61 | 18.95 | 21.30 | 17.21 | 16.83 | 18.18 | 16.29 | 15.74 |
| Agriculture | 16.56 | 12.92 | 16.11 | 11.88 | 11.59 | 12,85 | 10.16 | 10.13 |
| Household | 3.80 | 3.76 | 3.71 | 3.67 | 3.63 | 3.89 | 3.74 | 3.65 |
| Industry | 2.09 | 2.27 | 1.41 | 1.67 | 1.61 | 1.53 | 1.72 | 1.73 |
| Irrigation | 8.72 | 4.88 | 7.67 | 3.00 | 3.09 | 4.13 | 1.55 | 1.92 |

Source: Basin Water Management Authority (Apele Moldovei Agency), Annual reports generalized concerning the Water Management indices. THE PRUT RIVER BASIN MANAGEMENT PLAN., Cycle I, 2017 – 2022., Prepared by the Institute of Ecology and Geography of the Academy of Sciences of Moldova (ASM) with support and funding from Human Dynamics, Chisinau 2016.

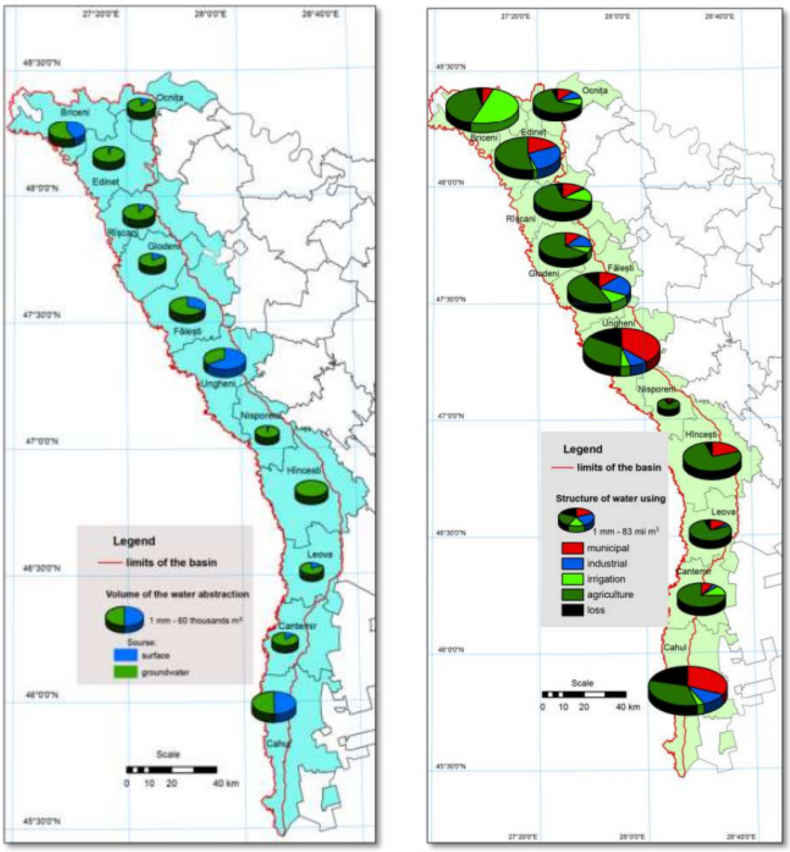


*Figure 14: Abstraction of water in Prut basin (left) and structure of water use (right)*

Source: THE PRUT RIVER BASIN MANAGEMENT PLAN., Cycle I, 2017 – 2022., Prepared by the Institute of Ecology and Geography of the Academy of Sciences of Moldova (ASM) with support and funding from Human Dynamics, Chisinau 2016.

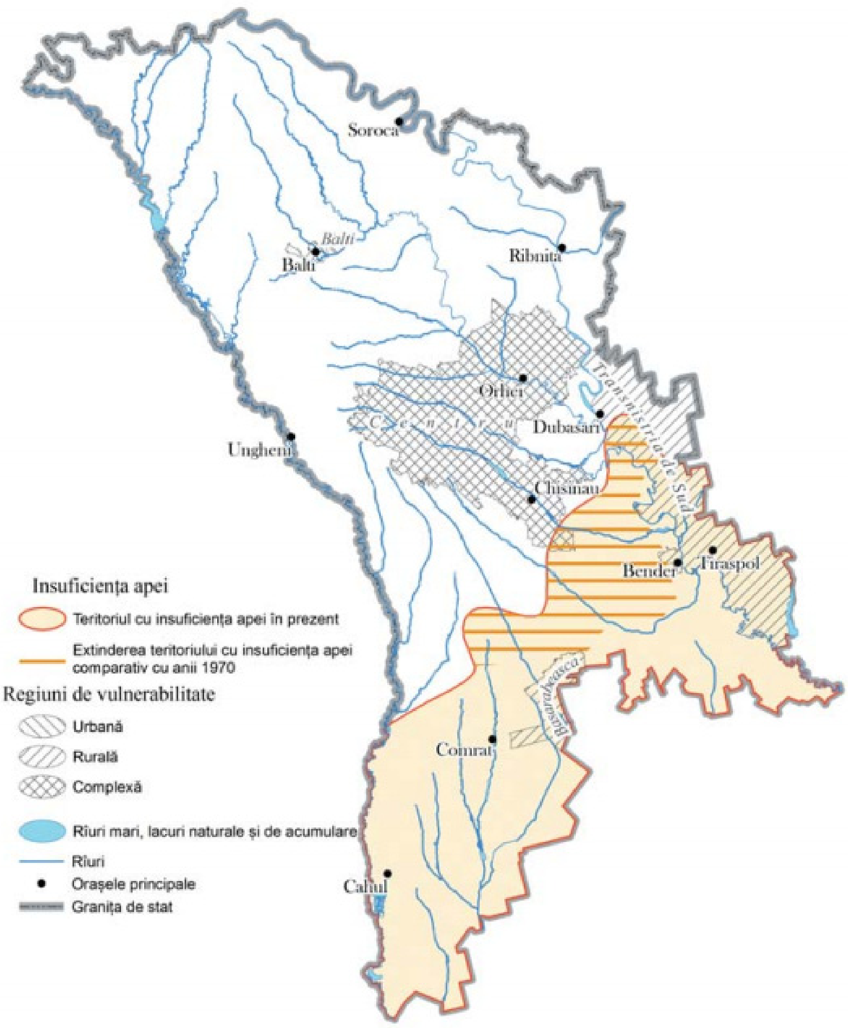


*Figure 15: Potential vulnerability to water deficiency in Republic Moldova*

Source: Sirodoev, I.G. and Knight, C.G., 2007, Vulnerability to Water Scarcity in Moldova.

*Table 27: Average water use by decades in Republic Moldova*

| | Average water use, mil. $m^3$ | | | Change (%), comparing to 1980s | |
|---|---|---|---|---|---|
| | 1980s | 1990s | 2000s | 1990s | 2000s |
| **Water withdrawal** | 3,651 | 2,000 | 864 | -45 | -76 |
| **Total water use** | 3,550 | 1,920 | 849 | -46 | -76 |
| **Non-drinking water supply for production needs** | 2,463 | 1,227 | 588 | -50 | -76 |
| **Drinking water supply for production needs** | 101 | 45 | 21 | -55 | -79 |
| **Irrigation** | 649 | 317 | 46 | -51 | -93 |
| **Water supply in agriculture** | 118 | 88 | 57 | -25 | -51 |
| **Drinking water supply for households** | 220 | 232 | 146 | 5 | -33 |
| **Transportation losses** | 57 | 87 | 64 | 53 | 12 |
| **Recycled water** | 755 | 604 | 369 | -20 | -51 |
| **Water losses in irrigation, mil. $m^3$** | 28 | 20 | 12 | -29 | -57 |
| **Using water for 1 ha irrigated land, $m^3$** | 2309 | 961 | 141 | -58 | -94 |

**Source:** *Calculated using statistical yearbooks and National Bureau of Statistics' website: http://www.statistica.md.*

*Table 28: Land use in Moldova*

| | *Area, 1,000 ha* | | | | *Structure, %* | | | |
|---|---|---|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2013 | 2014 | 2015 | 2016 |
| *Total Area* | 3.384,6 | 3.384,6 | 3.384,6 | 3.384,6 | 100,0 | 100,0 | 100,0 | 100,0 |
| *Agricultural land* | 2.497,8 | 2.500,1 | 2.499,7 | 2.499,6 | 73,8 | 73,9 | 73,8 | 73,9 |
| *arable land* | 1.814,1 | 1.816,1 | 1.817,4 | 1.822,9 | 53,6 | 53,7 | 53,7 | 53,9 |
| *perennial plantations* | 295,3 | 295,3 | 291,7 | 288,9 | 8,7 | 8,7 | 8,6 | 8,5 |
| *orchards* | 135,1 | 135,8 | 134,5 | 132,5 | 4,0 | 4,0 | 4,0 | 3,9 |
| *vineyards* | 142,6 | 141,2 | 137,5 | 136,2 | 4,2 | 4,2 | 4,1 | 4,0 |
| *pastures* | 348,9 | 348,0 | 346,4 | 345,0 | 10,3 | 10,3 | 10,2 | 10,2 |
| *hayfields* | 2,1 | 2,1 | 2,2 | 2,1 | 0,1 | 0,1 | 0,1 | 0,1 |
| *fallow lands* | 37,4 | 38,6 | 42,0 | 40,6 | 1,1 | 1,1 | 1,2 | 1,2 |
| *Forests and lands covered with forestry vegetation* | 464,2 | 465,2 | 464,5 | 465,2 | 13,7 | 13,7 | 13,7 | 13,7 |
| *Rivers, lakes, reservoirs and bogs* | 99,2 | 96,9 | 96,8 | 96,7 | 2,9 | 2,9 | 2,9 | 2,9 |
| *Other lands* | 323,4 | 322,4 | 323,6 | 323,1 | 9,6 | 9,5 | 9,6 | 9,5 |
| *Lands provided with Irrigation facilities* | 228,3 | 228,3 | 228,3 | 228,3 | 6,7 | 6,7 | 6,7 | 6,7 |
| *arable land* | 213,3 | 213,3 | 213,3 | 213,3 | 6,3 | 6,3 | 6,3 | 6,3 |
| *perennial plantations* | 13,3 | 13,3 | 13,3 | 13,3 | 0,4 | 0,4 | 0,4 | 0,4 |

Source: National Bureau of Statistics of the Republic of Moldova, Statistical Yearbooks of the Republic of Moldova, 2016. http://www.statistica.md/pageview.php?l=en&idc=263&id=2193

*Table 29: Livestock, as of January 1st*

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|
| | | | | 1,000 heads | | | | |
| Cattle | 218 | 222 | 216 | 204 | 191 | 189 | 191 | 186 |
| of which cows | 160 | 161 | 154 | 144 | 134 | 131 | 130 | 128 |
| Pigs | 284 | 377 | 478 | 439 | 410 | 420 | 473 | 453 |
| Sheep and goats | 866 | 915 | 905 | 832 | 824 | 849 | 875 | 869 |
| Horses | 56 | 54 | 52 | 50 | 46 | 45 | 43 | 39 |

Source: National Bureau of Statistics of the Republic of Moldova, Statistical Yearbooks of the Republic of Moldova, 2016. http://www.statistica.md/pageview.php?l=en&idc=263&id=2193

# 9 Country Report: Romania

Victor Platon

## 9.1 Economic and agri-environmental indicators

### *9.1.1 State of agriculture*

In Romania, in 2014, the total area of the land fund was 23.8 million ha out of which the agricultural area was 14.6 million ha out of which 64% is arable areas, 22% is pastures and 11% is hayfields. The remaining 3% are orchards and vineyards.

The ownership of the land is very fragmented in Romania. In 2013 were recorded 3.6 million farms out of which without legal status 99.23%. These are small farms owned by individuals or family enterprises. Legal entities are few: 14,531 registered companies (Table 32).

As a consequence, the dimension of a farm in Romania is small. A total of 92.07% of farms are small ones with less than 5 ha of land. Medium farms that own land between 5-20ha represent 6.8% of total. There are 13,075 big farms that own more than 100 ha (Table 33). Subsistence agriculture is spread due to so many small farms. In the last 10 years a consolidation process was noticed but is slow.

### *9.1.2 State of agri-environmental indicators*

In 2015[35], the total agricultural output was 15.5 billion € (4.4454 Lei/€) out of which 63.38% crop production, 35.37% animal productions and 1.25% agricultural services. The crop output was mainly cereals for grains (19.28 million tons), out of which wheat 7.96 million tons, maize grains 8.98 million tons, barley and two-row barley 1.623 million tons etc.

In Romania, in 2015, the livestock composed of 2,092 million cattles, 4,927 million pigs, 9.8 million sheep, 0.503 million horses, 78.648 million heads of poultry.

As regarding fertilizers, a quantity of 452 thousand tons of chemical fertilizers was used in agriculture in 2014 and a quantity of 16.26 million tons of natural fertilizers. Per ha were used 30.9 chemical fertilizers and 1,111.54 kg of organic fertilizers (Table 34).

Water used in agriculture has decreased significantly in the last 25 years from a consumption of 9.1 billion $cm^3$ in 1990 to 1.3 billion $cm^3$ in 2011. This important decrease in water consumption[36] was due to huge area covered by irrigation. After 1990, when economic principles and market oriented reforms were introduced, only a small fraction of the 3.1 million ha that was equipped for irrigation was still in use. In 2015, the total area that was irrigated was 173.2 thousand ha.

[35] Source: ROMANIAN STATISTICAL YEARBOOK – 2016, NATIONAL INSTITUTE OF STATISTICS.

[36] Source: 9,1ANAR, www.rowater.ro.

### 9.1.3 Information gaps

In Romania, the water monitoring system is run by ANAR which has the expertise and the know-how for surface water and groundwater quality. The monitoring is carried out mainly for point pollution sources and less for diffuse pollution. Due to EU pressure and money, Agri-environmental policy measures are step by step implemented but there are no important public funds allocated to deal with negative impacts of agriculture. There are some data collected but the influence on policy measures is fuzzy. One significant issue is that of the way in which indicators are used to estimate environmental performance. Very few studies are carried out in a random manner. There are scarce data regarding nitrates/nitrites pollution from agriculture.

## 9.2 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### 9.2.1 Review of region specific targets relevant for DRB

Romania is 100% part of the DRB. Romania is a national state part of the EU. All environmental acquis were transposed into the national legislation which has a uniform application on the whole territory.

In the process of implementing the Nitrates Directive, Codes of Good Agricultural Practice and Action Programs have been developed and implemented. Since June 2013, the decision has been taken to implement the Action Program throughout Romania, in accordance with Art. 3 par. 5 of the Nitrates Directive. Thus, Romania does not have the obligation to designate vulnerable zones of nitrates from agricultural sources, as the program of action applies without exception to the whole territory of the country.

Existing policy goals in respect with the Nitrates Directives are:

- Monitoring of waters polluted or at risk of nitrate pollution;
- Implementation of Codes of Good Agricultural Practice, by farmers.
- Elaboration of Action Programs to be implemented by farmers
- National monitoring and 4 to 4 years reporting on:
    - Nitrate concentration;
    - Eutrophication;
    - Assessing the impact of Action Plans;
    - Review of VHS and Action Programs.

### 9.2.2 National Rural Development Programme (NRDP) 2007-2013

One of the most important programmes that has included agricultural policy measures regarding nutrient discharge is the Programme of Rural Development (PRD). In the period

2007-2013, within PRD were allocated[37] a total of 9.5 billion € with a EU co-financing of 80.46%. For our analysis, there are two important axes which include measures regarding environmental protection and preventing nutrient discharge.

The Axis 2 has the measure 214 - Agri-environment payments and Axis 4 (Leader) has the measure 412. Improving the environment and countryside and the sub-measure: 214.3 „Protection of soil and water". The measure financed 100% of total. Minimum value for financing was 58 € / ha and the maximum was 130 € / ha.

The measure 214 has supported several actions as:

- decreasing the livestock density and extensive management of pastures; the effect would be decreasing the CH4 and N2O emissions
- Not appliance of fertilizers and pesticides on agricultural land with high natural value; the effect would be the preserving the types of vegetation rich in species, pastures protecting and maintenance
- Promoting perennial crop with high natural value management, creating and preserving pastures.
- Ensure water and soil protection.

For Measure 214 of the NRDP, the agri-environmental actions envisaged the combination of simple management requirements which can be easily understood and applied by farmers with efficient environmental protection. In order to reduce the risk of a limited absorption by farmers, complex requirements regarding the project management were avoided.

Specific objective of the measure: to contribute to a sustainable rural development by encouraging land users to introduce or continue methods of agricultural production compatible with the protection and the improvement of the environment, including biodiversity, water, soil and rural landscape

Financial allocation: 1,428,418,898 Euro (total public expenditure)

The total number of beneficiaries of the measure: 321,544 (supported farms)

- The output indicators were: total number of agricultural holdings or whose managers receive National Rural Development Programme 2007 – 2013, payments" support: 33,000
- Total assisted surface: 380,000 ha
- Total number of contracts: 60,000
- Total physical assisted surface: 195,000 ha

Measure 214 has had a compensatory role to grant some payments to farmers that may lose output or have extra expenditures while they are practicing ecological agriculture. No investment was financed within this measure.

[37] It should be mentioned that NRDP suffered many consolidations in time. On the site of Min. of Agriculture there are 19 consolidated versions of NRDP, each having more than 920 pages. We take into account the last version of 15/09/2015

### *9.2.3 Romania Integrated Nutrient Pollution Control Project (P093775) (2007-2013)*

Project Development Objective (from Project Appraisal Document ) was to support the Government of Romania to meet the EU Nitrates Directive requirements by (a) reducing nutrient discharges to water bodies, (b) promoting behavioural change at the commune level, and (c) strengthening institutional and regulatory capacity. The project initial cost was 126 million €, with four components. Components of the project were:

- Investments in Local Communities for Reducing Nutrient Pollution: (Cost 93.90 million €)
- Institutional Strengthening and Capacity Building (Cost 14.00 million €);
- Public Awareness and Information Support (Cost 7.52 million €);
- Project management (Cost 10.57 million €);

The Integrated Nutrient Pollution Control Project (INPCP) additional financing (48 million €) was approved by the Board of Executive Directors on March 28, 2016 and became effective in April 13, 2017.

Project Development Objective Indicators:

- Downward trend of nitrates concentration in waters: at least 70% of targeted project areas show 10% reduction in nitrates discharge to water bodies
- Percentage of population in the project area adopting preventative and remedial measures to reduce nutrient discharges; baseline 3%, end target 75%,
- Improved inter-governmental coordination and capacity to assess, monitor and report on progress with implementation of the EU Nitrates Directive; qualitative indicators
- Favorable EU assessment of Romania's progress towards meeting EU Nitrates Directive; Progress acknowledged through EU comments on reports.
- Nutrient load reduction (Nitrogen (N)) achieved under the project (Tones/year, Custom); end target 600 t/year.

The percentage of population in the project area adopting preventative and remedial measures to reduce nutrient discharges (+20%); the number of land users adopting sustainable land management practices as result of the project (+23%); the percentage of cropped area in the project communes under relevant nutrient reduction measures (+57%); additional 11 communal platforms for manure management; additional 46 (+67%) communes implementing at least one of the nutrient reduction measures (communal platforms, pasture rehabilitation, tree planting etc.); more than 3,300 ha in addition to the initial target for land area where sustainable land management practices were adopted as a result of project; 11 sewage systems constructed versus the target of 9 sewage systems, etc. So far, the project achieved clear benefits in addressing key elements in nutrient pollution of the Black Sea from poor agricultural practices in the Romanian catchments that drain into the Danube River.

The project's second phase (2017-2020) – with 48 million € additional financing - aims to support the Government of Romania to meet the EU Nitrates Directive requirements by (a) reducing nutrient discharges to water bodies, (b) promoting behavioural change at the communal level, and (c) strengthening institutional and regulatory capacity. The project will support several areas: (i) a menu of investment[38] focusing on Nitrate Vulnerable Zone-designated communes in ten river basins and eleven counties; (ii) capacity building within the Ministry of Environment.

For the investment area, it was developed a Guide for Applicants for the competitive financing program under INPCP Component 1, and a draft note on Knowledge and Training Providers.

The first projects (local community investment selected on competitive basis) for nutrients reduction will start effective implementation (works execution) only in the second half of 2018. This is because the timing necessary for the selected beneficiaries to prepare the full applications (feasibility studies, detailed design, obtaining all necessary approvals and the construction permit) is estimated at minimum 6 months after the receiving of the confirmation from the financing agency that the respective project was approved for financing.

Based on the actual situation, such confirmations of projects to be financed under the second phase could only be announced in late 2017. This is a challenging aspect of the investment component due to short period for implementation.

## 9.3 Overview of economic/regulatory/informational instruments to reduce water pollution

### *9.3.1 Measures observed / implemented / under review / discussed*

Main instruments to reduce water pollution could be found in several legal documents. Only instruments implemented and in force are discussed.

[38] Works will include constructions that will involve a range of interventions, including the construction/rehabilitation of commune level manure storage facilities, building composting/biomass/pelleting stations, rehabilitation/expansion of the commune sewage system, low-cost sanitation/wastewater control, biogas digesters associated with commune level manure storage facilities, enhancement of the existing monitoring network. Source: ENVIRONMENTAL MANAGEMENT PLAN and ENVIRONMENTAL GUIDELINES for Integrated Nutrient Pollution Control Project., MINISTRY OF ENVIRONMENT, WATERS and FORESTS, November 2015.

*Table 30: Overview of legal documents and instrument to reduce water pollution*

| Legal document | Instrument | Description | Obs. |
|---|---|---|---|
| | **Economic and financial** | | |
| Water law (no. 107/2002 and other ordinances and gov. decisions) | Charges on water abstraction from rivers, lakes, underground etc | Direct payment to ANAR[39] for water abstraction<br>Paid by all users. For agriculture and aquaculture, the fee[40] is 3 Lei/1000 cm (approx. 0.7 €) | National scale, all users |
| | Charges for discharging pollutants in water bodies | Payments are differentiated according to substances discharged (suspended matters, Cl, Na, Ca, Mg, nitrates, ammonia, P, Mn, Al, etc.)<br>For nitrates, it is paid 46,65 lei/t approx. 10€/t; for ammonia and nitrites it is paid approx. 41€/t | National scale, all users |
| | Charges for water use in hidro-centrales | Payments are differentiated according to the installed power | National scale, all users |
| | Charges for exploiting mineral aggregates for river bed | Payment of 1€/cm | National scale, all users |
| NRDP 2014-2020 | Direct payments to be paid to farmers if they fulfil eco-criteria in exploiting their farms | Payments in a range of 21-620€/ha<br>Min. farm area 1ha<br>Density of livestock of at least 0,3 UVM/ha (Great Beef Units/ha) | Selected areas according to official maps approx. 3100 communes out a total of 3200.<br>For details see Annex 5 |
| GEF Romania Integrated Nutrient Pollution Control Project (INPCP-2) | Investments in local communities to reduce nutrient pollution<br>Investments for management of garbage stable<br>Investments to reduce sewage waste water pollution<br>Improving the protection of watercourses against nutrients and surface leakage | Money available: approx. 74% of 48 mil. €<br>It is estimated that 30.000 small farms and 100 communes will benefit from this project | Request for projects; competitive financing. |
| | **Informational/legal** | | |
| GEF Romania Integrated Nutrient Pollution Control Project (INPCP-2) | CODE for GOOD AGRICULTURAL PRACTICES FOR WATER PROTECTION AGAINST NITRATE POLLUTION<br>FROM AGRICULTURAL SOURCES (ISBN 978-606-94088-0-3) | 196 pages of good agricultural practices.<br>Mainly there are good practices in avoiding water sources with nitrates from fertilisers. | Published in 2016 |
| GEF Romania Integrated Nutrient Pollution Control Project (INPCP-2) | Various seminars and training sessions with farmers and potential applicants for financing | More than 50 seminars and 85 lessons and seminars on Youtube[41] | Regional and national coverage |
| GEF Romania Integrated Nutrient Pollution Control Project (INPCP-2) | COMPETITIVE FINANCING PROGRAM<br>"Investments at the Local Communities Level to Reduce Nutrition Pollution"<br>APPLICANT GUIDE to inform the applicants how to fill in the forms and other documents in order to get financing from the Project | The Guide is giving various details to potential applicants for direct payments from NRDP 2014-2020 | Published in 2016 |

[39] National Water Administration in Romania

[40] HOTARARE nr. 1.202 din 2 decembrie 2010 privind actualizarea cuantumului contributiilor specifice de gospodarire a resurselor de apa EMITENT: GUVERNUL., PUBLICAT ÎN: MONITORUL OFICIAL nr. 826 din 10 decembrie 2010

[41] https://www.youtube.com/watch?v=r9nsnmvarHM

| | | | |
|---|---|---|---|
| EU, DG Environment | Nitrates Directive, Water Framework directive and daughter directives | Transposed in national legislation as Laws | National coverage |

- scale at which instruments are implemented
    - what is the rate of adoption on farms / number of farms affected
    - regional coverage of measures

Usually al instruments cover the national scale. In the case of NRDP 2014-2020, there are official maps that provide information about the regions covered by measures. These maps could be provided if requested[42]. As in all EU countries, there are overlapping maps taking into account the measures selected.

- Effectiveness
    - expected effectiveness of measures observed
    - observed effectiveness: is there causal evidence
    - cost-effectiveness of measures

Not possible to estimate the effectiveness. Lack of basic data as baseline and measurements after the measures have been finalized.

When discussing nitrates issues, the Ex-post Evaluation Report said, at the page 136:

"The latest updated values for nitrogen balance are for 2014. Regarding nitrate and pesticide pollution, no official sources for identifying the indicator have been identified. Thus, the evaluators analyzed a proxy indicator, namely the amount of nitrates per liter per intervals and types of water bodies recorded in the monitoring stations in Romania during 2004-2007 and 2008-2011".

Based on the data from Eurostat, the Ex-post evaluation report[43] draws some conclusions about the influence on PNADR on nitrates pollution (page 137): "The contribution of the Program: The program has influenced the water quality in particular through the implementation of measures 125, 322 and 214. At the end of the programming period, in terms of the reported result indicators, measure 214 has completed commitments that have contributed to improving the quality of the water on an area of 2.19 million ha. The irrigation systems on an area of 27,631 ha were also upgraded and rehabilitated through the projects finalized under Measure 125, and through the measure 322, 1,663.59 km of water supply pipes were realized. It can be concluded that the Program has made a positive contribution to improving water quality but it cannot be provided an accurate assessment of the level of contribution of the program to the evolution of this indicator".

## 9.4 Evidence from the literature, monitoring reports, evaluation studies

[42] http://www.madr.ro/docs/dezvoltare-rurala/PNDR-2014-2020-versiunea-aprobata-30-iunie-2017.pdf

[43] Source: EX-POST EVALUATION STUDY OF THE NATIONAL RURAL DEVELOPMENT PROGRAMME 2007-2013., 2017, MADR.

- DIAGNOSIS OF VULNERABLE ZONES TO POLLUTION WITH NITRATI - 2009[44]

The document elaborated by ICPA (Research Institute for Pedology) in 2009 provides a methodology to identify nitrates sensible zones in Romania. By applying this methodology have been identified sensible zones and maps were elaborated. The document gives information on definitions, measurement methods and criteria used in order to interpret the maps correctly.

- THE FERTILIZER PLAN AND THE EVIDENCE REGISTER; THE USE OF FERTILIZERS IN AGRICULTURAL HOLDINGS[45]

The document Correct evaluation and Determining the need for Nutrients for plants have in view: - local technological conditions for soil; climate; the expected yield of production; soil behavior, fertilizers applied in especially those with nitrogen etc.

The fertilization plan is a useful tool for setting doses for organic fertilizers and minerals; establishing the type fertilizer; determining the moment for application of fertilizers; making decisions on supply and / or disposing of quantities of fertilizers, etc

The fertilization plan has to be carried out for farms over 100 UVM (Great Beef Units) and based on an agrochemical study elaborated by specialized bodies of the Ministry of Agriculture and Forestry

Rural Development. The amount of organic fertilizer applied per unit area shall not exceed 170 kg N ha-1 an-1. This figure also includes nitrogen from liquids manure.

- CODE OF GOOD AGRICULTURAL PRACTICES FOR WATER PROTECTION AGAINST POLLUTION NITRATE FROM AGRICULTURAL SOURCES

The Code of Good Agricultural Practice for water protection against nitrate pollution from organic or mineral sources was drafted within the framework of the WB project. The revised version, is available to farmers and agricultural producers being a useful tool that includes recommendations on best practices, measures and methods that each farmer is obliged to apply, so as to avoid pollution of nitrate waters from agricultural sources.

The most important recommendations resulting from the research done in experimenting with long-lasting fertilizers, refers to periods of prohibition for application of Nitrogen fertilizers on the ground, manure storage capacity, limitation of the amount of fertilizer applied on the field in order to comply with the limit of 170 kg-N / ha. It takes into account organic fertilizers of animal nature, methods of application of fertilizers, specific requirements for sloping land, application of fertilizers on land that is adjacent to watercourses or in the vicinity of drinking water abstraction points, limitations on the application of fertilizers on saturated, flooded, frozen or contaminated land or covered with snow.

Code of Good Agricultural Practice for Water Protection against Pollution with Nitrate from agricultural sources, the revised version, is a key tool for Water protection against pressures

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[44] Source: DIAGNOZA ZONELOR VULNERABILE LA POLUAREA CU NITRATI – 2009; www.icpa.ro

[45] PLANUL DE FERTILIZARE ŞI REGISTRUL EVIDENȚEI UTILIZĂRII FERTILIZANȚILOR ÎN EXPLOATAȚIILE AGRICOLE ., www.icpa.ro

from agricultural activities. And together with the GAEC and SMR regulations of the Agriculture Payments Agency are the main instrument for regulating the financing of farmers in Romania.

Starting 2015, farmers requesting direct payments from European or national budgets, as well as those applying for European funds through certain payment plans from the 2014-2020 NRDP, will have to comply with 20 cross-compliance rules (GAEC and SMR ), according to a draft order of the Ministry of Agriculture.

### *9.4.1 Good practice example[46]:*

*Platform for stable waste (commune BALTA ALBĂ, county Buzau)*

Situated in the eastern part of Buzau County, at a distance of 22 km from Rm Sărat, the Balta Albă commune belongs to the Romanian Plain, characterized by a relatively flat surface, large and low areas, caused by the wind deposits specific to the plains

The commune Balta Alba has a population of 2714 persons. Main activity is agriculture.

In 2015 the project Integrated Pollution Control with Nutrients, financed by WB, decided to build a platform for stable waste in order to reduce the nutrient load from live stock.

It was built a rectangular platform, L x B = 32 x 28 m and wall height of 3.00 m with a storage capacity of 2,000 to / year of manure and a semi-buried storage basin of reinforced concrete, of 83 mc

The facility includes 3 reinforced concrete boxes for waste with a storage capacity of 6 cubic meters each (glass, metal and plastic / cardboard)

Fencing is with wire mesh and the access road into the platform has an entrance/exit gate.

The facility has a protection curtain made from vegetation.

As well two piezometers sensors were installed for periodic monitoring of groundwater quality and a container with 1mc cap for collecting any hazardous waste.

The facility has a cabin for both the administrator and the platform guard.

The project included some equipment:

- a number of 180 individual platforms for temporary storing the stable waste
- 2 tractors, one front loader
- 4 trailers, a cistern
- a machine to spread the compost resulting from the platform composition process

So far, similar platforms were built:

- 14 platforms built in 9 TDS communes (Demonstration and Training Centers), in 2011;
- 18 platforms built in common ZVN (Vulnerable to nitrate pollution), in 2012;
- 7 platforms built in common ZVN (Vulnerable zones to nitrate pollution), in 2013;
- another 35 platforms would have been built in 2015.

[46] Source: http://www.inpcp-campanie.ro/2013.

## 9.5 Future of agriculture in Romania

### *9.5.1 Forecast until 2020*

According to medium term forecast made by National Commission for Prognosis, the agriculture in Romania will continue the past trends (next table). Gross value added will decrease from 1.9% in 2017 to 0.9% in 2020. As well the output from agriculture will slightly decrease. The forecast considered that the contribution made by agriculture to GDP growth will be close to zero, meaning that the whole GDP growth will depend on industry and services.

*Table 31: Forecast of main indicators of Romanian Agriculture*

| Indicators | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| | | | % | | | |
| GVA Agriculture, silviculture and fisheries | – 11.8 | + 0.0 | + 1.9 | + 1.9 | + 1.9 | + 0.9 |
| Output Agriculture | – 7.3 | + 0.4 | + 2.0 | + 2.0 | + 2.0 | + 1.1 |
| GDP Growth rate | + 3.9 | + 4.8 | + 5.2 | + 5.5 | + 5.7 | + 5.7 |
| Agriculture contribution to GDP growth | – 0.6 | + 0.0 | + 0.1 | + 0.1 | + 0.1 | + 0.0 |
| Share of Agriculture, silviculture and fisheries in GDP | 4.2 | 3.9 | 3.8 | 3.6 | 3.5 | 3.3 |

Source: www.cnp.ro., Prognoza pe termen mediu 2017 – 2020 - varianta de primavara 2017.

In Romania, agriculture will continue to specialize on grains culture as cereals, corn etc. This will take advantage of large fertile agricultural surfaces existing on Romanians plains.

Other tendencies could be mentioned:

- livestock production will stagnate being influenced by environmental legislation that impose limits of livestock/ha;
- it is difficult to estimate if the income of the farm will increase; due to high fragmentation of the land productivity will remain low;
- there is a slow tendency toward consolidation of farms (in the period 2010-2013 the total number of farms decreased with 226,569 units (from 3,859,043 to 3,629,656) but the total number of farms is still high. All opinions agree that the consolidation process will continue.

### *9.5.2 Likely consequences for water related agri-environmental indicators in DRB*

As it was said, the water consumption decreased from 9.1 billion m³ in 1990 to 1.3 billion m³ in 2011. If the trends will continue it is not expected a significant increase in water consumption in agriculture. Due to the consolidation process and climate change it is expected a slow increase in water consumption in agriculture. On the other hand, in July 2017, was issued a new law (Law 133/2017) that has some provisions to supply water to agricultural associations free of charge. The water will be provided by the National Company for Land Improvement within the limit of the budgetary allocation. It is not clear how big will be the impact on water consumption in agriculture but will contribute to water increase in agriculture.

## 9.6 Synthesis for Romania

### *9.6.1 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.

### *9.6.2 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.

### 9.6.3 *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.

### 9.6.4 *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.

## Annex

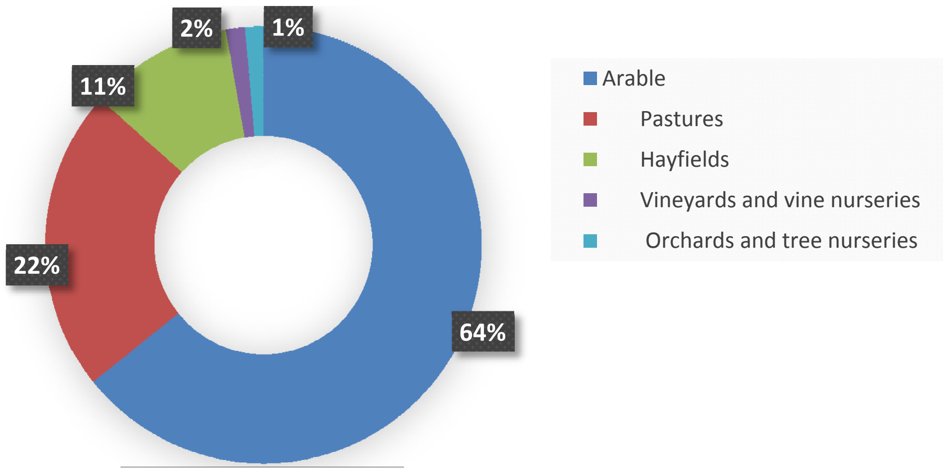


*Figure 16: Agricultural area in Romania*

Source: ROMANIAN STATISTICAL YEARBOOK – 2016, NATIONAL INSTITUTE OF STATISTICS.

*Table 32: Agricultural holdings in Romania (2013)*

| | Agricultural holdings in 2013 | |
|---|---|---|
| | number | % |
| Total | 3,629,656 | 100.00% |
| Agricultural holdings without legal status | 3,601,776 | 99.23% |
| Individual agricultural holdings | 3,587,724 | 98.84% |
| family enterprises | 14,052 | 0.39% |
| Agricultural holdings with legal status | 27,880 | 0.77% |
| Autonomous bodies | 86 | 0.00% |
| Agricultural companies / associations | 1,343 | 0.04% |
| Commercial companies | 14,531 | 0.40% |
| Units of public administration | 3,107 | 0.09% |
| Cooperative units | 66 | 0.00% |
| Other types | 8,747 | 0.24% |

Source: National Institute of Statistics (INS), Romanian Statistical Yearbook 2016.

*Table 33: Agricultural area for farms, in Romania (2013)*

| Size class Agricultural area of a farm | Agricultural farms in 2013 | |
|---|---|---|
| *ha* | number | % |
| *0 - 2* | 2,589,924 | 72.67% |
| *2 - 5* | 691,257 | 19.40% |
| *5 - 10* | 193,871 | 5.44% |
| *10 - 20* | 49,648 | 1.39% |
| *20 - 30* | 10,259 | 0.29% |
| *30 - 50* | 8,468 | 0.24% |
| *50 - 100* | 7,263 | 0.20% |
| *over 100* | 13,075 | 0.37% |

Source: National Institute of Statistics (INS), Romanian Statistical Yearbook 2016.

*Table 34: Use of chemical and natural fertilizers in Agriculture*

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|
| | | | 1,000 t | | | |
| CHEMICAL FERTILIZERS (active substance) | 426 | 481 | 487 | 438 | 492 | 452 |
| Nitrogenous | 296 | 306 | 313 | 290 | 344 | 303 |
| Phosphatic | 100 | 123 | 126 | 113 | 114 | 119 |
| Potassic | 30 | 52 | 48 | 35 | 34 | 30 |
| NATURAL FERTILIZERS | 13748 | 15232 | 14510 | 13293 | 13580 | 16262 |
| | | | 1,000 ha | | | |
| Agricultural area | 14,684 | 14,634 | 14,621.5 | 14,615 | 14,612 | 14,630 |
| | | | kg/ha | | | |
| CHEMICAL FERTILIZERS (active substance) | 29.01 | 32.87 | 33.31 | 29.,97 | 33.67 | 30.90 |
| Nitrogenous | 20.16 | 20.91 | 21.41 | 19.84 | 23.54 | 20.71 |
| Phosphatic | 6.81 | 8.40 | 8.62 | 7.73 | 7.80 | 8.13 |
| Potassic | 2.04 | 3.55 | 3.28 | 2.39 | 2.33 | 2.,05 |
| NATURAL FERTILIZERS | 936.20 | 1,040.83 | 992.37 | 909.54 | 929.38 | 1,111.54 |

Source: National Institute of Statistics (INS), Romanian Statistical Yearbook 2016.

*Table 35: Financial allocations of NRDP, by Axes (2007-2013)*

| Axes | Total public contribution | EU contribution rate | EAFRD amount |
|---|---|---|---|
| | million € | % | million € |
| Axis 1. Improving the competitiveness of the agricultural and forestry sector | 2,885.27 | 88.46 | 2,552.3 |
| Axis 2. Improving the environment and the countryside | 3,163.24 | 86.78 | 2,745.0 |
| Axis 3. The quality of life in rural areas and the diversification of the rural economy | 2,337.70 | 85.58 | 2,000.64 |
| Axis 4. LEADER | 386.16 | 94.49 | 364.87 |
| Technical assistance | 131.56 | 91.57 | 120.47 |
| Complements to direct payments | 392.53 | 80.00 | 314.02 |
| Total General | 9,296.460 | 87.10 | 8,097.27 |

Source: NRDP 2007-2013., consolidated version, Sept. 2015., Number CCI: 2007RO06RPO001, Chapter 5. Information on the axes and measures proposed for each axis and their description and Chapter 6. Financing plan.

*Table 36: Eligible land for direct payments to farmers*

| Measure/package | Agricultural land eligible | Number of administrative units (UAT towns and communes) |
|---|---|---|
| Measure 10 – agro-environment and climate with 8 packages: | | |
| Package 1 | Permanent meadows, traditional orchards | 998 |
| Package 2 | Permanent meadows, traditional orchards | 998 |
| Package 3 | Permanent meadows | 567 |
| variant 3.1 | Permanent meadows | 83 |
| variant 3.2 | Permanent meadows | 484 |
| Package 4 | arable land | 3,181 |
| Package 5 | arable land | 71 |
| Package 6 | Permanent meadows | 26 |
| Package 7 | arable land | 126 |
| Package 8 | N/A | 3,181 |
| Measure 11 – ecological agriculture | | |
| sub-măsura 11.1 | | - |
| Package 1 | arable land | 3,181 |
| Package 2 | arable land | 3,181 |
| Package 3 | Permanent crops - orchards | 3,181 |
| Package 4 | Permanent crops - vii | 3,181 |
| Package 5 | arable land | 3,181 |
| Package 6 | Permanent meadows | 3,181 |
| variant 6.1 | Permanent meadows | 1,551 |
| variant 6.2 (**) | Permanent meadows | 1,630 |
| sub-measure 11.2 | | - |
| Package 1 | arable land | 3,181 |
| Package 2 | arable land | 3,181 |
| Package 3 | Permanent crops - orchards | 3,181 |
| Package 4 | Permanent crops - vineyards | 3,181 |
| Package 5 | arable land | 3,181 |
| Package 6 | Permanent meadows | 3,181 |
| variant 6.1 | Permanent meadows | 1,551 |
| variant 6.2 | Permanent meadows | 1,630 |
| Measure 13 – payments for area confronted with natural difficulties | | |
| sub-measure 13.1 | arable land, Permanent meadows, Permanent crops | 658 |
| sub- measure 13.2 | arable land, Permanent meadows, Permanent crops | 769 |
| sub- measure 13.3 | arable land, Permanent meadows, Permanent crops | 24 |

Source: Information guide for applicants of environmental and climate measures within the national program for rural development (NRDP) 2014-2020, Min. of Agriculture and rural development, 02/2016.

*Table 37: Conversion coefficients for livestock*

| Livestock | Coefficient of conversion |
|---|---|
| Bulls, cows and other cattle for more than two years and horses for more than six months | 1,00 |
| Bovine animals between six months and two years | 0,60 |
| Bovine animals less than six months | 0,40 |
| Sheep | 0,15 |
| Goats | 0,15 |
| Breeding sows > 50kg (*) | 0,50 |
| Other pigs | 0,30 |
| Poultry | 0.007 |

Source: GHID INFORMATIV., PENTRU BENEFICIARII MĂSURILOR DE MEDIU ȘI CLIMĂ ALE PROGRAMULUI NAȚIONAL DE DEZVOLTARE RURALĂ (PNDR) 2014 – 2020.

*Table 38: Conversion of manure into nitrogen active substance (kg N s.a.)*

| Type of litter | Chemical composition (% of fresh mass) | | | Quantity of N in manure *(kg N / 1 tone)* |
|---|---|---|---|---|
| | *Azot (N)* | *Water* | *Organic matter* | |
| Horse manure | 0,58 | 71 | 25 | 5,8 |
| Bovine manure | 0,45 | 77 | 20 | 4,5 |
| Sheep manure | 0,83 | 64 | 31 | 8,3 |
| Fermented manure 3-4 month | 0,55 | 77 | 17 | 5,5 |
| Fully fermented manure | 0,98 | 79 | 14 | 9,8 |

In order to be able to calculate if a corresponding amount of manure was applied to the requirements of each package of NPRD (eg 40 kg N in the case of Package 1 of Measure 10), the following table shows the chemical composition of manure of different origins. Based on these data, it is possible to estimate the amount of nitrogen contained in one ton of manure.

Thus, in order to comply with the maximum permitted by the specific requirements and baseline requirements of Measure 10 and Measure 11, the maximum allowable quantity to be applied on the areas under the commitment or other farm areas is as follows:

*Table 39: Maximum allowable quantity to be applied on the areas under the commitment or other farm areas*

| Type of litter | Type of garbage | Maximum quantity of manure (tonnes / ha) | |
|---|---|---|---|
| | | *< 40 kg N s.a./ha* | *< 170 kg N s.a./ha* |
| Horse manure | Horse radish | 6,897 | 29,310 |
| Bovine manure | Bovine stump | 8,889 | 37,778 |
| Sheep manure | Sheep garbage | 4,819 | 20,482 |
| Fermented manure 3-4 month | Fermented fertilizer for 3-4 months | 7,273 | 30,909 |
| Fully fermented manure | Fully fermented stump (broth) | 4,082 | 17,347 |

Source: GHID INFORMATIV., PENTRU BENEFICIARII MĂSURILOR DE MEDIU ȘI CLIMĂ ALE PROGRAMULUI NAȚIONAL DE DEZVOLTARE RURALĂ (PNDR) 2014 – 2020.

**NOTE**

Pesticides and phytostimulators (fertilizers) cannot be used during autumn crop sowing until March 15th

*Table 40: PNADR impact on pollution with nutrients*

| Impact indicators | Related baseline indicators | The reference value | Updated value in 2015 |
|---|---|---|---|
| (6) Improvement in water quality | Gross Nutrient Balances – Nitrogen balance (kg/ha) | 12 kg/ha SAU (in 2005)[86] | -1 kg/ha SAU[87] (in 2014) |
| | Pollution by nitrates and pesticides - *The amount of nitrates per liter per intervals and types of water bodies* [88] | În 2004-2007[89]:<br>Groundwater<br><25 mg nitrates / l: 75% of monitoring stations (1,028 stations)<br>25-40 mg nitrates / l: 10% of monitoring stations (137 stations)<br>40-50 mg nitrates / l: 4% of monitoring stations (55 stations)<br>> 50 mg nitrates / l: 11% of monitoring stations (151 stations) | În 2008-2011[90]:<br>Groundwater<br><25 mg nitrates / l: 76.5% of monitoring stations (1,380 stations)<br>25-40 mg nitrates / l: 8.3% of monitoring stations (150 stations)<br>40-50 mg nitrates / l: 3.8% of monitoring stations (69 stations)<br>> 50 mg nitrates / l: 11.5% of monitoring stations (206 stations) |
| | | In 2004-2007:<br>Groundwater[91]<br><2 mg nitrates / l: 21% of monitoring stations (261 stations)<br>2-10 mg nitrate / l: 71.2% of monitoring stations (884 stations)<br>10-25 mg nitrates / l: 6.5% of monitoring stations (80 stations)<br>25-40 mg nitrates / l: 0.7% of monitoring stations (9 stations)<br>40-50 mg nitrates / l: 0.2% of monitoring stations: (3 stations)<br>> 50 mg nitrates / l: 0.4% of monitoring stations (4 stations) | In 2008-2011:<br>Groundwater[92]<br><2 mg nitrates / l: 22.7% of monitoring stations (253 stations)<br>2-10 mg nitrates / l: 70.4% of monitoring stations (787 stations)<br>10-25 mg nitrates / l: 5.3% of monitoring stations (59 stations)<br>25-40 mg nitrates / l: 0.8% of monitoring stations (9 stations)<br>40-50 mg nitrates / l: 0.3% of monitoring stations (3 stations)<br>> 50 mg nitrates / l: 0.5% of monitoring stations (5 stations) |

Source: EX-POST EVALUATION STUDY OF THE NATIONAL RURAL DEVELOPMENT PROGRAMME 2007-2013, 2017, MADR.

# 10 Country Report: Serbia

Matej Bedrač, Tomaž Cunder

## 10.1 Economic and agri-environmental indicators

### *10.1.1 State of agriculture*

Regarding to natural conditions and production resources Serbia belongs to the circle of countries with respectable capacity for diversified agricultural production. Its terrain ranges from rich, fertile plains in the northern Vojvodina region to limestone ranges and river-basins in the east and mountains and hills in the southwest. Due to its topography, climate, soil quality, farm production systems and socio-economic development, Serbia could be divided into three broad agricultural zones – Vojvodina, Central Serbia and Southern Serbia.

The contribution of agriculture to the Serbian whole economy is considerable. The share of agriculture in GVA has decreased over the last decade from over 12% to about 10%, whereas the share of agriculture in employment remains over 20%. Relatively high share of agriculture in the country's GVA and employment is due to a slowly progressing restructuring of the rest of the economy, overall low investment activity and consequently low employment opportunities in non-agricultural sectors (van Berkum & Bogdanov, 2012). Agricultural sector also contributes significantly to the country's trade balance. In total exports the share of agriculture and food exports is about 20%. Since 2004, when the agro-food sector had a negative trade balance, exports have grown at a faster rate than imports as a consequence of the CEFTA agreement resulting in a positive trade balance since 2005.

The results of 2012 agricultural census in Serbia recorded 628,552 family farms and 3,000 agricultural enterprises (386 cooperatives). A distinctively dual farm structure with significant regional variations in farm size and type of farming operations in the main characteristic of agricultural sector in the country. The average farm size is 5.4 ha of UAA per holding, with large differences at the regional level, ranging from 3.6 ha in Southern and Eastern Serbia Region to 10.9 ha in Vojvodina Region. 48% of farms cultivate less than 2 ha and only 3.1 % of farm holdings have 20 ha or more. According to the census data, Serbia has 2.02 million LSU. The average numbers of LSU per holding (4.1) and per hectare of UAA (0.59) suggest the predominance of small herds.

From crop production comes about two-thirds of Serbia's Gross Agricultural Output (GAO) and one-third from animal production. Cereals, particularly maize and wheat, hold the dominant position in the GAO structure, accounting for 30-35%. The production of fruit and vegetables accounts for approximately 20 percent of the GAO, while industrial crops contribute 9 percent to total GAO. In the frame of the livestock products, pig meat (11-14 percent) and cow's milk (8-10 percent) contribute the largest shares to GAO.

### 10.1.2 State of agri-environmental indicators

In the frame of different indicators reduction of the negative impacts of agriculture on the environment can be detected in the past period. Increasing of the area of agricultural land and the number of farms managed according to the standards prescribed by the Organic Farming Act is obvious.

Fertilizer use in Serbia has (especially because of the economic crisis) noticeably declined during the period 1985 – 1998 (from approximately 1.45 million tons in the period from 1982–1987 to 0.411 million tons in 1991–1998). This amount has not significantly changed while even in 2014 an average total consumption of fertilizers did not overcome 0.4 million tons. Over time, the threat posed to the environment has decreased, resulting in a significant reduction in the eutrophication of water bodies.

On the other hand serious regional diversities are still evident regarding the impact of agriculture on the environment. From the pollution point of view Vojvodina (the most important agricultural area) remains the most problematic. 25% of analyzed soils samples in that area had high phosphorus content and 56% of the analyzed territory is in danger of further acidification. According to the analyses soils contain 5 g/kg of pesticides and their metabolites.

### 10.1.3 Information gaps

Economic sanctions and consequently, production and economic drop, have significantly reduced capabilities of the state activities and investment in environmental protection. As well care for the environmental concerns on the side of farmers, which is still predominantly driven by profits, is still at a very low level. Agro-environmental measures seem to have a low priority or have remained just as a declarative issue.

In the field of environmental pollution control diversification and overlapping of duties and responsibilities within government institutions is still evident, although to a lesser degree since the new environmental legal framework of 2009 has been in force. The main obstacles for generally less effective action are still the ineffective monitoring and reporting system and insufficient institutional capacities, insufficient capacity in surveying the legislation implementation, insufficiently efficient inspection supervision, and inadequate sanctioning system. They can only be solved by a systematic reform of the regulatory process and public administration coordination.

### 10.1.4 Review of region specific targets relevant for DRB

The territory of Serbia includes parts of the Black Sea Basin (through Danube River), the Adriatic Sea Basin and the Aegean Sea Basin. Most of the country (about 92%) is situated in the Black Sea Basin (the Danube River Basin). The Danube River, with a discharge at its mouth of some 6,500 $m^3/s$, is joined in Serbia by three major tributaries: the Tisa, the Sava and the

Velika Morava, as well as a number of minor tributaries. Because only 8% of water volume represents no DRB, other two water areas are not excluded from the present analysis.

From the administrative point of view Serbia is structured only on the national and the local level. In July 2009, the Government of the Republic of Serbia adopted a law that divided Serbia into seven statistical (NUTS3) regions. Further Serbia is divided into 29 districts and the city of Belgrade. In the area of the Autonomous Province of Vojvodina there are 7 counties, while in the area of Central Serbia there are 17 administrative districts and the territory of the city of Belgrade. Each administrative district is composed of several municipalities, and municipalities are composed of urban communities.

Water management is under the jurisdiction of the national government, which has delegated the various tasks to the Ministry of Agriculture, Forestry and Water Management, other ministries, provincial administrative bodies, agencies of local administrations, and government-held water management companies. Major administrative functions related to water management reside with the Ministry of Agriculture, Forestry and Water Management, or rather the National Water Directorate attached to it. Three government-held water management companies operate in Serbia: Srbijavode (Serbia Waters), Vode Vojvodine (Waters of Vojvodina) and Beogradvode (Belgrade Waters).

### *10.1.5 General agricultural policy*

The Agricultural and Rural Development Policy in Serbia of the last fifteen years has changed constantly and its instability is evident. During the period, 2005–2014, budgetary support to Serbian agriculture varied in both amount and structure. The agricultural budget increased in the period 2005 – 2008 from 150 million € to 279 million €, it was followed by a sharp decline in 2009, began to grow from 2012 and reached a peak in 2014 with 316.4 million €.

Budgetary support is mainly directed to market and direct producer support measures. Direct producer support measures have varied significantly from year to year. The main reason are market failures resulting from adverse weather conditions and price fluctuations, but also a lack of appropriate strategic guidelines and clearly defined policy framework and priorities. An average share of the funds for this policy pillar accounted for about 77 % of the total budget in 2005–2011 and increased to over 86% on average for 2012–2014.

In the light of amount and structure direct supports are extremely heterogeneous, particularly when it comes to variable input subsidies. Such radical changes showed that this instrument was widely used to solve urgent needs and cope with the challenges posed by the policy framework and system shortcomings.

From the rural development point of view is interesting that support was considerably higher at the beginning of the last fifteen years period, and the measures and program through which it was implemented were much more diversified. But, the importance of rural development measures was gradually marginalized, reaching less than 1.4 % of the total budget in 2014. The rural development budgetary support in Serbia is mostly oriented on on-farm investment support (grants for renovation of facilities, farm mechanization and equipment purchase), replanting and expanding of orchards and vineyards, and subsidized interest rates.

An average amount of 22.5 million € (7.5% of total agricultural budget) was aimed to the transfers for general services in agriculture. Under this part of the budget the regular support for extension services, expert services and food safety control are included. As they are implemented on a multi-annual basis, the funds are more stable than for other groups of measures.

Other transfers to agriculture include funding of activities financed from the sub-accounts of different directorates (Forestry Directorate, Budgetary Fund for Forestry, Budgetary Fund for Hunting, Directorate of Agricultural Land).

### *10.1.6 Agri-Environmental programs*

From the general point of view some progress has been made in addressing environmental concerns associated with agriculture in the current NRDP (National Rural Development Plan). The agro-environment-related incentives in Serbia include payments for maintenance of genetic agricultural resources (per hectare/head) and farms engaged in organic farming.

In 2006, a new Organic Farming Act was adopted and introduces subsidies to support organic certification and production methods. Organic farming improves the natural balance of plant nutrients by using crop rotations and the integration of crop and livestock production. Due to limited use of fertilizers and pesticides, organic farming plays a positive role in biodiversity conservation, improves soil and water quality and contributes to the sustainable management of the soil, crops and livestock. Organic production encourages the use of traditional plant varieties and livestock breeds, which tend to be more resistant to pests and diseases due to their adaptability to local conditions. This type of farming helps to maintain rural landscapes by maintaining biodiversity and protecting natural habitats, which also helps to attract and retain people in rural areas. Organic farming is supported per capita or head (or per beehive) of organically raised animal or hectare of organically produced crop, fruits or vegetables, etc. Long-term goals of organic farming in Serbia are:

- 2% of all Serbian food products sold on national market to be organic,
- 5% of the whole utilized agricultural area to be under organic management.

Serbia has not yet started to implement management practices, technologies and policies that promote the positive and mitigate the negative impacts of agriculture on biodiversity, and enhance productivity and the capacity to sustain livelihoods. Many of these key management practices are likely to be found within farming systems, which will need carefully targeted support during and beyond any period of restructuring and adaptation of the agricultural sector.

Measures aimed at improving the environment and the countryside are slowly and rarely implemented. This group of measures has about 0.2 % of total budgetary support. In 2014 funding increased from the previous period: it reached 1 million €, i.e. 0.5 % of the agricultural budget.

### *10.1.7 Gap analysis*

Serbia still has not fulfilled the main requirements set out in the Nitrates Directive 91/676/EEC. This is, among other problems, a practical consequence of the inability to fulfil the goals set out in the EU Water Framework Directive. The implementation of Nitrates Directive and Communal Wastewater Directive 91/271/EEC requires high costs of approximation with the EU acquis and it is certainly one among most urging issues in the field of agro-environmental measures.

## 10.2 Overview of instruments to reduce water pollution in each country

### *10.2.1 Measures Observed*

The right to a healthy environment and water as an important element is guaranteed by the Constitution of the Republic of Serbia. The Republic of Serbia regulates and provides a system for the protection and improvement of the environment.

Water is within the domain of public welfare and is under state ownership. Water must be used rationally and economically, and the right to use water, with the exception of certain purposes is acquired by a water permit, or on the basis of contracts (special water use). The territory of the Republic of Serbia represents a unique territory for integrated water management. Within this territory there are seven water areas defined as basic units for water management.

#### 10.2.1.1 Training, education and information

Knowledge transfer in the field of agriculture and environment in Serbia is delivered through formal education at all levels (from secondary education to doctoral studies), through a variety of training organized by educational and research institutions or agricultural expert extension services.

Educational and research institutions in agriculture include 25 secondary agricultural schools, whose establisher was the state. Expert education in agriculture can be got also in some other secondary schools of technical, chemical or general type. As for faculties, according to data in the Ministry of Science and Technological Development, out of 118 accredited higher education institutions in the Republic of Serbia, 4 faculties of agriculture stand out (3 with excellent international reputation: Belgrade, Novi Sad, Čačak) and faculties of bio-farming, veterinary medicine and forestry.

The public agricultural extension services include 34 agricultural extension and professional branches (PSSS) - 22 in the area of Central Serbia that are working under MAEP and 12 PSSS and the Ecological station whose work is monitored by the Provincial Secretariat for Agriculture, Water and Forestry6. The existing structures and systems of knowledge transfer are not efficient enough and fail to adequately fulfill the needs of dynamic technical and technological restructuring of the sector. There are no functional networks with specialized centers of knowledge. Additionally, knowledge is not systematically stored and it is difficult to access relevant information on local level.

41,500 holdings, the majority of which are selected farms, which are intensively monitored four times a year (4,000 in Central Serbia and 2,500 in Vojvodina), while other holdings are included in the extension system in other ways, mainly through participation in group classes and the occasional farm visits/consultations. This type of education covers 25,000 households in Central Serbia and 10,000 in Vojvodina. Organized knowledge transfer through the extension services reaches a relatively small number of recipients.

#### 10.2.1.2 Regulatory instruments

The basic legal act in the field of water is the *Law on Water*, which "regulates the legal status of water, integrated water management, management of water facilities and wetland areas, water sources and funding of water-related activities as well as other issues of importance for water management." This law applies to all surface water and groundwater on the territory of the Republic of Serbia, including thermal and mineral water, except groundwater from which useful mineral raw materials and geothermal energy are obtained, then the waterways that form or intersect with the Republic of Serbia"s borders and the related groundwater, as well as the exploitation of river sediment which do not contain the ingredients of other useful minerals

#### 10.2.1.3 Fiscal instruments

The Law on Water also regulates the area of funding activities of general interest related to water management. Funding for these activities is generated from the budget of the Republic of Serbia (for the territory outside the AP), the budget of the autonomous province (on the territory of AP), water charges, concession fees and other sources of financing (own funds of investors, loans, public loans, grants, etc.). The operations of waterways and protection from the harmful effects of water, water management and use, construction and reconstruction of regional and multi-purpose hydro systems and other activities of general interest laid down by the Law are financed from the budget. In Serbia there are no special environmental taxes on effluents, emissions or potentially harmful inputs of agriculture.

### *10.2.2 Scale at which the instruments are implemented*

Water management falls under the responsibility of the Republic of Serbia and all documents are adopted at this level providing a normative framework for the integrity of the water system, the Water Management Strategy in the Republic of Serbia, Water Management Plan for the Danube River Basin, management plans for water areas, as well as plans for flood control, flood risk management, and water protection. At this level, international cooperation in the field of water management is organized and implemented. A number of competencies in the field of water management are transferred to the autonomous region, the capital city and local government.

### *10.2.3 Literature review*

There is a significant lack of adequate analyzes and studies on the effectiveness of individual measures in the field of agriculture to reduce water pollution in Serbia. Only a few publications that were used to prepare this report are also concerned with this issue (Cooper, et al., 2010; Jovanić, 2013; Ørum et al., 2010; Roljević et al., 2012; World Bank, 2012).

On the strategical and operational level the most important issues of these studies are implementation measures where it is necessary to emphasize:

- establishment of a suitable legislative environment for full implementation of the Water Law,
- an organizational and institutional system, capable of ensuring integrated water management,
- preparing of the planning documents (water management plans for water districts, flood risk management plans and water pollution control plans),
- completion of missing documentation also applies to the environmental sector, specifically the segment that involves water

### *10.2.4 Knowledge gaps*

According to the literature review could be concluded that the physical links between the interaction of agriculture and water quality on the national level are not well understood. Different sources show that there is lack of useful data on the farm level (how implementation of agri-environmental measures influence on the quality of ground and surface water).

### *10.2.5 Best practice example*

On the basis of basin-wide water quality models Serbia (together with Montenegro) has been ranked in the second part of 1990s as third in nitrogen pollution levels and second in phosphorus pollution among the 13 Danube countries. One of the largest sources of water pollution was livestock sector where:

- large pig and cattle farms in Vojvodina and central Serbia dumped liquid waste in lagoons, from where it seeped into groundwater,
- manure storage practice was inadequate and farmers were usually unaware of its harmful environmental impact,
- slaughterhouses typically collected and transported animal waste for disposal in the municipal waste water system or landfill lagoons, often without any treatment.

The project **Better Agricultural Practices in Serbia for a cleaner Danube River** was designed to strengthen Serbia's policy framework regulating nutrient runoff and discharge from livestock farms and slaughterhouses in line with the EU Nitrate Directive. It was implemented under the World Bank-led GEF Black Sea and Danube Strategic Partnership on Nutrient Reduction and envisaged investments in the reduction of agricultural pollution through awarding grants for nutrient control to selected medium and large farms and slaughterhouses, with the aim of introducing cost-effective methods for reducing nutrient runoff.

From 2006 to 2011, storage facilities and equipment for better animal waste management were financed in 105 farms, seven agricultural schools, three slaughterhouses and meat processing plants, and two rendering plants. The annual reduction in nutrient pollution flow from project-beneficiary farms is estimated to be 44 percent for nitrogen and 100 percent for phosphorus. At least 65% of beneficiary farms and slaughterhouses were implementing nutrient reduction plans properly two years after being awarded the sub-grant. Over 650 professionals, including 180 agricultural advisors, were trained between 2006 and 2011. Seven agricultural schools throughout Serbia included good manure management practices into their curriculum to train future generations of farmers.

To measure the long-term impact of nutrient reduction on water quality laboratory equipment was installed at the Hydro-Meteorological Institute. At the same time, activities to raise awareness among the general population and farmers and to stimulate investment were expanded. From results of the beneficiary survey from July 2010 is evident that 58 percent of farmers in project areas were aware of environmental issues in agriculture. A study was prepared to assist Serbia with the implementation of the EU Nitrate Directive and tap into pre-accession funds for agriculture (IPARD) once the country gains EU candidate status.

The cost of the project was 20.73 US$. In its implementation was included Serbia's Ministry of Agriculture, Forestry and Water Management, the World Bank and Swedish International Development Cooperation Agency (SIDA).

## 10.3 Future of agriculture in Serbia

### *10.3.1 Production trends in Serbia*

Also in Serbia there is a lack of scientific studies and models about the production trends in agriculture. For countries that do not have an appropriate predictive models for assessing agricultural production, the only possible solution is an assessment based on existing data trends. Assessment for Serbia was made on the basis of statistical data and also with using of different strategical documents (Strategy of Agriculture and Rural Development in Serbia: 2014-2024). The following developmental disparities are expected:

- Livestock production will increase for more than 50% (mostly due to the increase in the number of cattle and sheep in mountain and other areas with limited conditions)
- Consequently especially the production of beef meet will increase.
- The production of cereals (wheat and corn maize) will increase to around 50% due to higher productivity (yield t/ha).
- Areas of irrigated and drained agricultural land will increase for more than six times (on about 250.000 ha).
- The area under permanent crops - orchards, vineyards and others will grows from current 4,000 ha up to 10,000 ha.
- Due to environmental legislation intensification of livestock production will be limited.
- Increase of agricultural land under organic production by a third.

### *10.3.2 Farm structure development in Serbia*

There are no forecasts on a future development of farm structure in Serbia. The forecasts are based on trend extrapolations. Based on the data from agricultural censuses in 2000 and 2012 it is anticipated that structural changes in Serbian agriculture will continue or even accelerate over the next ten year period. The main indicators of this development will be:

- Rapidly reducing the number of farms.
- Continuous increase in average size of holdings and improvement of ownership structure.
- Changing the production structure and the level of specialization of agricultural holdings.

## 10.4 Synthesis for Serbia

### *10.4.1 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.

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# 11 Country Report: Slovakia

Ina Meyer

## 11.1 Economic and agri-environmental indicators

### *11.1.1 State of agriculture*

The complete territory of the Slovak Republic (hereafter: Slovakia) is part of the Danube River Basin (DRB) management area, more precisely 96% of the Slovakian territory belong to it.

The agricultural sector's share of the gross value added in Slovakia was 4.0% on average for the years 2012/14 and 4.5% with respect to the period 2002/04 and thus declined slightly. The contribution of the agricultural sector to the overall value added is rather small compared to the value added in other economic sectors of the economy, but it is substantially higher with respect to "old" EU Member States such as Austria where the agricultural share in gross value added figures less than 1%. The contribution of the agricultural sector to the gross valued added in the different NUTS2 regions of Slovakia is quite stratified which indicates different economic structures, i.e. in the NUTS2 region of Bratislavský kraj (NUTS2 SK01) the share of the primary sector is much lower (1.3% in 2012/2014) than in the other regions which show agricultural shares between 5.3% in Stredné Slovensko (SK03) and 4.4% in Východné Slovensko (SK04). All regions show a decreasing relative contribution of the agricultural sector to gross value added when comparing the two time periods, except for Bratislavský kraj which shows an increasing trend in agricultural output with respect to the period 2002/2004 (0.9%). In absolute terms, the added value in agriculture increased. The share in animal output declined from 45.9% in 2002/04 to 38.7% in 2012/204.

The national agricultural sector employment was at 3.3% in 2014. It is characterized by a decline (measured in annual working units) by -43.2% (2005-2010), and -48.8% (2005-2013) respectively. The gross value added per annual working units increased by about 130% on average between the periods 2002/04 and 2012/14 which indicates an enormous rise in productivity compared to other regions in the old EU member states.

The total utilized agricultural area of Slovakia amounts to about 1.9 m ha which is about 38.8% of the total Slovakian area. The utilized agricultural land showed a slight increase of about 1% from 2005 to 2013.

In Slovakia, the average farm has around 521.5 ha of utilized agricultural area. It is the largest area of all EU countries. The utilized agricultural area is cultivated by a small number of farms which operate on large land areas. Average utilized agricultural land in the EU is around 33 ha per farm, and just in other four EU countries, the utilized land area has more than 100 ha per farm – the Czech Republic (227.86 ha), the United Kingdom (161.13 ha), Estonia (125.87 ha) and Sweden (101.27 ha, Ladvenicová – Miklovičová, 2015).

According to the statistical data, the owner structure of farmed areas is markedly different from the European average. While average European farmers rent on average around 55% of the total utilized agricultural area, Slovak farmers rent about 95% of agricultural land they operate on. In absolute value, this is about 495.3 ha per farm (Ladvenicová – Miklovičová, 2015).

As in the Czech Republic but in contrast to the average structure in the EU 25, a relative small number of farms over 100 ha of area occupy a high share of the utilized agricultural land, i.e. in the year 2000, 3 farms of over 100 ha occupied 93% of the agricultural area.[47]

Organic farming in Slovakia has been developed since 1991. More significant increase is evident from the accession into the EU when Slovakia adopted the commitment to increase the acreage of agricultural land for the implementation of organic farming. At the same time it was possible to obtain farmers´ subsidies for the establishment and operation of organic production. This factor played an essential role in 2004 and between 2008–2009 when the most significant impact on the development of active farmers was evident. In 2013 there were 355 organic farms in Slovakia, out of this amount 11 were in conversion. There is the highest share of organic farmers in Prešov region (24.42%) and Košice region (17.44%). The lowest amount of organic farms is evident in Bratislava (3.78%) and Trnava (5.81%) regions. Animal organic production prevails over plant organic production. Financial incentives to compensate the loss of the income from reduced production and additional costs related to the implementation of organic farming were the main drivers of establishing organic farming (Palšová et al., 2014).

### *11.1.2 State of agri-environmental indicators*

Agriculture deals no longer with the production of food only, but now engages in important social and environmental functions. Across most European Union Member States agriculture is still an important source of nutrients (and pesticides) pollution into surface and groundwater. Large inputs of nitrogen and phosphorus to water bodies from agricultural production can lead to eutrophication. This causes ecological changes that can result in loss of plant and animal species and have negative impacts on the use of water for human consumption and other purposes. Indicators related to agricultural water pollution include changes in nitrate and phosphate pollution attributed to agricultural sources in surface water, groundwater and marine waters. The European Environment Agency (EEA)[48] provides indicators on concentrations of phosphate and nitrate in rivers, total phosphorus in lakes and nitrate in groundwater bodies. Nutrient concentrations in rivers and lakes cannot exclusively be attributed to agricultural sources but are the result of nutrient pollution from urban areas and industry as well. Groundwater nitrate concentrations, in contrast, primarily reflect the relative

[47] According to a presentation by Katalin Kovács from the Hungarian Academy of Sciences www.helsinki.fi/aleksanteri/english/conference/files/kovacs.ppt, accessed September 21, 2017

[48] https://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-freshwater/nutrients-in-freshwater-assessment-published-6 (accessed: September 21, 2017)

proportion and intensity of agricultural activity. According to the EEA-indicators, the nitrate concentration of groundwater in Slovakia increased from 14.5 mg $NO_3$/l in 1992 to 38.6 mg $NO_3$/l in 1996 (+166%) from where it declined to 16.4 mg $NO_3$/l in 2012 (-57.5%).

Under the EU Nitrates Directives, expert studies and analyses on concentrations of nitrate in groundwater were carried out between 2001 and 2003. In 2008, maps of groundwater risk were established and a system of differentiation of NVZs was established with different claims for management restrictions based on the Nitrates Directive (see Figure 17). Groundwater with nitrate content over 25 mg/l was classified as water facing the risk of nitrate contamination. Low concentrations occurred especially in mountain areas. About 15-20% of total groundwater sources in Slovakia show nitrates concentrations exceeding the standard of 50 mg/l (Holubec et al., 2011).

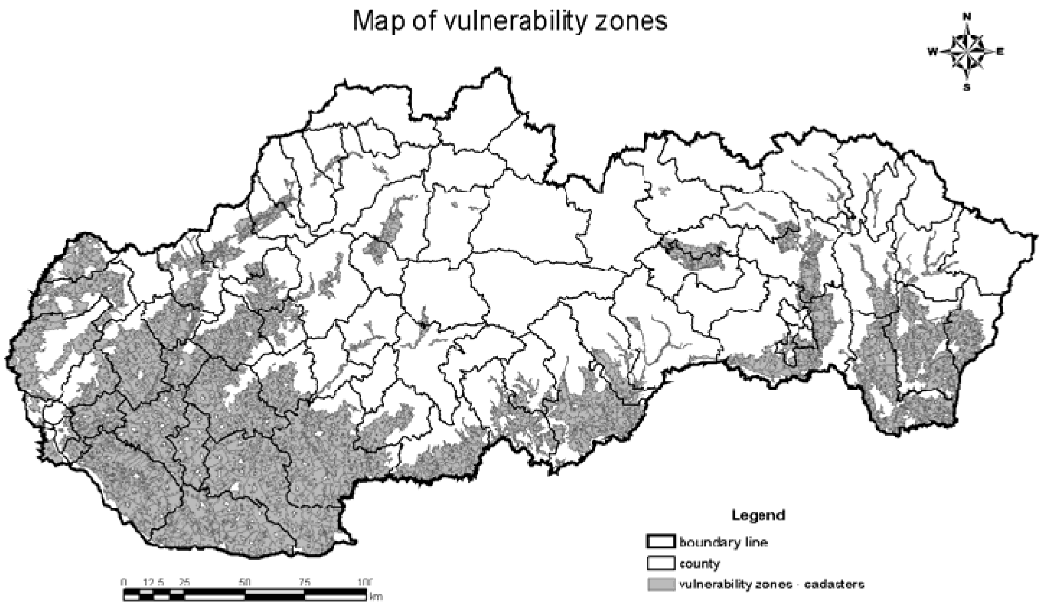


*Figure 17: Map of designated nitrate vulnerable zones*

Source: Holubec et al., 2011

In 2016, NVZs have been revised and Slovakia has designated a growing share of about 30% of its territory as NVZ (EU, 2017). The action programme has differentiated measures per areas depending on farming restrictions that apply. Discussions on the implementation of the Nitrates Directive are on-going between the EU Commission and Slovakia in the context of an infringement procedure launched in 2012. A recent report by the Court of Auditors (ECA, 2015) stated there is a lack of ambition in Slovakia (and other Member States) to address causes of pollution and in using all the possibilities offered by the Nitrates Directive. According to this report, the ecological status of surface water bodies has deteriorated in Slovakia: While in 2009, 63% of water bodies showed a "good & high" quality or potential, in 2015 this quality share reduced to 55%. In contrast, the shares of water bodies showing lower quality or potential increased (for the status "moderate" from 34% in 2009 to 36%  in 2015 and for the status "poor & bad" from 3% in 2009 to 9 % in 2015; ECA, 2015).

The gross nitrogen or phosphorous balance (surplus or deficit) calculates the difference between the nitrogen/phosphorous inputs entering a farming system (i.e. mainly livestock farming manure and fertilizers) and the nitrogen/phosphorous outputs leaving the system (i.e. uptake of nitrogen for crop and pasture production). In both, nitrogen and phosphorous balances, Slovakia made progress in reducing the surplus substantially between 1990 and 2009 turning the phosphorous balance even negative in the period 2007-2009 (see Table 41 41).

*Table 41: Nitrogen and phosphorous balance volume in Slovak Republic, 1990-2009*

| | Average (Thousand tonnes of nitrogen/phosphorous) | | | Average annual % change | |
|---|---|---|---|---|---|
| | 1990-1992 | 1998-2000 | 2007-2009 | 1990-1992 to 1998-2000 | 1998-2000 to 2007-2009 |
| Nitrogen | 177 | 97 | 71 | -7.2 | -3.5 |
| Phosphorous | 33 | 2 | -3 | -31.8 | n.c. |
| | Average (kg nitrogen/phosphorous/ha | | | | |
| Nitrogen | 76 | 41 | 37 | -7.4 | -1.0 |
| Phosphorous | 14 | 0 | -2 | -37.3 | n.c. |

Source: OECD, 2013.

From 2000-2012, an increase in the use of fertilizers per area of land was recorded. The use of nitrogenous fertilizers almost doubled and the use of potassium and phosphorous fertilizers increased by 43% and 71% respectively in 2012 compared to 2000 (Fifth National Report on the Implementation on the Convention of Biodiversity in the Slovak Republic, 2014).

In the period 2012-2014, an increase in nitrogen consumption in fertilizers by 28% was recorded compared to 2008-2011 but compared to 1990, the average nitrogen consumption in fertilizers in the period 2012-2014 was only approximately 50%. Similarly, for phosphorus, a 34% increase in this nutrient consumption in fertilizers in the period 2012-2014 was recorded on average compared to 2008-2011 but the average phosphorus use in fertilizers in 2012-2014 was at about 12% of consumption of this nutrient in 1990 (Cibulka et al., 2016)

A significant decline in livestock (especially cattle and pigs) since 1990 has reduced the production and consequently the application of animal manure. Comparing livestock in the period 2012-2014 with 1990, there was a continuous decline in the stock of all livestock species, especially cattle (-70%) and pigs (-75%). This means a marked and long-lasting decline in the environmental burden since 1990 from livestock production at the expense of the overall productivity of animal production (Cibulka et al., 2016).

Over exploitation of water resources by agriculture may damage ecosystems by reducing water flows below minimum flow levels in rivers, lakes and wetlands which is also detrimental to recreational, fishing and cultural uses of these ecosystems. Agri-environmental indicators related to agricultural freshwater resources show that the share of agriculture in freshwater withdrawals is 3% on average in Slovakia for 2008 to 2010, and hence being much lower than on average in the EU 15 (26%). There is a declining trend in average annual freshwater withdrawal from the agricultural sector of -12.8% from the period 1990/92 to 1998/2000 and of -11.3% from 1998/2000 to 2008/10, thus a sustained declining trend (OECD, 2013). The total irrigated area has significantly decreased from 250,000 ha to 178,000 ha (-6.6% per annum) in the period of 1990/92 to 1996/2000, and a further drop to 25,000 ha in 2008/10 (-17.8% per annum). Much of the decrease in water application rates have been driven over the past decade by improvements in irrigation technologies and management practices related to economic reasons. Although in period 2005 to 2016 farmers had not to pay for the abstraction of irrigation water, their consumption did not rise which indicates a low demand elasticity primarily caused by high energy intensity of existing irrigation systems. It is possible to assume that the irrigation water consumption in the near future should not increase significantly, also due to the gradual increase in efficiency of irrigation systems (they often need reconstruction) as well as in terms of their cost-effective use oriented to cash crops (personnel communication, Water Research Institute, Bratislava).

Organically farmed land tripled from 2000 to 2011 and achieved an acreage of almost 180,261 ha in 2011, representing 9.3% of the agricultural land (Palšová et al., 2014, see Table 42). By the end of 2011, there were 364 organic farms. Since 2004, a significant increase of organic farming is observable, i.e. the area of agricultural land under organic farming increased by almost doubled between 2005 and 2016. This development is due to the implementation of commitments of the government under the Rural Development Plan (2004–2006) and the Rural Development Programme (2007–2013) which aimed to achieve the implementation of organic farming for at least 5% of the total agricultural land. In 2011, the share of organic agriculture in the total agricultural land area was at 9.3%. Therefore it can be concluded that the regulatory stimulation by the State to introduce organic farming was successful in the development of organic farming in Slovakia (Palšová et al., 2014).

*Table 42: Development of organic farming in Slovakia, 2000-2011*

| | Area of agricultural land in organic farming | Share of total agricultural land area | Farms | Average area per farm |
|---|---|---|---|---|
| Year | ha | % | number | ha |
| 2000 | 58,466 | 2.39 | 88 | 664.4 |
| 2001 | 58,706 | 2.40 | 81 | 724.8 |
| 2002 | 49,999 | 2.05 | 76 | 657.9 |
| 2003 | 54,479 | 2.20 | 88 | 619.1 |
| 2004 | 53,091 | 2.18 | 117 | 453.8 |
| 2005 | 93,591 | 4.93 | 205 | 456.5 |
| 2006 | 121,956 | 6.42 | 256 | 476.4 |
| 2007 | 123,918 | 6.52 | 280 | 442.6 |
| 2008 | 136,669 | 7.25 | 349 | 391.6 |
| 2009 | 146,762 | 7.50 | 458 | 320.4 |
| 2010 | 182,403 | 9.40 | 497 | 367.0 |
| 2011 | 180,261 | 9.30 | 364 | 495.2 |
| 2015* | 181,882 | 9.47 | 420 | 433.1 |
| 2016* | 187,024 | . | 431 | 433.9 |

Source: Palsova et al. 2014, *Fully converted and under conversion, Eurostat Organic Farming Statistics.

### *11.1.3 Information Gaps*

A wide range of monitoring systems and data related to the agricultural sector and agri-environmental status are well established and deliver important information on the structural development and the development of critical environmental loads. However, some key information was missing in publicly available sources, at least in English, during this desk review. For instance, geographical references of organic farming was missing but would be helpful in order to determine whether organic farming is situated mainly in NVZ or moreover in the mountainous regions. According to the evaluation of the implementation of the Rural Development Programme (2007-2013), the allocation of organic farming is not primarily related to vulnerable areas but moreover to land productivity (personnel communication Water Research Institute, Bratislava). The conversion to organic farming in NVZ could yet be a strategic approach for designing water protection policy instruments in a more meaningful and region-specific way.

## 11.2 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *11.2.1 Review of region specific targets relevant for DRB*

National environmental goals with respect to eutrophication are not determined. National environmental goals with respect to nitrate leaching and designation of nitrates vulnerable zones (NVZs) are covered by the requirements of the Nitrates Directive (Holubec et al., 2011), i.e. an application limit of animal manure of 170 kg N/ha/year.

There is no EU legislation addressing phosphorus use. National regulatory limits are generally based on the Nitrates or Water Framework Directives, the Industrial Emissions Directive (ICPE for large farms) or the Common Agricultural Policy. Regulations restrict differently fertilizer application rates, use of different types of material (manure, organic fertilizer, biosolids …), manure processing/use and buffer zones of different widths. In most EU member states, application limits vary with crop type, whereas in only a few cases do limits vary with soil P status (Amery – Schoumans, 2014). In the Slovak Republic, information on available soil P is used for correction of P rates in fertilizers (personnel communication Water Research Institute, Bratislava).

### *11.2.2 General agricultural policy*

Slovakia is part of the EU and therefore the Common Agricultural Policy (CAP) is defining the framework for most policy measures in this field. The CAP is an important economic driver for farming decisions across the EU and has the potential to advance the water quality in terms of nutrient pollution reduction. The CAP (2014-2020) has three general objectives – viable food production, sustainable management of natural resources and climate action, and balanced territorial development. The CAP is structured as two pillars (Frelih-Larsen et al., 2016): Pillar 1 mainly provides direct payments (including greening payments) to farmers per hectare of land farmed, and Pillar 2 supports Member States' and regions' Rural Development Programs with a wide range of measures to address environmental, social and economic priorities. Horizontal elements of the CAP applicable to both Pillars include cross-compliance rules and a requirement for Member States to provide a Farm Advisory Service (FAS).

Farmers receiving direct payments under Pillar 1 and area-based payments under Pillar 2 must comply with cross-compliance requirements which incorporate "basic standards concerning the environment, climate change, good agricultural and environmental conditions of land, public-health, plant and animal welfare".

Pillar 1 Greening payments relate to crop diversification, maintenance of permanent grassland and Ecological Focus Areas (EFA). But organic farmers are exempt from all Pillar 1 greening requirements given the recognized environmental benefits of organic farming systems.

### *11.2.3 Agri-environmental regulations and programs*

#### **11.2.3.1 Nitrates Directive and Action Programs**

The main measures aimed at reducing diffuse pollution of waters from agricultural sources are based on the Nitrates Directive 91/676/EEC which has the objective of protecting waters against pollution caused by nitrates from agricultural sources. The Nitrates Directive is an integral part of the Water Framework Directive. The Nitrates Directive requests the identification of water pollution by nitrates from agricultural sources and to determine nitrates vulnerable zones (NVZs). It establishes the implementation of measures reducing leakage of nitrates from agricultural sources into such NVZs, as requested by Action Programs. Action Programs regulate the use and storage of fertilizers and livestock manure, crop rotation and implementation of erosion control measures. In addition to Action Programs, whose measures are mandatory in defined NVZs, binding good agricultural practices must be compiled as preventative measures.

The implementation plan for the EU Nitrates Directive for Slovakia was developed in 2001. It included a timeline for securing relevant actions in the field of planning, legislative measures, monitoring etc. (Holubec et al., 2011). With Regulation No 249/2003 of the Slovak Government (update: October 2004 by Regulation of the Government No. 617/2004), nitrate vulnerable zones (NVZs) were designated. Also the Code of Good Agriculture Practice was developed in 2001. In 2008, maps of different NVZs were established with specific management restrictions based on the Nitrates Directive. One of the main results from the Nitrates Directive was, thus, the implementation of monitoring sites which are the prerequisite for evaluating the impact of agricultural activities on groundwater quality and to assess the effectiveness of adopted measures formulated in the Action Programmes (Holubec et al., 2011). One of the claims in establishing the monitoring sites was that monitoring had to allow identification of contaminators in every land registry classified in a NVZ.

#### 11.2.3.2 Other Programs

The EU ***rural development program*** (***RDP***, Pillar 2 of the CAP) promotes sustainable rural development in a way that contributes to the development of a more territorially and environmentally balanced, climate friendly and resilient, competitive and innovative agricultural sector (Frelih-Larson, 2016). In contrast to Pillar 1 of the CAP, which is wholly financed by the European Agricultural Guarantee Fund (EAGF), the rural development program (RDPs) is partly funded by the European Agricultural Fund for Rural Development (EAFRD) and co-financed by the Member States' national or regional authorities.

One measure of funding within this program deals with agri-environmental and climatic issues (measure 10) or with organic farming (measure 11). The measures consist of sub-measures that further address specific objectives.

The Slovak Rural Development Programme for the programming period 2014-2000 outlines priorities for using 2.1 billion € of public money for the 7-year period from which about 1,545 million € are funded by the EU budget and 534 million € are contributed by the national government.

The ***Operational Programme Quality of Environment*** (2014-2020) is a programming document for dedicating funds from the EU Structural Funds and the Cohesion Fund to the area with respect to sustainable and efficient resource use ensuring environmental protection, active adaptation to climate change and promotion of an energy efficient, low-carbon economy.

The programme includes funding for adaptation measures to climate change. Under the investment priority 2 "Investment in the Water Sector" action is addressed at monitoring and assessments of quality, status and quantity of ground and surface water and at improving the monitoring network including provision and optimization of the information tools in the field of water management (Ministry of Environment, 2014).

### *11.2.4 Gap analysis*

There is a comprehensive portfolio of programs which address environmental issues related to water quality standards, in particular, these are addressed under different EU Directives such as the Nitrates Directive, the EU Water Framework Directive. In addition, the CAP and the Rural Development Programme address greening issues of the agricultural sector. However, an overall evaluation across all the programmes which address water quality issues is missing. In particular, a comprehensive compilation of measures from different programmes, their time horizon and budgetary provision together with their geographical reference could be a helpful tool in order to evaluate the effectiveness and coherence of different measures in terms of improving the water quality.

## 11.3 Overview of instruments to reduce water pollution in each country

### *11.3.1 Measures Observed*

#### 11.3.1.1 Training, education and information

Measure 1 of the RDP deals with knowledge transfer and information action. The aim of the measure is to strengthen the knowledge base and to support knowledge transfer in agriculture, food-processing and forestry. To achieve this, support will be provided to life-long learning and vocational training in the agricultural, food and forestry sectors. The measure is divided into training actions and information actions. In Slovakia, more than 6,500 persons will be trained and 25 operational groups will be linked to the European Innovation Partnershipf for agricultural productivity and sustainability.[49]

Under the Operational Programme Quality of Environment, the specific objective "Ensuring effective implementation of the programm" addresses activities for training of employees involved in the implementation of the Programme. Funds that address key educational activities in the field of management and control systems will be provided. The EU support for this objective (together with the objective "Broad awareness of the Operational Programme") amounts to 77 million € which corresponds to 2.4% of the total EU support for the Operational Programme Quality of Environment (Ministry of Environment, 2014).

[49] European Commission Factsheet on 2014-2020 Rural Development Programme for Slovakia.

#### 11.3.1.2 Regulatory instruments

The Action Program of the Nitrates Directive addresses regulatory instruments such as bans of fertilizer application with respect to soil and climatic conditions and toward certain crops. An Action Program of Slovakia could, however, not be found in the English language on publicly accessible sites but information was supplied by the 'Questionnaire to support the compilation of the knowledge base on agriculture' (ICPDR, 2017). Accordingly, there are regulatory instruments in use to obey the Nitrates Directive, such as standards for minimum storage capacities for animal manure, periods when fertilizer/manure containing nitrogen is prohibited, limitation soil fertilizer application with respect to slope, soil moisture condition, occurrence of water course etc.

The recent programming period (2014-2020) of the Rural Development Program entails the implementation of agro-environmental-climatic activities. Agri-environmental measures (RDP) work in synergy with measures implemented under the Operational Programme Quality of Environment (2014-2020).

#### 11.3.1.3 Fiscal instruments

Fiscal instruments such as environmental taxes are levied in Slovakia, but the biggest share of these revenues is related to energy and transport taxes. However, the share of environmental taxes levied on resource use is also significant: they are represented by charges on groundwater abstraction as well as by prices for surface water abstraction. In Slovakia the abstraction of both surface and groundwater is paid on the basis of the volume abstracted. In addition, there are charges for discharge of waste water paid by the polluters which significantly contribute to the reduction of water pollution.

### *11.3.2 Effectiveness of measures*

The effectiveness of the measures listed above is - to the knowledge of the author - not evaluated in a comprehensive way. In the "Green Report" (Ministry of Agriculture and Rural Development, 2016) a chapter on the Rural Development Programme of Slovakia (2007-2013) presents an overview on the number of the contracts made under this programme and the budget dedicated to specific measures but no detail or reference is given on the effectiveness of the subsidies and direct payments granted.

## 11.4 Evidence from the literature, monitoring reports, evaluation studies

### *11.4.1 Literature review*

A performance audit by the European Court of Auditors (ECA) on the effectiveness of the Water Framework Directive and the co-finance measures by Member States deals with surface water pollution from agriculture, agglomerations and industrial installations (and thus did not focus on agricultural issues alone). The scope of the study was the Danube River in the countries of Czech Republic, Hungary, Romania and Slovakia (ECA, 2015).[50] The ECA criticized that not all areas relevant for the achievement of good water status are designated as Nitrate Vulnerable Zones (NVZ). One of the recommendations to the European Commission was hence to take into account all information on nutrient pollution pressures gathered in River Basin Management Plans. ECA recommendation for the Member States included a more demanding compulsory establishment of actions regarding the existing requirements for farms in areas draining into eutrophic waters. These recommendations were implemented in the revised national action programmes on NVZ (documented inter alia by Slovakia). ECA further recommended that Member States should identify ways of simplifying the implementation of the checks and for ensuring their effectiveness. Although there are indirect requirements to prevent phosphorus pollution, these would be insufficient. Member States therefore were advised to consider the introduction of an obligation to set limitations to the quantity of phosphorus to be applied on land, as it is the case for nitrogen. So finally, an extended area of application and a more rigorous action programme were demanded as well as a more simple and consistent concept of monitoring nutrient pollution from agriculture in the Nitrates Directive and the Water Framework Directive (ECA, 2015).

### *11.4.2 Knowledge gaps*

The complex nexus between financial support mechanisms (i.e. payment schemes) and the effectiveness of measures in terms of physical processes and realization of stipulated thresholds e.g. in nitrate and phosphorous concentration in water bodies, is difficult to assess and further research is needed in this field. In particular in areas that are assessed as being at high risk of diffuse pollution of groundwater by nitrogen substances from agriculture, evaluation should be carried out with respect to measures, instruments and their effectiveness (Bujnovský et al., 2016).

### *11.4.3 Best practice example*

Information on organic farming or sustainable agriculture that could represent best practice examples for a sustainable nutrient management in Slovakia could not be found by desk review in the English language. There are, for instance, two associations that promote organic agriculture (The Association of Organic Agriculture Ekotrend and Biospotrebitel) but both do not run English websites. However, according to a personnel communication, EKOTREND Slovakia has developed “The Action Plan for the Development of Organic Agriculture 2020” that is regularly evaluated. Examples of best practices from the community level are given in the database for best practices about community initiatives for the sustainability in practice in the partner countries' but they do also not provide information in English.

[50] http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=24017&no=3

## 11.5 Future of agriculture in Slovakia

Future agriculture faces multiple challenges. Next to socioeconomic, political and market drivers (prices) climate change will be impacting agricultural production. The area of the agricultural land used for growing crops in Slovakia will possibly be reduced in the long term according to a study by Nejedlík and Šiška (2013). This is due to land-use change, i.e. land related to the urbanization and the relevant infrastructure and buildings. Global warming (doubling of $CO_2$ in the atmosphere) will bring about a partial shift of the productive regions from the south to the north and from lower to higher elevations. The duration of the vegetation period will increase and despite the increase in precipitation due to more evapotranspiration, a higher frequency of drought will be expected which impacts, in particular, on the water balance. In addition, the pattern of precipitation will change and much more precipitation will come in heavy rains during the vegetation period which will increase the run-off and decrease the effectiveness of watering effects. One of the adaptation measures that will improve the resilience of agriculture in the future is to construct irrigation systems and to generally ensure a sufficient amount of irrigation water (Nejedlík - Šiška, 2013). Other adaptation measures that need to be applied in a regional-climatic-specific way are changing the structure of grown crops and the structure of the varieties and a more sustainable managements of soils, i.e. by organic farming practices.

### *11.5.1 Production trends*

The deterioration of soil properties through unsustainable agricultural practices and changing climate conditions could lead to a fall in productivity if adaptation measures to climate change will not be implemented in a rigorous way. Adaptation measures enhance the resilience against climate change impacts. Identifying areas with the highest hazard levels should therefore be a top priority together with adapting the crops variety, the farming practice and dealing with issues of water stress.

Soil fertility loss is another issue that may impact agricultural productivity due to soil damages and irreversible soil loss from erosion, local and diffuse pollution etc. (EEA, 2006).

### *11.5.2 Farm structure development*

Farm structure development is influenced by a multitude of factors in the fields of socio-economic development and in policy-related fields (CAP policy and other policies described above). Regionalized assessments and scenarios analyses are available from the CAPRI (Common Agricultural Policy Regionalized Impact Modelling System) model.[51] Thereafter, the nitrate balance will slightly progress and be reduced from 22.7 kg N/ha in 2015 to 18.3 kg N/ha in 2030. Agricultural income is projected to grow by 58.1% from 2015 to 2030. In

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[51] http://www.capri-model.org/

the same period the output of crops [in €] is forecasted to grow by 24.3%, the output of animals by 6.1%.

### 11.5.3 Consequences for water related indicators

The consequences for water related environmental indicators based on the studies and forecasts cited above will be a slightly reduced pressure of nitrate (and phosphorous) balance only. Given a potentially growing influence of extreme weather events, in particular droughts, there is a marked need for adaptive measures to either increasing soil water availability, or drought resistance of crops, or irrigation technologies according to Best Available Technologies (BAT).

## 11.6 Synthesis for Slovakia

### 11.6.1 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.

### 11.6.2 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.

### *11.6.3 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.

### *11.6.4 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.

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# 12 Country Report: Slovenia

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## 12.1 Economic and agri-environmental indicators

### *12.1.1 State of agriculture*

Slovenia is a small European country with a total area of 20,207 km$^2$ and 2 million inhabitants. In 2016, agriculture, together with hunting, forestry and fisheries contributed 2.3% to total value added and 7.8% to total employment. According to the results of the latest agricultural sample census (2016) there are around 70,000 agricultural holdings in Slovenia. On average they were using 6.9 hectares of utilised agricultural area and were breeding 6.0 livestock units. An average agricultural holding had 2.8 persons in employment; the average annual work input of each of them was 0.4 AWU.

The economic results of agriculture depend mainly on the volume of production and price-cost ratios. According to the provisional data of economic accounts for agriculture (SORS, second estimate), in 2016 results were significantly lower than in the year 2015, but still higher than in the least favourable years 2012 and 2013 in the last five-year period.

The deterioration of economic results in 2016 is primarily the result of a decline in the value of crop production, mainly due to the large drop in fruit and grape crops with relatively unchanged livestock value. Compared to the year before, there are slightly more favourable price-cost ratios at the aggregate level.

Despite the significant fall in 2016 crop production contributed more than half (54%) to the gross value of agricultural production. The utilised agricultural area is decreasing in the long run. According to annual statistics on crop production, around 480 thousand hectares of UAA were used, which slightly more than in 2015 (477 thousand ha). The area of arable land increased by 1.5% (to 174 thousand ha) and the area of permanent plantations by 2.3% (to 28 thousand ha), while the area of permanent grassland decreased by 0.9% (To 276 thousand ha). As in previous years, , more than half of the arable land were intended for the production of cereals (55%), in particular maize for grain and wheat, and almost a third (31%) for the production of green fodder.

Changes in the production volume of livestock production are generally lower than in crop production, although there are some fluctuations observed over the years. The negative trend in livestock production is largely due to the reduction in the volume of pig breeding.

Domestic consumption in 2016 increased noticeably in rye, maize, vegetables (the largest ever) and meat. The increase in meat consumption is the result of increased consumption of all kinds of meat, most notably of pig meat. The consumption of other types of cereals, rice and potatoes remained quite similar to the previous year, while the consumption of fruit, sugar, milk, eggs and honey was lower. Self-sufficiency rates fluctuated due to changes in production volumes and consumption in the recent period. In 2016 were higher than in the previous years in cereals, vegetables, meat, milk, and eggs, and lower in potatoes, fruits and honey.

### *12.1.2 State of agri-environmental indicators*

In recent years, reduction of the negative impacts of agriculture on the environment can be noticed: the use of pesticides and mineral fertilizers is less intensive, the share of legumes in crop rotation and the area of minor agricultural plant species are both increasing. Also, the agricultural area with organic farming is increasing; in 2016 organically farmed land was 43.6 thousand ha (9% of all UAA) with permanent grassland still predominant in the structure (81 %).

### *12.1.3 Information gaps*

In Slovenia different monitoring systems have been established (e.g. surface water and groundwater quality) but potentially polluting sources are not equally well monitored. Agri-environmental policy measures are very important in Slovenia and significant public funds are made available to reduce negative impacts of agriculture (over 200 million € in the period 2014-2020). The Agency of the Republic of Slovenia for Agricultural Markets and Rural Development collects a lot of different data which are necessary to govern such programmes, but administrative data are often not sufficiently suitable for pursuing environmental impacts.

### *12.1.4 Review of region specific targets relevant for DRB*

The surface waters of Slovenia are divided by a watershed into two drainage basins, the Danube drainage basin (DRB) and the Adriatic Sea drainage basin. A total of 155 water bodies of surface waters have been determined. Almost the complete territory of Slovenia is part of the DRB. Only two statistical regions in western part of Slovenia (Goriška in Obalno Kraška region) are part of the Adriatic Sea drainage basin. Those regions represent 17 % of Slovenian territory.

The administrative organization of Slovenia is structured only on the national and the local level. On the NUTS 3 level Slovenia is divided into twelve statistical regions. They function only for statistical purposes and for implementation of direct aids under the national and regional policy.

According to the EU Nitrates Directive for the protection of water from pollution by nitrates from agricultural sources, the entire territory of the Republic of Slovenia is defined as a vulnerable zone.

Water protection areas are one of the most important forms of protection of water bodies for the abstraction of drinking water. This type of designation was implemented in 1981 by the Water Act. Water protection areas were designated by municipalities. The new Water Act, which transposed into Slovenian legislation assumes the requirements of the EU directive on measures in the field of water policy, and transmits power to impose safeguard zones of the country. Water protection areas governed 13 regulations.

Regulations define water protection areas and water protection regimes. Within the water protection area, different levels of protection are determined. The level of protection depends on the natural characteristics and the degree of risk of aquifers or surface waters. The regulations provide for three levels of protection or classification of water protection areas, namely: VVO I (narrowest areas) subject to the strictest security regime (prohibited or limited use of mineral fertilizers, slurry and slurry and plant protection products), VVO II (narrower areas) and VVO III (Wider areas).

Most surfaces in water protection areas are covered by forest, followed by agricultural land, urban land and other surfaces. The structure of land use within water protection areas remained relatively unchanged. Less than half of agricultural land is covered by permanent grassland and pasture. Fields account for 36% of the surface of water protection areas, which are significantly decreasing in area, mainly on account of grassland and pastures.

In addition to the water protection areas defined by government regulations, there are still many water protection areas defined by municipal ordinances adopted by municipal assemblies until 2002 in accordance with the then-applicable water law and, in accordance with the transitional provisions of the current law.

### *12.1.5 General agricultural policy*

Slovenia is a part of the EU and therefore the Common Agricultural Policy (CAP) is defining the framework for most policy measures in this field. The Rural Development Programme (RDP) for Slovenia was formally adopted by the European Commission on 13 February 2015, outlining Slovenia's priorities for using the 1.1 billion € of public contribution that is available for the 7-year period 2014-2020 (of which 838 million € from the EU budget).

The RDP for Slovenia focuses mainly on three priorities. Under the first - restoring, preserving and enhancing ecosystems related to agriculture and forestry – 29% of farmland will be placed under funded contracts to improve biodiversity, with land also under contracts for improving water and soil management.

Under the second – competitiveness of agri-sector and sustainable forestry – 3.4% of farms will receive support for economic and environmental investments (including in greater resource efficiency).

Under the third – social inclusion and local development in rural areas – 66% of the population will be covered by local development strategies and nearly 600 jobs will be created.

### *12.1.6 Agri-Environmental programmes*

The agricultural policy in Slovenia started to support environmentally friendly farming in 1999, and to a greater extent after the adoption of the Slovenian Agri-Environmental Program in 2001. The measures were divided into three basic groups:

- Decreasing of negative impacts of agriculture on environment (9 measures)
- Preservation of nature, biodiversity, soil fertility and traditional cultural landscape (8 measures)
- Maintenance of protected areas (5 measures)

In the first year (2001), ten measures were tested experimentally, and in the following years their number has increased to 22. After the accession to the EU in 2004, they became part of the Rural Development Programme of the Republic of Slovenia (2004-2006, 2007-2013 and 2014-2020). Measures under the new programming period 2014-2020 started in 2015. New agri-environmental-climate payments are pursuing similar objectives in the same way as in the previous programming periods, and they are implemented within 19 operations, containing a total of more than 50 compulsory and optional requirements. The organic farming scheme is implemented as an independent measure. Due to differences in the types and number of measures, the land area included in agri-environment measures in 2015 is not directly comparable with previous years.

The area included in the implementation of agri-environmental measures increased strongly after 1999 and in 2014 covered 254,772 ha (gross). The proportion of the area with one or several agri-environmental measures (net area) to the total utilised agricultural area has increased from 0.6 % in 1999 to 39.2 % in 2014. In 2015, new agri-environmental programme started on the gross area of 317,458 ha,

The impact of Rural Development Programme 2007-2013 on reduced nitrogen pollution in water can be assessed based on those RDP measures which set stricter requirements on implementation than those imposed by statutory regulations on limiting values: these include all area eligible for agri-environmental payments where sub-measures "Humpy meadows mowing", "Extensive grassland maintenance", "Preservation of extensive karstic grassland", "Preservation of special grassland habitats", "Preservation of grassland habitats of butterflies", "Preservation of litter meadows" and "Bird conservation in humid extensive meadows in Natura 2000 sites" were being implemented.

In the new programming period 2014-2020, agri-environment-climate payments promoting sustainable agricultural practices which in addition to preserving biodiversity and landscape, focusing on proper water and soil management. They are more focused on mitigating and adapting farming to climate changes. The measure is carried out through 19 pre-defined operations. Operations include compulsory and optional requirements. Beneficiaries can choose between all operations, but they must select all mandatory requirements within a single operation, but they can also choose one or more optional requirements.

### *12.1.7 Gap analysis*

For the evaluation of water quality, the Water Framework Directive in Article 8 requests the introduction of surface and groundwater monitoring programmes. Monitoring and water quality status evaluation is one of the key tasks of the Environmental Agency of the Republic of Slovenia. The monitoring of water quality in Slovenia has a long tradition. In 2007, it was carried out according to the requirements of the Water Framework Directive for the first time. Slovenian Environment Agency in 2016 prepared Assessment of the ecological status of watercourses for the period 2009 – 2015. The ecological status of surface waters is determined on the basis of biological, general physico-chemical and hydromorphological elements and specific pollutants. Monitoring of the status and classification of surface water bodies in Slovenia is carried out in accordance with the Water Directive (Directive 2000/60 / EC), the Regulation on the Status of Surface Waters (Official Gazette of the Republic of Slovenia, No. 14/09, 98/10, 96/13, 24/16) and the Ordinance on Surface Water Monitoring. Methodologies for evaluating the ecological status of watercourses are available on the website of the Ministry of the Environment and Spatial Planning:

http://www.mop.gov.si/en/delovna_podrocja/voda/ekolosko_stanje_povrsinskih_voda/.

Slovenia has been divided into 21 water bodies of groundwater. The monitoring program was comprised of 194 monitoring sites, distributed on 14 water bodies. The most intensive agricultural production is in the north-eastern and central part of Slovenia (the river valleys Drava, Mura, Savinja, Sava), where prevails alluvial aquifers. This is reflected in the content of the nitrate in the groundwater, which is at several monitoring points above 50 mg NO3 / l. The most polluted waterbodies with nitrates are in Savinjska valley, Drava valley in Murska kotlina, but from 2007 the average annual values wasn't exceeded. On water bodies Mura basin and Savinja basin average annual levels of nitrate in the period from 1998 to 2015 show a statistically significant downward trend in nitrate levels. On the other water bodies declining nitrate levels are not statistically significant. The results of the monitoring of groundwater bodies shows that measures for reduced intake of nitrogen in soil have positive effects at several water bodies.

*Table 43: The average value of nitrate levels in Europe and in Slovenia and Slovenian groundwater bodies with predominantly intergranular (alluvial) and karst/fractured aquifers.*

| | | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Slovenija - alluvial aquifers | mg/l | 40.6 | 40.3 | 38.6 | 31.8 | 32.8 | 32.9 | 31.9 | 31.2 | 30.2 | 32.3 | 32.2 | 31.1 |
| Slovenia - karst-fractured aquifers | mg/l | 7.5 | 7.4 | 7.4 | 7.3 | 6.8 | 6.6 | 5.5 | 6.6 | 5.4 | 5.3 | 5.3 | 5.8 |
| Slovenia - average | mg/l | 15.4 | 15.2 | 14.8 | 13.1 | 13 | 12.8 | 11.8 | 12.5 | 11.3 | 11.7 | 11.7 | 11.8 |
| Europe - average | mg/l | 19.3 | 19.9 | 20.4 | 20.4 | 19.7 | 19.2 | 19.3 | 19.3 | 19.1 | | | |

Source: Standardised Database for Water Quality Monitoring, Environmental Agency of the Republic of Slovenia, 2015; EEA Waterbase_groundwater, 2016.

## 12.2 Overview of instruments to reduce water pollution in each country

### *12.2.1 Measures Observed*

An abundance of water resources and a system of water rights and payments underpin Slovenia's low water use intensity and low level of water abstraction. Discharge of nurtrients, chemical substances and other pollutants have been reduced due to expansion of the sewerage network and increasing wastewater treatment capacity, better agricultural practices and measures to reduce discharges from the industry (OECD, 2012).

In 1993 the Ministry of Environment and Spatial Planning commissioned a national water management programme where the current state, including water protection, was well analyzed. They proposed measures for the protection of individual catchment areas,

According to the Environment Protection Act, the Environmental Agency of the Republic of Slovenia is responsible for the water quality monitoring and evaluation of water quality status in Slovenia. Monitoring programmes are drawn up in accordance with regulations that summarize the provisions of European directives, and in accordance with the status assessment and pressure analysis of each individual water body. They include quality monitoring of rivers, lakes, sea, groundwater, and water in protected areas.

A number of technical measures have been selected to address the pressures from agriculture. Reduction of nitrogen pollution includes various measures connected to implementation of the relevant national legislation. Basic measures for reduction of pesticide pollution include more stringent controls on the use of plant protection products. Additional measures include site and problem specific guidelines, education of farmers, and the development of alternatives to the current farming practice. Basic measures linked to fishing and fish farming include provisions for fishing and fish farming practice, additional measures require adaptation of fishing and fish farming practice by restrictions in feeding. Measures for improving water use management through introduction of adaptation of farming to climate change (droughts) with the selection of different crops and use of more efficient irrigation systems are also included as well as measures linked to restrictions of use of surface water for irrigation and restrictions of use of water in the areas with large irrigation systems.

Financial compensation is provided for losses of income due to reduction of pollution in drinking water safeguard zones and other protected areas (biodiversity, eutrophication etc.).

#### 12.2.1.1 Training, education and information

The linkage between agriculture and the environment is part of the standard curriculum at agricultural high schools and universities. The beneficiaries included in nature protection schemes and schemes for the protection of water sources under the Agri-Environment-Climate payments in programming period 2014-2020 will have to attend trainings on this subject, and they will also be eligible to target-oriented advisory services for their farms. The implementation of measure Cooperation will be focused on areas that are crucial for nature conservation and water source protection through thematic tenders for pilot projects.

In accordance with the current legislation in the Republic of Slovenia, additional training dealing with Plant Protection Products began to develop already in 1994. With the adoption of the new EU legislation in 2009 was followed by the new legislation. In accordance with the new rules of this legislation, additional training is provided for persons directly related to the traffic and use of the Plant Protection Products (PPP). Training is mandatory for PPP users for professional use, PPP sellers and PPP advisors in accordance with the law.

#### 12.2.1.2 Regulatory instruments

Slovenia has adopted Action plan for the implementation of measures concerning the protection of waters against pollution caused by nitrates from agricultural sources. The basic objective of the Action plan derives from the requirements of Directive 91/676 / EEC, namely reducing pollution and preventing further pollution of nitrates from agricultural production. Therefore, the Directive defines:

- the limit values of nitrogen input from agricultural sources to soil or soil, and
- measures to reduce and prevent water pollution caused by nitrates from agricultural sources

The measures are:

- periods in which the application of certain fertilizers into the soil or on the ground is prohibited;
- the rules of fertilization on steep terrain;
- groundwater fertilization rules that are saturated with water, flooded soils, frozen soils
- the rules of fertilization near watercourses;
- adequate storage capacities for livestock manure, which must exceed the needs □
- measures to prevent pollution of water from discharges from the storage of farm manure;
- fertilization procedures, including the dosage and homogeneity of mineral spraying and livestock fertilizers that will maintain nitrogen losses in water at an acceptable level;
- Restrictions on the application of fertilizers into the soil, where the characteristics of the vulnerable area must be taken into account.

Another important document is Rules on proper use of plant protection products for preventing the contamination of groundwater and drinking water. The preparation of spraying mixture, PPP application and cleansing of the PPP spraying equipment in close vicinity of the surface water or on the areas with big risk for the run-off of PPPs into surface water or rainwater canalization or in close vicinity of the facilities for drinking water supply is not allowed.

#### 12.2.1.3 Fiscal instruments

In Slovenia water abstraction, gravel abstraction and use of waterside land are only possible when water rights are paid. Water rights can be paid by water permit or by concession.

Slovenia encourages the reduction of waste water pollution and the reduction of water use also through financial measures. One of the most important measures is the collection of environmental charges for environmental pollution due to the discharge of waste water.

The method of charging and paying environmental taxes is laid down in the Decree on the environmental tax for pollution of the environment for the discharge of waste water. The amount of the environmental tax payment shall be determined by the decision fixing the unit price for the water load. This tax applies to non-agricultural point and sources.

In Slovenia there are no special environmental taxes on effluents, emissions or potentially harmful inputs of agriculture.

#### 12.2.1.4 Other measures

Among other measures is important Encouraging efficient and sustainable use of water

### *12.2.2 Scale at which the instruments are implemented*

According to the data from 2016 water protection areas comprise almost one fifth, or about 340.000 hectares of the area of Slovenia, of which more than 7,000 hectares fall under the strictest protection regime.

Water protection areas are protected by municipal legislation and government decrees. They have been designated with a view to protecting water bodies which are used, or intended to be used, for the public supply of drinking water against contamination or other types of pollution that might affect the wholesomeness of water or its quantity.

### *12.2.3 Effectiveness of measures*

In the programming period 2007-2013 and 2014-2020 the Ministry of Agriculture, Forestry and Food regularly published reports which shows the progress of the Rural Development Programme according to the defined goals, the financial implementation of the program, a summary of the ongoing evaluation activities and description of other activities related to the implementation of the program. For the whole programming period (2014-2020) 203.6 million € are devoted for agri-environment-climate payments. Within the subsidy campaign for 2015, 5,523 agricultural holdings were paid out in the amount of 24.3 million € for 277,906 ha of gross area. Within the subsidy campaign for 2016, 6,770 agricultural holdings have submitted 26,798 applications for 340,873 ha of gross area or 95,739 ha of net area. It is estimated that 31.5 million € will be paid will be paid for Agri-Environment climate payments.

Compared to the year 2015, the number of agricultural holdings has increased by 30% and the area for 23%. Almost half (43%) of agricultural holdings carried out the operation Arable farming and vegetable cultivation, followed by operation of Water sources (29%) and Preserving of plant genetic resources (20%). The applied area increased in all operations with the exception of Hummocky meadows. The areas under wine-growing (+119%) and fruit growing (+114%) increased the most.

*Table 44: Comparison of implementation of Agri-Environmental Climate Payments; 2015 and 2016*

| Operation | 2015 (Paid) Number of holdings | 2015 (Paid) Area* (ha) | 2016 (Applications) Number of holdings | 2016 (Applications) Area* (ha) |
|---|---|---|---|---|
| | 2,707 | 58,896 | 2,900 | 62,928 |
| Hop growing | 34 | 527 | 37 | 619 |
| Water sources | 1,868 | 34,694 | 1,967 | 36,593 |
| Fruit growing | 218 | 937 | 469 | 2,001 |
| Wine-growing | 472 | 2,948 | 1,117 | 6,451 |
| Special grassland habitats | 532 | 3,226 | 651 | 3,742 |
| Grassland habitats of butterflies | 186 | 468 | 257 | 593 |
| Habitats of birds of humid extensive meadows | 177 | 1,063 | 210 | 1,246 |
| Litter meadows | 8 | 14 | 8 | 15 |
| Conservation of steep meadow habitats | 266 | 350 | 286 | 385 |
| Hummocky meadows | 6 | 12 | 5 | 9 |
| Livestock rearing in the area of occurrence of large carnivores | 38 | 1,061 | 77 | 1,923 |
| Mountain pasture | 113 | 5,300 | 130 | 5,844 |
| High-trunk meadow orchards | 591 | 617 | 694 | 743 |
| Breeding of local breeds in danger of being lost to farming | 613 | 0 | 772 | 0 |
| Preserving plant genetic resources under threat of genetic erosion | 995 | 9,467 | 1,358 | 13,821 |
| Permanent grassland I | 209 | 1,472 | 227 | 1,585 |
| Permanent grassland II | 757 | 5,571 | 841 | 6,136 |

Sorce: MAFF.

The measure Organic farming is implemented through two sub-measures, which include payments for conversion to practices and methods of organic farming and payments for the maintenance of these practices and methods. In the 2014-2020 programming period, 65.3 million € is earmarked for this measure. Until the end of the year 2016 was paid over 17 million €. Within the subsidy campaign for 2015 2.558 agricultural holdings, which cultivate 32.116 hectares of UAA received 5.4 million €, while for the conversion to organic farming, 1,341 agricultural holdings, which cultivate 7,225 ha of UAA received 2.2 million €.

Within the subsidy campaign for 2016 3,289 applicants filed claims for 41,933 ha of land. Compared to the year 2015, the number of holdings increased by 4%, while the volume of areas included increased by almost 7%. In 2017, about 9.4 million € will be paid for this measure.

The implementation of the agri environmental measures in the previous programming period 2007-2013 shows that the effectiveness of measures is Implementation of the RDP (2007-2013) has only to a lesser extent contributed to the reduction of nitrogen pollution, while they were carried out to a very small extent.

## 12.3 Evidence from the literature, monitoring reports, evaluation studies

### *12.3.1 Literature review*

There are only few studies that provide evidence on the effectiveness of measure to reduce water pollution from agriculture in Slovenia. Under the mid-term evaluation report was written that the impact of Rural Development Programme 2007-2013 on reduced nitrogen pollution in water can be drawn based on those RDP measures which set stricter requirements on implementation than those imposed by statutory regulations on limiting values: these include all area eligible for agri-environmental payments (measure 214) where sub-measures "Humpy meadows mowing", "Extensive grassland maintenance", "Preservation of extensive karstic grassland", "Preservation of special grassland habitats", "Preservation of grassland habitats of butterflies", "Preservation of litter meadows" and "Bird conservation in humid extensive meadows in Natura 2000 sites" were being implemented. Their total size amounted to 11,383 ha or 1.72% of all agricultural land in Slovenia in 2009. In all other agricultural land included under remaining RDP measures (all but those listed above), implementation of RDP had no additional positive effect on water quality. Thus, implementation of RDP did contribute to a lower use of nitrogen, but the impact of implementation was small at the national level due to the small area of land included under RDP measures or sub-measures with stricter requirements than those set forth by statutory regulations on limiting values. Areas of water bodies recognised as polluted by national environmental monitoring coincide with areas of intensive agriculture, where sub-measures of agri-environmental payments that reduce nitrogen pollution, were implemented at a very small extent. The areas where these sub-measures listed above were implemented have lowered the application of nitrogen, but their total area is so small that RDP did not contribute to reducing nitrogen levels on heavily polluted areas.

The national gross balance surplus of nitrogen per hectare of utilised agricultural area in 2015 was 44 kg. With the nitrogen air emissions subtracted, the net surplus of nitrogen was 10 kg per hectare (9 kg per hectare in 2014). In 2015 the nitrogen input (75,293 tons) was 97% of the average of the past 20 years. The nitrogen output (54,138 tons) was 114% of the average of the past 20 years; hence the gross balance surplus of nitrogen (21,155 tons) was just 70% of the average of the past 20 years. The nitrogen air emissions (16,193 tons) were 93% of the average of the past 20 years and the net balance surplus of nitrogen (4,962 tons) was just 38% of the average of the past 20 years (SORS).

As part of the ongoing evaluation of the RDP 2007-2013 in 2014 results of impact assessment of the CAP's first pillar (direct payments and coupled subsidies) and RDP investment measures on effectiveness of the implementation of agri-environment payments in the period 2007–2013 were presented (Bartolj et al, 2015). It is evident from the estimated country-level effects of the payments that direct payments, coupled subsidies and investment payments have a statistically insignificant or a rather small impact on effectiveness of the implementation of agri-environment payments on the area of environmental protection (protection of soil and water), agricultural landscape and biodiversity preservation. The only exceptions are coupled subsidies, as 1 percent increase in these payments raised the nitrate levels in groundwater for 0.167 percent. Furthermore, we did not find a relation between the amount of payments for the investment measure 122 and natural/environmental factors. However, the evaluators discovered that the investment in irrigation system in Gorišnica municipality (investment measure 125) improved the values of pesticides and nitrates in groundwater one year after the investment.

Slovenian Environment Agency regularly publishes Environmental indicators in Slovenia which provide data that are collected and presented in an agreed form, bring forward pressures on the environment, pollution level, impacts of the polluted environment (on human health and ecosystems), policy responses (as economic instruments of environmental protection), and driving forces that generate environmental pressure through socio–economic activities. Knowledge of this five–level assessment framework, which is based on indicators, is a key to successful environmental management (KOS, 2014).

Leaching of excess nitrogen (N) from agricultural in to water bodies is a serious environmental problem which is addressed in the Nitrate Directive (91/767/EEC) and in the Water Framework Directive (2000/60/EC). A study which used Soil and Water Assessment Tool (SWAT) model shows the effect of fertilisation norms for crops on nitrogen leaching from the soil and crop yield. Whether the technology of production, especially in the fertilizer norms are adopted is a matter of agreement between stakeholders. Society has to decide how it will regulate the relationship between ecosystem services of water supply and food supply (Glavan et al., 2015)

### *12.3.2 Information gaps*

In an ongoing evaluation study, the suggestion was made to use a comparison data between the beneficiaries and non-beneficiaries of Agri-Environment Climate Payments (AECP) as a basis for the impact assessment of AECP. The main obstacle in the evaluation process of AECP's impacts is the requirement that the area covered by the obligation may vary only up to 10 percent compared to the year of entry into the program. Since the assessment of impacts requires also information from environmental databases, the authors (Bartolj et al, 2015) propose the inclusion of Shannon index of agricultural landscape, birds and indicator of soil quality for the estimation of impacts on biodiversity and soil fertility.

### *12.3.3 Knowledge gaps*

According to our literature review we conclude that the physical links between the interaction of agriculture and water quality on the national level are well understood. The evaluation of Rural Development Programme shows that there is lack of useful data on the farm level (how implementation of agri-environmental measures influence on the quality of ground and surface water).

### *12.3.4 Best practice example*

A "best practice example" for Slovenia is the project entitled »Riparian Ecosystem Restoration of the Lower Drava River in Slovenia« with acronym »LIVEDRAVA« started on 01.09.2012 and will last till 31.12.2017.

Main project activities are:

*Nature conservation*

In the area of the river Drava, will implement measures to improve the habitats of nesting and migrating waterfowl (breeding island, river branches, river banks).

Restoration of previous wastewaters basins into a semi-natural wetland of outstanding importance for breeding birds conservation and for migrating birds as a stopover site.

Project aim is also to preserve populations of other endangered and internationally protected plant and animal species.

*Education*

Declaration of the area of restored basins as a state nature reserve and establishment of education center for visitors.

Arrangement of adventure trails in the new state nature reserve that are adapted for all generations of visitors and especially for people with disabilities

Promotion of voluntary work and

promotion and development best practice case of nature-friendly tourism.

*Scientific research*

Establishment of the research station for monitoring of migrating birds in Ormož Basins Nature Reserve.

Major project actions under the project are:

*Restoration of previous wastewaters basins into a semi-natural wetland and establishment of state nature reserve.*

*Achieving declaration of the area of restored basins as a state nature reserve.*

*Achieving declaration of nature park between Ormož and Središče ob Dravi.*

*Installation of notice and interpretation boards.*

*Creation of project web site.*

*Publication of brochure about*

*environmental importance of the area.*

*Construction of breeding island for Common Terns (Sterna hirundo) at Lake Ptuj.*

*Publication of the guidebook of the Ormož Basins Nature Reserve.*

*Restoration of step river banks as breeding habitat for Kingfisher (Alcedo atthis.*

*Restoration of the river branches*.

Filming of a short documentary entitled Drava River – Nature's Gift for Every Generation was prepared, presenting the story of Drava River from the times of our ancestors to present days, when its image is quite different. The documentary shows the effort of numerous organizations and individuals for conservation and nature friendly management of Drava river-bed, taking into account both the perspective of flood safety and nature conservation and setting new trends in development along the river. The video with English subtitles is available on http://livedrava.ptice.si/.

## 12.4 Future of agriculture in Slovenia

### *12.4.1 Production trends in Slovenia*

There is a lack of scientific studies about the production trends in Slovenia. Based on the projections from the model AGMEMOD for the period 2015 to 2025 we may conclude that:

- Livestock production will remain the most important activity of Slovenian agriculture because of large share of LFA areas, the great share of absolute grassland and a relatively small share of arable land and permanent crops.
- Production of pig meat will increase. The main reason is the declining trend of production stopped due to the introduction of measures in pig sector (Animal welfare)
- According to the model results the production of beef meat will slightly decrease, mostly because of the increase of pig and poultry meat due to the change in the consumption patterns.
- The production of cereals is likely (wheat and corn maize) to increase due to reduction in production of oilseeds and protein crops.
- Current forecasts about future climate conditions indicate that in Alpine regions where grassland is the dominant agricultural land use, plant growth will benefit mainly because of longer growing seasons.
- Milk production will remain on the same level as in the year 2015.
- Due to environmental legislation intensification of livestock production will be limited.

### *12.4.2 Farm structure development in Slovenia*

There are no forecasts on a future development of farm structure in Slovenia. The forecasts are based on trend extrapolations. Therefore the level of uncertainty about the results is relatively high.

Based on the data from agricultural censuses in 2000 and 2016 the rates of structural change were –1.1 % per year for agricultural holdings and –1.5 % per year for farm labour force. In recent years, the share of employment in agriculture has fluctuated slightly more than the number of agricultural holdings. Based on such observations the trend projections for farm structure are:

- The number of agricultural holdings in the year 2025 is likely to decline to around 61,000 (from 70,000 in 2016). There is significant uncertainty about these forecasts because agriculture in Slovenia has a much wider role than just production of food.

Apart from its production function, agriculture encompasses other functions such as the preservation of the rural landscape, the protection of the environment and contribution to the viability of rural areas. There are over 6,000 settlements and only 55 of them are considered as urban. Relatively unfavourable natural conditions result in dispersed settlement and large number of small settlements, since only 16 has more than 10,000 inhabitants.

- The decline of Utilised Agricultural area Agricultural land will be much smaller. If the trends will continue holdings in Slovenia will cultivate around 475.000 hectares of which arable land will be around 180.000 hectares (in 2016: 480,000 ha UAA and 176,500 ha of arable land).
- The number of persons employed in agriculture is likely to decline by 25% until 2025 compared to the level observed in 2016. The expected number of AWU in agriculture is 60,000 in 2025 (compared to 80,000 in 2016).

### *12.4.3 Consequences for water related indicators*

- Balanced consumption of mineral fertilizers, gradual increase of the scope of ecological production, and prevention of pressure on soil both from the point and the non-point sources, fertilizer plants in a way to make the best use of nutrients without being wasted into the groundwater and the atmosphere will reduce and prevent further pollution of waters with nitrates from the agricultural production.
- Promotion and implementation of applied and developmental research linked to pest control is extremely important to reduce the risk of pesticide use. Establishment of experimental demonstration centres, in frame of which research and various experiments would be conducted, would contribute through the transfer of research results into practice to development and optimization of plant protection strategies.
- The level of intensification in agriculture is moderate, focusing mostly on improving labour intensity in agricultural production. The number of livestock units (LU) per ha of utilised agricultural area as the most aggregate indicator of production intensity is stable. Due to economic pressures (market-price relationships) agricultural holdings are forced to reduced costs and increase productivity and farming intensity. The intensity of agricultural production in Slovenia in the period 2000-2013 was moderately increasing. The increase is the result of the continued reduction in the number of agricultural holdings and concentration of agricultural production.
- Climate change and extreme weather events could have negative impacts on water systems. The frequency of agricultural drought is expected to increase during warm periods.

## 12.5 Synthesis for Slovenia

### *12.5.1 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.

### *12.5.2 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.

### *12.5.3 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.

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# 13 Country Report: Ukraine

Victor Platon

## 13.1 Introduction

Three sub-basins of the Danube are partly located in Ukraine – the Tisza, Prut and Siret Basins, as well as part of the Danube Delta. Nearly 3 million people[52] live in the Ukrainian share of the Danube River Basin which is more than 3% of the total population in the Danube basin.

Like the Tisza Basin, the Prut and Siret Basins are located mainly in the Ukrainian Carpathians, but in the eastern hills. The source of the Prut is in the Chernogora Mountains at around 1,600 meters above sea-level. The total area of the sub-basins is 30,520 km², which makes up only 3.8% of the total Danube Basin area and 5.4% of the Ukrainian territory.

*Prut river basin*

The largest part of the Danube river basin in Ukraine lies in the Carpathian Mountains. The Danube itself flows through the lower part of Ukraine and is divided into three branches, one of which – the Kiliya – forms the border between Ukraine and Romania. The region enjoys mild winters and summers. Annual precipitation in the mountains is around 1,750 mm and 700 mm in the lowlands.

Natural highlights include: The Danube Biosphere Nature Reserve of the National Academy of Sciences of Ukraine, is located at the Kiliya branch of the Danube in the Delta. With a total area of approximately 46,000 ha, protected areas include islands with attached areas of water and wetlands. More than 5,000 animal species live in the reserve, including pink pelicans, geese, dolphins, seal-monks, true otters and minks.

*Human Uses*

The largest part of the Tisza and Prut sub-basins is covered by forests; the rest of the land is used for agriculture, human settlements and infrastructure. There are several hydropower stations in the Tisza Basin, with a total capacity of 31,600 kW. The Tisza River Basin in Ukraine is rich in groundwater bodies, both alluvial and karstic waters. More than 60% of the centralized drinking water supply comes from groundwater sources.

While the rivers of the Tisza and Prut Basins cannot be used for navigation, Ukraine is united with Europe by the Danube River. However, only a quarter of the shipping capacity on the Ukrainian part of the Danube is used. Currently, Ukraine is working to make the existing natural branches of the Danube River suitable for navigation. These activities, however, are under debate in Ukraine and Romania.

The Tisza and Prut are mountain rivers in Ukraine, and floods are therefore common. The biggest floods on the Tisza occurred in November 1998 and March 2001, when the highest

[52] Source: Danube Facts and Figures Ukraine (September 2015), https://www.icpdr.org/main/danube-basin/Ukraine.

water levels were recorded. Much has been done since then to improve flood protection, including installing automatic gauging stations.

River control in the Prut basin in Ukraine exerts no significant pressure on water resources in the Prut River, as the volume of constructed ponds and reservoirs is much smaller than the river flow.

Ukraine Pressures from agriculture on water bodies in the Prut basin in Ukraine include: water abstraction, wastewater disposal, increased erosion, inflow of mineral and organic fertilizers, and inflow of untreated wastewater from cattle and poultry farms. As Prut River is large and deep, results from pollution monitoring show no significant impact of these pressures on the river as whole, and they are considered to be mostly local sources of pollution.

The total volume of introduced fertilizers can be estimated from district statistics[53]. In 2011 in Chernovtsy Region the volume of introduced mineral fertilizers was about 2.15 tons, on average 88 kg/ha of crops. On the whole, the level of fertilization of the Prut River catchment area may be considered equal to this average. Smaller volume of fertilizers was introduced in the mountain areas (30–40 kg/ha), and much larger volume in the planes – e.g. 128 kg/ha in Khotyn District. Data regarding the use of organic fertilizers is limited; it suggests use of 0.5 tons/ha of crops.

The Prut River basin in the territory of Ukraine is unique in nature and climate, and rich in mineral, water, forest and recreational resources. Economic development in the basin started in the 1950s. As in the basins of other rivers in Ukraine, the impact of human economic activity became apparent in the second half of the 20th c. In the years following independence, long-accumulated environmental problems have exacerbated. New problems have emerged as well, which cannot be dealt with using the capabilities (especially financial capabilities) of a single region. Even so, the Prut River basin remains a fairly clean and beautiful region of Ukraine. It is a choice destination for recreation for people of Ukraine and other countries. However, local sources of pollution, large-scale non-compliance with environmental legislation, and exposure to natural disasters pose a serious threat to local populations and economy. The potential environmental risk and associated damage are high.

Key environmental problems and risks in the Prut river basin. 1) The basin territory, especially in the mountains, is exposed to floods. These may become more frequent and devastating due to global climate change. 2) Deforested areas have considerably increased. Deforestation heightens the probability floods, facilitates monotipization of the environmental system, intensifies processes of soil erosion and degeneration, and starts exogenous geological processes, including earth flows, mudflows, etc. 3) In areas of intensive economic activity, water bodies receive pollution through point and diffuse sources. The main point source of

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53 RIVER BASIN MANAGEMENT PLAN FOR PRUT PILOT BASIN IN THE TERRITORIES OF UKRAINE AND MOLDOVA., COMPONENT A – RIVER BASIN ANALYSIS., Prepared by Institute of Ecology and Geography, Academy of Science of Moldova (Moldova) Ukrainian Center of Environmental and Water Projects, Academy of Sciences (Ukraine)., March 2013.

pollution is discharge of untreated or insufficiently treated industrial and utility wastewater. Diffuse sources of pollution include unauthorized landfills, agricultural lands, increased number of private hotels without connection to sewerage facilities and treatment plants, etc. 4) Stream channel alluvium extraction (sand and gravel) and construction of small HPPs on mountain rivers disrupt the natural hydrological, hydromorphological and hydrobiological regimes of rivers.

The quality of surface waters in the Prut refers to class II – "clean," or in most cases, class III – "moderately polluted." Key water and environmental problems in the Prut basin are:

1. Devastating rainfall floods, which form in the Ukrainian Carpathians, result in flooding of considerable part of floodplains. Long-term data analyses show doubling of the expected frequency of floods in the basin in the last 40 years.

2. Intensive development of slopes leads to activisation of a range of geodynamic processes, most significantly landslide and rockfall (talus) processes.

3. Results from hydrobiological monitoring show that the quality of waters in the Prut remains at the same level from year to year, without major changes.

4. The most polluted part of Prut River is the section downstream of the Jijia River (Romania) inflow near Valea Mare (Ungheni District). Pressures from hydraulic engineering structures and infrastructure, drainage and intensive use of floodplain lands in agriculture have resulted in disruption of the hydrological regime and the living environment of many valuable species of animals and plants.

## 13.2 Economic and agri-enviornmental indicators

### *13.2.1 Prut basin (Agriculture and irrigation)*[54]

The agrarian sector has always played crucial role in the Prut River basin in Ukraine – both for food security and for socio-economic development. The share of agriculture in the area's gross value-added output (13% of Ukraine's total) is about 20%. Over half of Bukovina's population live in villages and are involved in farming. Growth in agriculture is steady and dynamic – both in terms of gross output and for select crops. Efficient cooperation of authorities and investors has allowed integration of landowners in large agricultural enterprises and much higher efficiency of land use.

Chernovtsy Region is a leader among western regions in Ukraine by indices for incremental rate of gross output and yield of cereals. In recent years, cultivated areas have been gradually re-oriented toward more profitable and marketable crops, such as wheat and corn

[54] Source: RIVER BASIN MANAGEMENT PLAN FOR PRUT PILOT BASIN IN THE TERRITORIES OF UKRAINE AND MOLDOVA., COMPONENT A – RIVER BASIN ANALYSIS., Prepared by Institute of Ecology and Geography, Academy of Science of Moldova (Moldova), Ukrainian Center of Environmental and Water Projects, Academy of Sciences (Ukraine) March 2013.

(cereals) and rapeseed and soy (industrial crops). Gardening is another priority in the development of the agro-industrial complex in Chernovtsy Region.

Food industry enterprises are predominant in Bukovina. Regional production of food and beverages meets almost the entire regional demand.

In the Prut basin, agriculture is most widespread in the watershed section downstream of the river's exit from the mountains. Fertile soils, optimal watering conditions and warm climate benefit the development of agriculture. The warm climate stems from the area's location on the southern slopes of the Khotin upland. Most favourable for agriculture are conditions in Chernovtsy Region, particularly on the left bank of the Prut – Kitsman, Novoselitsa and Kelmentsy districts.

Of special interest is the strip of villages east of Chernovtsy toward the towns of Khotin and Kelmentsy: Mahala, Toporovtsy, etc. Garden farming has been well developed here, and local produce is exported to Ukraine's northern regions and Russia.

In part, farming activities utilise ameliorated lands. The Prut drainage system is the largest amelioration system in Chernovtsy Region. It is located near the Prut, on its left bank.

In animal farming, the key enterprises are in poultry farming and pig-rearing. The quantity of animals has decreased several times between 1990 and end-2011.

Animal farming has received priority investment. Modern technologies for production and processing of animal products have been introduced in enterprises, e.g. Kolos Corporation, Ukrainian Food Group Ltd, Tarasovetsky Broiler Building Ltd, Bukovina's meat state enterprise, etc.

New animal-breeding facilities completed in 2010 include: turkey-rearing complex for 25 000 turkeys, Malinovka village, Novoselitsa District; pig-breeding complex for 5 000 pigs, Zarozhany village, Khotin District; pig-breeding complex, Dovzhok village, Novoselitsa District.

Reconstruction of animal-breeding facilities is nearly complete for: turkey-rearing complex for 25 000 turkeys, Malinovka village, Novoselitsa District; poultry-breeding complexes in Kadubovtsy village, Zastavna District, Vashkovtsy village, Vizhnitsa District, and Panka village, Storozhintsy District; five turkey-rearing facilities at Drachinetske–1 Ltd, Kitsman District.

Construction has started for two facilities for keeping 2000 cows and a milking hall, Boyany and Vanchikovtsy villages, Novoselitsa District – with combined investment of 20 million €.

### *13.2.2 Tisa River Basin (TRB) in Ukraine*[55]

Tisa basin in Ukraine has an area of 12,732 km² which represents 8.1% of total Tisa river basin. Number of inhabitants in the Tisza River Basin (Ua) is 1,248,000 inhabitants with a GDP of 70.381 million € (approximately 857 €/head in Zakarpattia Oblast). The climate of the area is

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[55] Integrated Tisza River Basin Management Plan, ICPDR / International Commission for the Protection of the Danube River, 2011.

Continental with high precipitation in the mountains which are covered 50% in forests. There are registered frequent floods and soil erosion.

In the Ukrainian side of the Tisa basin there are 30 localities, out of which 17 with a population (pe) between 2000-10,000 inhabitants and 13 localities with more than 10,000 inhabitants.

The Upper Tysa catchment area covers only 2 per cent of the Ukrainian territory and lies in the Zakarpatska Oblast, with 1.3 million inhabitants. Most of the Ukrainian basin area is located in the Eastern Carpathian Mountains, with the highest elevation peak of 2,061 m and average elevation of 550 m.

In the Ukrainian Tisa River Basin area, agriculture has a limited importance owing to unsuitable natural conditions, producing only small amounts of grain, meat and milk for domestic needs. Traditional agriculture (based on seasonal pasturing of mountain meadows) is well preserved in the Carpathians, although the cattle and sheep stock decreased significantly during the past decade.

Main economic sectors operating in the TRB are: timber processing, food production, some mining. Small-scale mining also occurs in the Ukrainian TRB section, with the extraction of salt, kaolin, mercury, gold, complex ores, zeolites and rocks used as construction material. However, the environmental risks involved in these activities continue to raise concerns throughout the region as many mining sites are significant sources of pollution and the development of additional mines is envisaged.

## 13.3 Current agricultural policy measures, programmes and ongoing reforms relevant for nutrient discharge in the regions

### *13.3.1 Measures observed / implemented / under review / discussed*

In Ukraine, measures to support farmers are limited and low. According to the data provided by OECD, in Ukraine, agricultural support has registered sums many times lower than in the EU (28 countries).

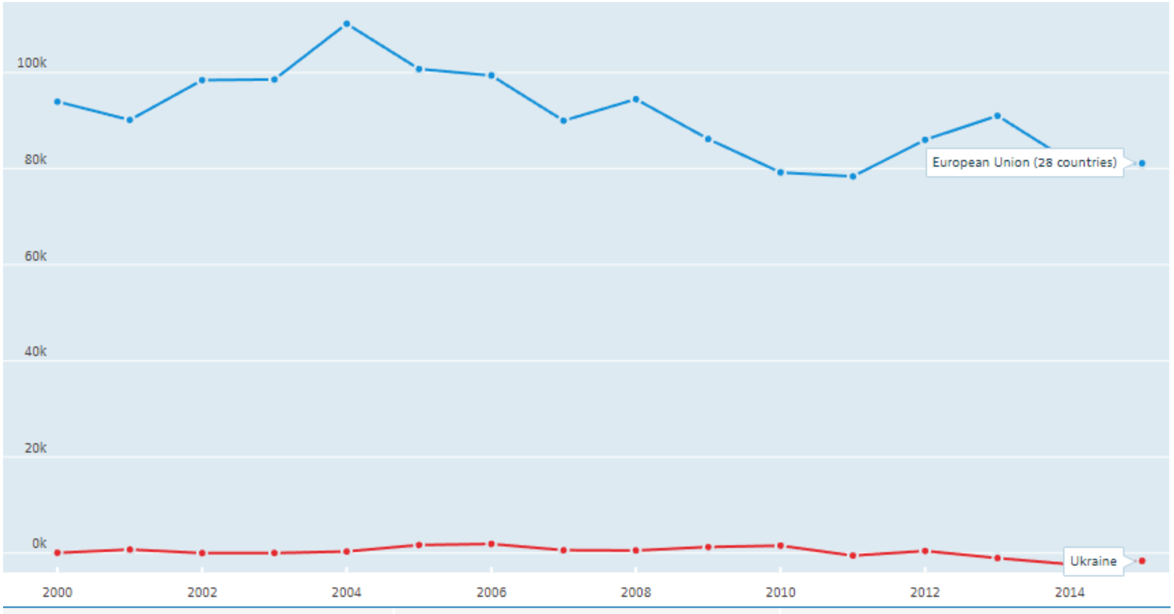


*Figure 18: Agricultural support in Ukraine and EU*

Source: https://data.oecd.org/agrpolicy/agricultural-support.htm

## 13.4 Overview of economic/regulatory/informational instruments to reduce water pollution

### *13.4.1 Legal instruments to reduce water pollution in Ukraine*

The normative acts that perform legislative functions in water protection, in Ukraine are:

- The Water Code of Ukraine (The Water Framework Directive (WFD) has been partially transposed into Ukrainian legislation. The rules regulating water resources are codified in the Water Code of Ukraine, 6 June 1995. Ukraine is also a party to bilateral and multilateral treaties on the management, rational use and protection of transboundary waters and is an active member of various international organizations in the sphere of water protection and management.)
- Regulation on Protection of Surface, Marine and Ground Waters;
- Normative Requirements to content and properties of water in water bodies used as sources of industrial and drinking water as well as water for cultural and domestic and fishery purposes;
- Standards for maximum permissible concentrations of pollutants for the above water bodies;
- Regulation for development and approval of the standards for maximum permissible discharge of pollutants and list of pollutants, discharge of which is subject to standard;
- Regulation for the State water monitoring;

Anyhow, according to the 2014 EU-Ukraine Association Agreement, Ukraine is slowly transposing the environment acquis.

### *13.4.2 Economic instruments for water extraction and consumption*

In accordance with the Water Code of Ukraine, in 2004, there were two forms of water use[56]:

- General use of water is realized by individuals for the satisfaction of their needs (bathing, sailing, amateur and sport fishing, watering domestic animals, and water abstraction from water reservoirs without the use of special facilities or devices and from wells). The general use of water is free of charge and no permits are required.
- Special use of water in Ukraine means water abstraction from water reservoirs with the use of special facilities and/or devices and discharge of return water into water reservoirs. Special water use is realized by legal and physical persons, first of all, for the satisfaction of the population's needs in drinking water, as well as for public services, medical treatment, health resort maintenance, agriculture, industry, transports, energy production, fishery, and other government and private purposes. A charge is levied on special uses of water which require a water abstraction permit.

Ukraine has implemented economic instruments that require economic entities to pay for the abstraction and/or extraction of surface or ground water. Therefore, the water abstraction tax includes the tax on water use (charge for a special use of fresh water resources) and the tax for ground water ("the charge on geological exploration works for search and extraction of underground water"). Thus, "charge on geological exploration works for search and extraction of ground water" is simultaneously a form of water extraction/abstraction tax (Table 46).

### *13.4.3 Evidence from the literature, monitoring reports, evaluation studies*

The Report "DEVELOPMENT OF DRAFT RIVER BASIN MANAGEMENT PLAN FOR SELECTED PILOT BASIN IN UKRAINE - THE PRUT BASIN" [57] was realized in order to estimate and identify the pressures and impact on the Ukrainian Prut river basin.

The main conclusions of the report show that the basin territory, especially in the mountains, is exposed to floods. These may become more frequent and devastating due to global climate change.

Deforested areas have considerably increased. Deforestation heightens the probability floods, facilitates monotipization of the environmental system, intensifies processes of soil erosion and degeneration, and starts exogenous geological processes, including earth flows, mudflows, etc.

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[56] Economic Instruments for the Protection of the Black Sea Final Report Stefan Speck and Ece Özdemiroglu 7 May 2004, EFTEC.

[57] Prepared by UNENGO "MAMA-86" May 2014.

In areas of intensive economic activity, water bodies receive pollution through point and diffuse sources. The main point source of pollution is discharge of untreated or insufficiently treated industrial and utility wastewater. Diffuse sources of pollution include unauthorized landfills, agricultural lands, increased number of private hotels without connection to sewerage facilities and treatment plants, etc.

Stream channel alluvium extraction (sand and gravel) and construction of small Hydro Power Plants on Mountain Rivers disrupt the natural hydrological, hydromorphological and hydrobiological regimes of rivers.

From the analysis resulted that it's necessary to conduct a complete inventory of point and diffuse sources of pollution in the basin. These studies could hold regional bodies of the relevant ministries, regional administrations and research institutions. Hydromorphological and hydrobiological studies to meet the requirements of the WFD may be assigned to the system of the Hydrometeorological Service of Ukraine, research institutes and universities.

### *13.4.4 Good practice example*

NOT FOUND in the field of fertilizers.

## 13.5 The future of agriculture in DRB

### *13.5.1 Trends in agriculture in Ukraine*

There are few publications to give some details for future trends[58] regarding agriculture in Ukraine. Based on the papers and articles and some hypothesis developed by UNDP and IMF some info were extracted.

In Ukraine, the term 'drought management' has never been applied to the country's part of the Upper Tisza River Basin due to the fact that in Transcarpathia the annual surface water resources potential per capita is three times as much (3,130 m³) as the same index for the whole country (1,000 m³). 'Water scarcity' or 'water deficit' are the only terms relevant there. There have been dry years (1961, 1963) which didn't result in water shortage.

Climate change, including changes in temperature, precipitation and snow cover, is intensifying the hydrological cycle. At the same time, other factors such as land-use changes, water management practices and extensive water withdrawals have considerably changed the natural flow of water, making it difficult to detect climate change induced trends in hydrological variables. However, it is already clear that extreme events such as floods and droughts are likely to occur more frequently and with greater intensity. The impacts on low water flow may be particularly problematic, and naturally a healthy aquatic ecosystem is more resilient to climate change impacts.

[58] Unleashing Ukrainian Agricultural Potential to Improve Global Food Security, The Blayzer Foundation, 08/2016.

In Danube River Basin that is part of Ukraine, classical agriculture has no place. The landscape is hilly and mountainous. There are significant areas covered by forests. In this area, human activities are related to small farming with vegetables, animal husbandry, forestry, small industries etc. In these areas, more problematic will be floods and less drought or the lack of water.

### *13.5.2 Consequences for water related indicators*

In the area of rivers Tisa, Prut and Siret will not be a problem of water shortage but that of floods.

## 13.6 Country specific synthesis

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.

## 13.7 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.

## Annexes

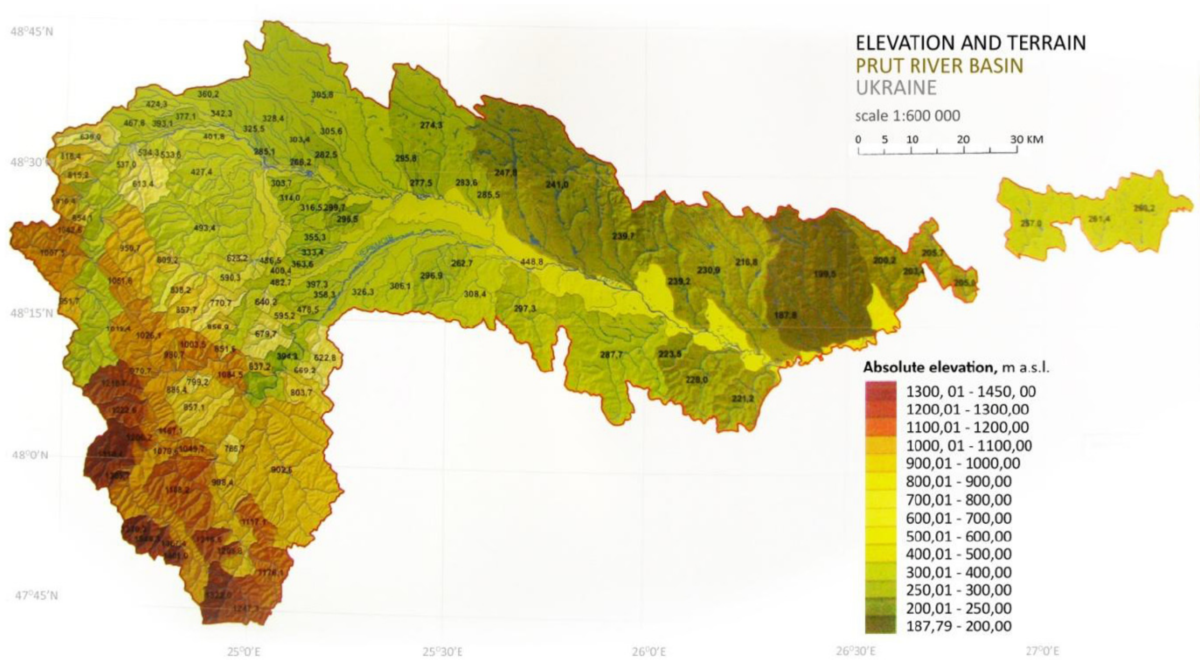


*Figure 19: Prut River basin in Ukraine*

Source: RIVER BASIN MANAGEMENT PLAN FOR PRUT PILOT BASIN IN THE TERRITORIES OF UKRAINE AND MOLDOVA., COMPONENT A – RIVER BASIN ANALYSIS., Prepared by Institute of Ecology and Geography, Academy of Science of Moldova (Moldova)., Ukrainian Center of Environmental and Water Projects, Academy of Sciences (Ukraine)., March 2013.

*Table 45: Summary List of LEGISLATIVE ACTS of water related legislation of UKRAINE*

- The Water Code of Ukraine (6/6/95)
- Regulation on Protection of Surface Water (typical provisions) (1/3/91)
- Regulation on Protection of Surface Waters from Pollution by Wastewater (draft, 3/4/97)
- Regulation on Protection of Internal Sea Waters and Territorial Sea from Pollution and Littering (29/2/96)
- Regulation on Protection of Groundwater (draft, 5/12/96)
- Hygienic Requirements to Content and Properties of Waters at Sites of Industrial and Drinking, Cultural and Domestic Water Use (14 parameters) (4/7/88)
- The Maximum Permissible Concentrations of Hazardous Substances in Water of Water Bodies, Used for Industrial, Drinking, Cultural and Domestic Water Use (1345 substances) (4/7/88)
- General Requirements to Content and Properties of Waters in Water Courses and Water Bodies at Sites of Fishery Water Use (11 parameters) (1/3/91)
- List of Maximum Permissible Concentrations (MPC) and Approximately Safe Impact Levels (ASIL) of Hazardous Substances on Water of Fishery Water Bodies (relating to Regulation on Protection of Surface Waters. 1991, 1072 MPC and 48 ASIL) (31/12/92)
- Procedure for Development and Approval of Maximum Permissible Discharges of Pollutants (11/9/96)
- List of Pollutants, Discharge of Which Is Subject to Regulation (3 lists, total of 297 substances) (11/9/96)
- Regulation on the State Water Monitoring (20/7/96)
- Environmental Assessment of Water Quality in Surface Waters and Estuaries of Ukraine. Guidelines (28/12/94)
- Biological Testing and Determination of Acute Lethal Toxicity Levels of Wastewater Discharged into Water Bodies. Guidelines (30/5/95)
- Instruction on Procedure for Development and Approval of Maximum Permissible Discharges (MPD) of Substances into Water Bodies with Wastewater (22/12/94)
- Procedure for Levying Charges for Special Use of Water Resources and Normative Tariffs for the Special Water Uses (8/2/94, 8/2/97)
- GOST (State standard) 2874-82 Drinking Water. Hygienic Requirements and Quality Control

Source: WATER MANAGEMENT IN WESTERN UKRAINE., Petro Hrytsyszyn, Oleg Zynyjuk., The Western Center of the Ukrainian Branch of the World Laboratory, Lviv State Agrarian Universyty., Lviv, Ukraine.

*Table 46: Rates of the water effluent tax in Ukraine*

| [redacted] Rates of the water effluent tax in Ukraine | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Nitrates ($NO_3$) | | Phosphorous | | BOD | | Suspended solids |
| | (in UAH per tones) | (in US$ per tones) | (in UAH per kg) | (in US$ per kg) | (in UAH per tones) | (in US$ per tones) | (in UAH per tones) |
| 1995 | 3 | ... | 28 | ... | 14 | ... | 1 |
| 1998 | 3 | 1.2 | 28 | 11.4 | 14 | 5.7 | 1 |
| 2001 | 3 | 0.6 | 28 | 5.2 | 14 | 2.6 | 1 |
| 2002 | 3 | 0.6 | 28 | 5.2 | 14 | 2.6 | 1 |
| 2003 | 52.5 | 9.9 | 42 | 7.9 | 21 | 4 | 1.5 |

Source: Economic Instruments for the Protection of the Black Sea Final Report Stefan Speck and Ece Özdemiroglu 7 May 2004, EFTEC.

41

41