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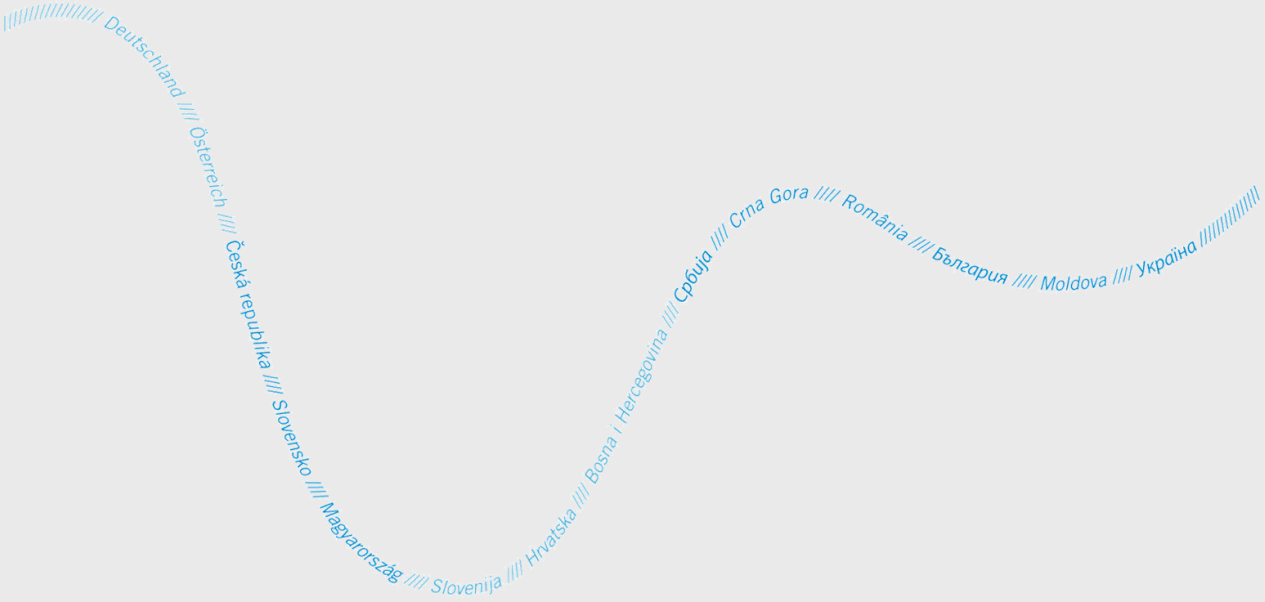
International Commission for the Protection of the Danube River

Internationale Kommission zum Schutz der Donau

Guidance Document on Sustainable Agriculture in the Danube River Basin



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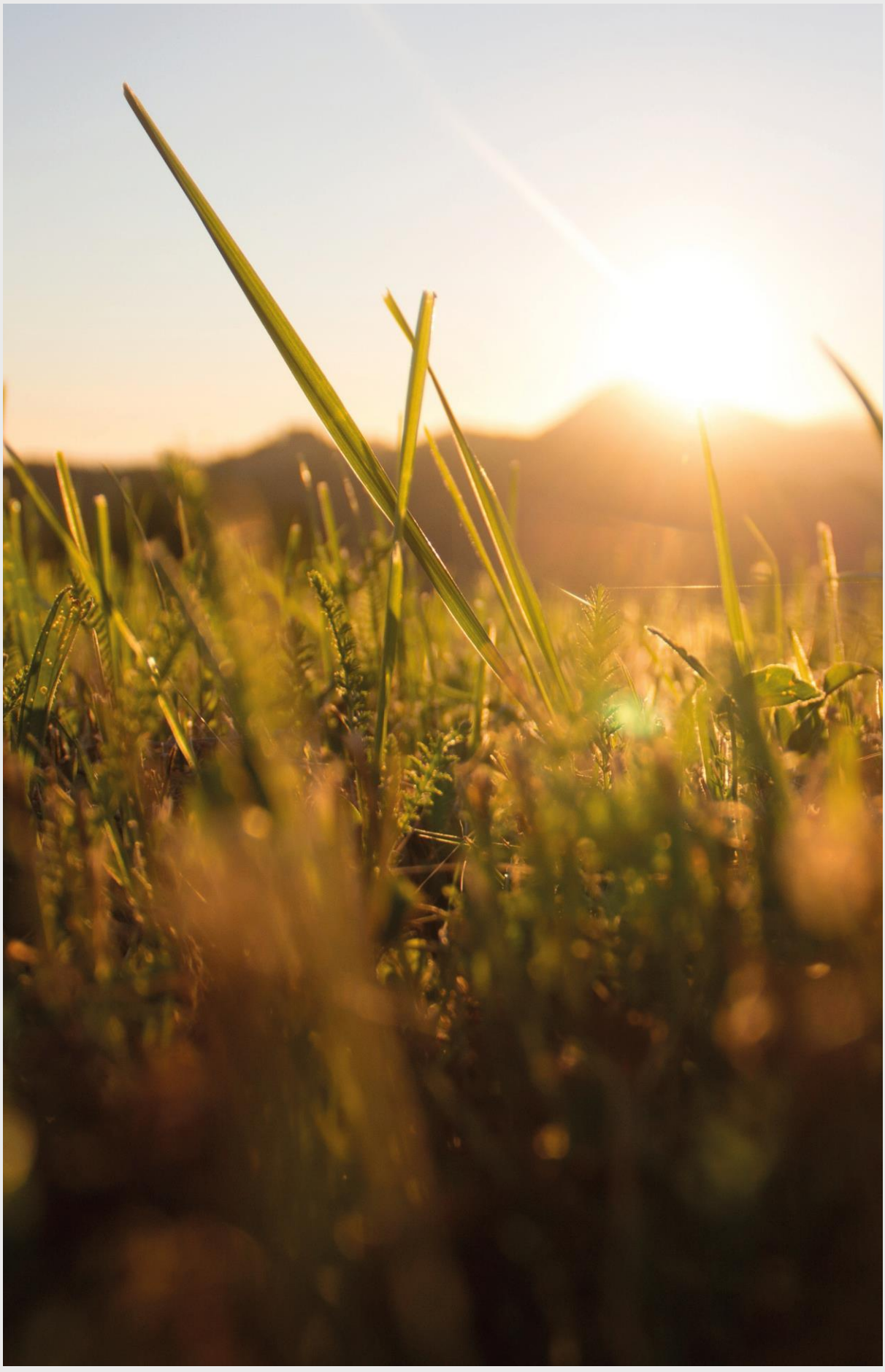

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Executive summary

This guidance document was developed through a series of studies and projects targeted to the Danube River Basin and taking into account the **specific situations in the Danube countries**. Both, water and agriculture were addressed including policy making, measure implementation and socio-economy. The guidance shall contribute to achieve **sustainable agriculture and rural development** in the Danube countries by considering the economic, environmental and social aspects together and by advocating appropriate policies, strategies, instruments and measures. The guidance was elaborated based on an **open dialogue between the water management and agricultural sectors**, which brought together a number of relevant organizations, experts and stakeholders providing them with the opportunity to express their opinion. Danube countries are encouraged to make use of the guidance for designing and implementing their national agri-environmental policies and river basin management **in good synergy**, as appropriate.

Agriculture is an important component of the economy in many Danube countries since the geographical and climatic conditions in large parts of the Danube River Basin (DRB) are favourable for agriculture. More than 50% of the basin territory are under agricultural cultivation. Agronomic conditions are especially favourable for maize (corn), soybeans, sunflowers and other thermophilic crops besides the ordinary cereals. In the Western regions agriculture plays a key role as local supplier of commodities that are further transformed into food (mainly milk and meat products, fruits and vegetables). In the Eastern regions agriculture is one of the most important employers in rural regions. Although agriculture is substantially subsidized by the European Union (EU) and the national governments, the sector is facing socio-economic challenges. Despite the high share of land being cultivated, agriculture is not among the strongest economic sectors in the DRB. The share of the agricultural sector in the total national Gross Domestic Product of the EU Member States (MSs) is not significant (less than 5%), whilst non-EU MSs have a share around and above 10%. In many regions the intensity of agricultural production is low due to the less favourable economic situation. In areas where land productivity is low, farmers are often facing difficulties, as agriculture in these regions may not be competitive at all. In many Danube countries, there is a significant number of small farms working on a few hectares, which are highly depending on EU or national subsidies and often subsistence farms and have limited capacity to comply with strict and ambitious cultivation and environmental provisions. These regions are often threatened by land abandonment, poverty and social exclusion. Only a few countries have integrated and powerful advisory systems, which are key instruments to reach and support farmers. In addition, agricultural production highly depends on circumstances that that cannot or can only be partly controlled such as weather conditions, plant diseases and market instabilities, which may make agriculture economically vulnerable.

Water-related environmental concerns are also related to agriculture. Agriculture needs large amounts of clean water to satisfy the increasing demand for high quality food. However, intensive agriculture may cause quality and quantity problems of surface- and groundwater by pollution, over-abstraction and inappropriate land management endangering the status of the water bodies but also the sustainability of its own water resources. Nutrients have been released from agricultural areas of the DRB in significant amounts during the past decades. Nutrient pollution has been identified as one of the significant water management issues in the DRB. Currently, about 20% of the surface water bodies are at risk of failing good ecological status/potential by 2021 due to nutrient pollution, for which agriculture is one of the main sources alongside other sources such as urban areas or municipal wastewater. The ultimate recipient water body of the Danube is the Black Sea, which is, being the world's most isolated sea, sensitive to eutrophication. Nutrient loads transported by the Danube to the Black Sea peaked in the late 1980’s triggering a serious eutrophication problem in the north-western shelf.

Nevertheless, river loads entering the Black Sea have been significantly dropped in the last decades. Measures have been implemented in agriculture throughout the DRB. As of 2018, on more than 60% of the areas of the DRB strict rules on manure and fertilizer application are being implemented. Out of the agricultural areas of the DRB, 70% are determined for direct financial support and 20% receive additional subsidies for implementing environmentally friendly measures (only in EU countries of the DRB). In the last decade, more than 70 billion EUR were spent to support farmers and to finance effective environmental measures and methods (best management practices). Direct payments amounted to ca 55 billion EUR and support of agri-environmental measures reached ca 15 billion EUR. Thanks to these measures implemented in agriculture, but also as consequence of low agricultural intensity in several Danube countries, the nutrient surpluses (gross balance) of the agricultural fields are rather low or even negative in many countries indicating lack of nutrient inputs which is compensated by the soil stocks accumulated over the previous years. However, the severe eutrophic conditions of the late 1980's might arise again if wastewater treatment and agriculture are not managed sustainably in the catchment area. Moreover, nutrient emissions frequently represent unutilised losses of soil nutrient resources, which have to be supplied by external inputs in order to sustain the required production rates.

With regard to water quantity, water scarcity and drought situations are emerging issues in the DRB and will likely become more intense, longer and more frequent in the future. Serious drought periods hit the Danube region in 2003, 2007, 2011, 2012, 2015 and in the period of 2017-2020, affecting different water-dependent economic sectors, vegetation and the water resources. The estimated economic losses caused by the drought in 2017 in the Danube countries are more than 1 billion EUR.

To address these multi-dimensional challenges, agriculture and water management should be well aligned by coordinated strategies and joint actions to ensure the protection of water resources, the economic livelihood of the farmers and the production of high quality food. However, at the regional scale of the DRB, a proper dialogue between the water and agricultural sector and coordinated policy tools have not been fully established yet. To tackle this shortcoming, Danube countries agreed in 2016 to start, in close cooperation with the agricultural sector, a broad discussion process aiming at developing a sound guidance document on sustainable agriculture. The initiative is driven by the recognition that improving the socio-economic situation in the agricultural sector is a prerequisite for a successful implementation of agro-environmental policies. Water and agricultural policies should be designed and harmonised in a way that income losses for the farmers are minimised or compensated when implementing measures to protect water bodies. Policies should seek win-win solutions wherever possible. However, finding the way towards these objectives needs to change the paradigm: policies should be shifted from the traditional, purely command-control type regulative enforcement to more balanced approaches, taking into account the perspective of farmers' economic benefits. This new direction should be based on open dialogue, mutual trust and common understanding that is expected to result in willingness to make certain compromises by both sectors. With the paradigm change the initiated dialogue can have an ambitious objective: to develop a policy guidance in order to support decoupling future agricultural development from increasing nutrient pollution of surface and ground waters and from prolonged water scarcity. In this way, it may contribute to achieving sustainable agriculture by balancing the economic, ecologic and social aspects of agriculture and rural development. The initiative is fully in line with the objectives of the European Green Deal, the current political momentum of aligning water and agricultural policies at the EU level and the stronger ambitions of the proposed Common Agricultural Policy (CAP) post 2020 regarding environmental protection and climate change adaptation.

To achieve its ambitious goal the guidance paper recommends sound policy instruments, financial programs and cost-effective agricultural measures to protect water bodies for decision makers in the agro-environmental policy field. It offers Danube countries support for the preparation and implementation of their tailor-made national agro-environmental policies, CAP Strategic Plans and relevant strategies of the River Basin Management Plans in good synergy. The recommendations provide the Danube countries with a framework to adjust their national agro-environmental policies. They on one hand give specific advice on how to implement more efficiently existing legislation (e.g.

Nitrates Directive, cross-compliance/conditionality of the CAP) and on the other hand help countries to better identify, target and finance additional measures going beyond legal obligations. Thus, the guidance should act as a strategic policy framework providing consistent approaches into which the Danube states are encouraged to integrate their individual national methods. It lays down the basis for designing cost-effective, targeted national measures according to national needs and conditions taking into account that no "one size fits all" standardisation could work in the DRB.

The primary focus of the guidance is sustainable nutrient management related to agriculture and rural land management. Nevertheless, Danube countries have recently declared that climate change effects, including water scarcity and drought is to be considered as a significant water management issue in the DRB. Bearing in mind the strong linkage of the drought issue to agricultural water management, the scope of the guidance document has been extended to the drought issue besides the nutrients. Moreover, pesticide pollution related to agriculture is also an emerging issue to be tackled. Further editions will broaden the scope towards pesticides and other harmful substances.

In the policy context, huge opportunities can be identified in the post-2020 CAP proposal that could potentially trigger significant steps towards sustainable agriculture in the DRB and to contribute to decoupling agricultural production from nutrient pollution and water scarcity in a cost-effective way. In order to address the environmental and sustainability challenges of agricultural production in the DRB with higher ambitions and to effectively contribute to the objectives of the Green Deal, Danube countries are particularly encouraged to:

1) Design flexibly the obligatory measures under the CAP enhanced conditionality.
2) Examine closely the potential of the new, flexible and potentially very effective voluntary 'eco-schemes', in particular for supporting agro-eonomy, agro-forestry, organic farming, precision farming and carbon farming practices.
3) Commit to the development of DRB-specific approaches for voluntary agri-environment-climate interventions with particular focus on development and implementation of collective / cooperative approaches and result-based payment schemes for more sustainable soil and water management.
4) Make a significant investment in strengthening Farm Advisory Systems and building an Agricultural Knowledge and Innovation Systems for sustainable agriculture in the DRB and pay much greater attention to capacity building of all actors (farmers, advisers, researchers, small and medium-sized enterprises etc.).
5) Strongly and actively recommend and promote applying nutrient management planning in the farming practices to assist farmers in an efficient use of fertilizers at field level adjusted to crop nutrient demand and soil nutrient content via information, knowledge exchange and advisory activities funded in the new CAP Strategic Plans.
6) Develop and maintain advanced regional drought monitoring and forecasting systems with special emphasis on early detection, along with drought risk and impact assessment tools.
7) Elaborate drought management plans and set up operational management models focusing on preventive and early responses in order to enhance resilience and preparedness.
8) Put emphasis on soil management practices and support farmers to properly implement erosion control, soil conservation and natural water retention measures.
9) Make use of the funding instruments to compensate certain difficulties and constraints (e.g. natural disadvantages, constraints related to WFD implementation and NATURA 2000 sites).
10) Promote community-led local developments under the LEADER programme and the concept of Smart Villages as an emerging and potentially well-suited opportunity for rural communities in the DRB making the best use of technology and social innovation.

In addition, Danube countries are advised to consider the following recommendations for policy making:

- It is crucial to establish a proper partnership-dialogue between the agricultural and water sector to develop a cross-sectoral and mutual understanding of needs, expectations and constraints of the two areas.

- Active and early involvement of environmental authorities in the preparation of CAP Strategic Plans as well as taking environmental knowledge and planning tools into closer consideration should be achieved to support the design of relevant and effective agro-environmental policies at national level. There is a huge need for finding synergies between the CAP interventions and the measures identified in the RBMPs in order to contribute to the achievement of the environmental objectives of the WFD.
- Countries should define national standards for obligatory measures with flexibility to tailor the implementation of these standards to specific local or regional needs and characteristics.
- Measures controlling nutrient pollution should be targeted on emission hot-spots, those areas where there is a significant risk of local resource loss (e.g. via soil erosion or leaching) or water pollution (due to high transfer rate of nutrients or vulnerability of water bodies) and the requirements should be adjusted to the risks accordingly.
- Specific attention should be paid to the farming structure in the countries, certain environmental standards and targets should be achieved everywhere, whereas the standards might be differing for different farm structures.
- Countries are encouraged to take into account favourable and disadvantaged areas, crop rotation, environmental impacts, water body vulnerability and potential administrative burden when designing and implementing measures.
- Voluntary measures should be attractive, practicable and financially acceptable for farmers, particularly those that would lead to additional costs or result in income losses for the farmers when adopting and implementing them.
- Advisory services should support digital transition in agriculture including modern technologies, accompanied by smart devices and digitised supporting tools.
- Countries are encouraged to acknowledge drought as a national priority. Policy coherence, coordinated legal approaches and harmonized implementation related to drought on the national/regional level are essential for successful drought management, supported with sufficient resources.
- It is necessary to introduce available practical tools into daily work routine (i.e. using national data sets, operational use of tools in institutions, etc.) and to share knowledge on good practices to better support and guide drought management activities.

The guidance outlines two land management categories according to soil productivity and land conditions and recommends a set of measures for both constellations. Favourable areas with high soil productivity and good climate conditions may attract investments and sustainable intensification to increase competitiveness. This would lead to a desirable sustainable development to improve the economic situation in rural areas, would give perspectives to people to stay and live there but would also fully integrate natural resources protection. A clear legal framework and an efficient implementation of cross-compliance/conditionality and „greening“/eco-schemes should be the focus here, backed up by appropriate control schemes. On the other hand, disadvantaged areas - i.e. areas with limited productivity, natural constraints or unfavourable social conditions - are threatened by depopulation and land abandonment, which need to be counteracted by integrated rural development programs including an economic basis for site-specific, traditionally extensive agricultural systems. In these regions but also in areas of high ecologic interest (e.g. riparian zones, floodplains and wetlands) agri-environmental programmes and compensations for ecosystem services (e.g. biodiversity, landscape maintenance and biotope management) and other income options for the agricultural sector like sustainable tourism are necessary. In both cases, competent advisory services, for which recommendations are also provided, should be part of any solution.

This guidance is to be considered as a living document subject to further update and fine tuning, particularly in line with the on-going discussions on the CAP post 2020 and taking into account additional inputs of the agricultural sector. The potential amendments and implementation aspects are planned to be discussed on joint follow-up workshops of the water and agricultural sector and relevant stakeholders.

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List of Abbreviations

AKIS	Agricultural Knowledge and Innovation Systems
AWU	Annual Working Unit
BAT	Best Available Techniques
BMP	Best Management Practices
CAP	Common Agricultural Policy
CAPRI	Common Agricultural Policy Regionalized Impact Model
DIN	Dissolved Inorganic Nitrogen
DRB	Danube River Basin
DRBMP	Danube River Basin District Management Plan
EAFRD	European Agriculture Funds for Rural Development
EAGF	European Agricultural Fund
EC	European Commission
EFA	Ecological Focus Area
EIP-AGRI	European Innovation Partnership for Agricultural Productivity and Sustainability
EU	European Union
EUR	Euro
EUROSTAT	Statistical Office of the European Union
FAO	Food and Agriculture Organization of the United Nations
FAS	Farm Advisory System
FaST	Farm Sustainability Tool for Nutrients
GAEC	Good Agricultural and Environmental Condition
GAP	Good Agricultural Practices
GVA	Gross Value Added
HELCOM	Baltic Marine Environment Protection (Helsinki Commission)
IED	Industrial Emissions Directive
ICPDR	International Commission for the Protection of the Danube River
IPARD	Instrument for Pre-accession Assistance in Rural Development
LEADER	Liaison Entre Actions de Développement de L'économie Rurale (connection between actions to develop rural economy)
LFA	Less Favoured Area
LSU	Livestock Unit
MBPS	Management-based Payment Schemes
MONERIS	Modelling Nutrient Emissions into River Systems
MS	Member State
NAP	Nitrates Action Programme
ND	Nitrates Directive
NGO	Non-Governmental Organisation

NO_3-N	Nitrate Nitrogen
NRN	National Reporting Network
NVZ	Nitrate Vulnerable Zone
ODMM	Optimal Drought Management Model
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing Power Parities
PRTR	Pollutants Release and Transfer Register
RBMP	River Basin Management Plan
RDP	Rural Development Programme
RBPS	Result-based Payment Scheme
R&D	Research and Development
SMR	Statutory Management Requirement
SO	Specific Objective
SPD	Sustainable Use of Pesticides Directive
TNMN	Transnational Monitoring Network
TN	Total Nitrogen
TP	Total Phosphorus
UAA	Utilised Agriculture Area
WFD	Water Framework Directive
WWF	World Wide Fund for Nature

Part A – Context

1. Setting the scene

Water is an indispensable resource for life. Water is essential for all living organisms and provides natural habitat for aquatic ecosystems that enables developing a wide variety of flora and fauna and various ecosystem services. Moreover, water is a cross-cutting issue as many water users depend on its quality and quantity and compete for better resource availability. Besides its vital functions, water is a crucial resource for several economic sectors and social activities like energy production, industrial water supply and processing, navigation, irrigation, livestock drinking, fisheries, tourism, sport and recreation. However, anthropogenic drivers like population and economic growth, climate change, globalisation, urbanisation and land uses continuously increase water demand. At the same time they trigger pressures such as pollution, over-abstraction, hydromorphological alterations, which might endanger the sustainability of water resources. Therefore, this precious, multi-functional and vulnerable resource needs to be carefully managed and preserved to ensure that it can provide its vital, ecological, economic and social functions in the long run.

Agriculture is one of the most important water–dependent economic sectors using large water amounts that supplies the population with healthy food and food-products. While farming practices are usually being conducted on a high proportion of fertile soils, agricultural production is facing certain risks related to weather conditions, droughts, climate change, plant diseases and market instabilities, which might cause economic disadvantages for the farmers. To satisfy the increasing demand for food at good quality, agriculture needs both, sufficient quantity and quality of water for its production. On the other hand, agriculture may induce deterioration of water resources by over-abstraction and pollution. Thus, agriculture and water management should be well aligned to ensure both, the protection of water resources and the production of high quality food.

1.1 Mandate

The International Commission for the Protection of the Danube River (ICPDR) as the coordinating body for transboundary water management in the DRB has achieved significant progress in inter-sectorial fields such as inland navigation[1], sustainable hydropower[2] and climate change adaptation[3] resulting in key strategic documents adopted by the Danube countries. The ICPDR is also committed to assisting Danube countries with addressing challenges associated with nutrient and drought management. However, challenges relating to the agricultural sector have not been fully addressed so far at the basin-wide level despite the fact that the strong link with water management issues in the DRB has long been recognised.

The Danube Declaration[4] adopted at the ICPDR Ministerial Meeting in February 2016 asks the ICPDR (under paragraph 31) “to organize in close cooperation with the agricultural sector and all relevant stakeholders a broad discussion process with the aim of developing an ICPDR Guidance document on agricultural practices towards the reduction of water pollution caused or induced by nutrients from agricultural sources and the prevention of such pollution in the Danube River Basin. The document could i.a. provide a sound knowledge base on the agricultural sector and its impacts on water quality in the Danube River Basin, highlight the existing European legislative framework and financial mechanisms, summarize cross-compliance as well as supplementary measures related to the EU Common Agricultural Policy and other financial programs as well as recommend good agricultural practices and potential policy tools and cost-effective measures supported by case studies. This ICPDR

[1] Development of Inland Navigation and Environmental Protection in the Danube River Basin. Joint Statement on Guiding Principles. ICPDR, 2008

[2] Sustainable Hydropower Development in the Danube Basin. Guiding Principles. ICPDR, 2013

[3] Climate Change Adaptation Strategy. ICPDR, 2019

[4] Convention on Cooperation for the Protection and Sustainable Use of the Danube River. 1994

Guidance would aim at the effective protection and use of water bodies as well as a sustainable and balanced agricultural production in the Danube countries."

Since the endorsement of the Declaration, Danube countries have declared that climate change effects, including water scarcity and drought is to be considered as a significant water management issue in the DRB[5]. Bearing in mind the strong linkage of the drought issue to agricultural water management, the scope of the guidance document has been extended to the drought issue besides the nutrients. Moreover, pesticide pollution related to agriculture is also an emerging issue to be tackled. Although the current version of the document is focused on nutrients, further editions will broaden the scope towards pesticides and other harmful substances.

1.2 Policy context

In the broader policy context, the Water Framework Directive[6] (WFD) of the European Union (EU) aims at protecting inland surface waters, transitional waters, coastal waters and groundwater, and to ensure sustainable use of water resources. As an ultimate objective of the WFD, EU Member States (MS) have to ensure that all water bodies are in good status/ecological potential by 2015 with exemptions until 2027 at the latest. The WFD assigns water management to river basins rather than administrative borders and requires the elaboration of river basin management plans. The management plans have to describe the current water status, pressures by which ecosystems and water status are perturbed and measures to be implemented in order to achieve good status/potential and to prevent further deterioration. For surface waters, good status is defined as good ecological status/potential and chemical status, whereas for ground waters good chemical and quantitative status must be reached. The recent fitness check of the WFD[7] concluded that the WFD largely fits for purpose and has led to a higher level of protection for water bodies. Progress towards good status can be expected to be slow but steady.

With respect to agricultural activities, the Nitrates Directive[8] (ND), the Sustainable Use of Pesticides Directive[9] (SPD) and the Industrial Emissions Directive[10] (IED) are the most relevant pieces of legislation, regulating farming activities to achieve specific goals but also contributing to the WFD objectives. The ND requires designation of Nitrate Vulnerable Zones (NVZs) that are hydraulically connected to waters affected or potentially endangered by nitrate pollution or alternatively, to apply the whole territory approach. In the zones (or over the whole territory) the amount of nitrogen that is applied on agricultural fields in fertilizer or manure is limited and the application is strictly regulated through nitrates action programmes (NAPs) with basic mandatory measures. Moreover, codes of good agricultural practices (GAP) are also recommended to be respected outside the NVZs on a voluntary basis to ensure low nitrogen emissions entering the groundwater and river network. The SPD controls the release of agricultural chemicals through measures enforcing the use of less toxic substitutes, ensuring proper management and safe application and storage of pesticides and biocides, setting emission limits, minimizing or avoiding pesticide use in sensitive areas and establishing buffer zones to protect aquatic ecosystems. The IED dictates that authorities need to ensure that pollution prevention and control measures at the major industrial units (including intensive livestock enterprises, e.g.

[5] Interim Overview: Significant Water Management Issues in the Danube River Basin District. ICPDR, 2019

[6] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

[7] https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/index_en.htm

[8] Council Directive 91/676/ EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources

[9] Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides

[10] Directive 2010/75/EU of the European Parliament and the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)

poultry and pig farms) are up-to-date with the latest Best Available Techniques (BAT) developments. The industrial plants covered by the Directive must have a permit in line with BAT Reference Documents (e.g. for installations with intensive rearing of poultry or pigs) and must respect emission limit values for polluting substances to ensure that certain environmental conditions are met.

With regard to water scarcity and droughts, the European Commission (EC) has recognised this issue as an important challenge and in 2007 adopted the communication "Addressing the challenge of water scarcity and droughts"[11]. The implementation of this communication is evaluated through annual Follow-up Reports.

The new EC acting since December 2019 has been putting great emphasis on the environmental and climate dimension of European agricultural production. This is reflected in the Mission Letter from the President of the Commission to the Commissioner for Agriculture and the Commission Communication on the European Green Deal[12]. This involves a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. These Green Deal also highlights that the agricultural sector is both central to achieving the Union´s climate-neutrality commitments and also sharply exposed to the effects of climate change. A specific focus on healthier and more sustainable food production is to become an important part of the Green Deal, the first headline target of the EC. Another key aspect is the Zero Pollution ambition for creating a toxic-free environment that needs enhanced pollution monitoring, prevention and remediation. To address these challenges, the Commission will adopt a zero pollution action plan for air, water and soil in 2021.

The 'Farm to Fork' strategy for sustainable food of the EC[13], one of the key elements of the Green Deal, will be looking at how the agri-food sector can improve the sustainability of food production across the food chain, including through organic production. The Zero Pollution ambition of the EC will ensure that agriculture and food production contributes to climate, environmental and biodiversity goals, notably by reducing the use of pesticides, fertilisers and chemicals in Europe and beyond (such as the Non-EU countries in the DRB). Regarding nutrients, the Commission's aim is to reduce nutrient losses by at least 50% by 2030, while ensuring that there is no deterioration in soil fertility. This will reduce the use of fertilisers by at least 20% by 2030. Moreover, at least 25% of the EU's agricultural land must be organically farmed by 2030. The Commission will put forward an Action Plan on organic farming, helping Member States stimulate both supply and demand of organic products. This guidance document is a tool for serving these EU policies and objectives.

The 'Farm to Fork' strategy will be implemented in close coherence with the other elements of the Green Deal, particularly the Zero Pollution ambition, the new Circular Economy Action Plan[14] and the Biodiversity Strategy for 2030[15]. The new Circular Economy Action Plan announces initiatives along the entire life cycle of products, targeting their design, promoting circular economy processes, fostering

[11] COM(2007) 414 Communication from the Commission to the Council and the European Parliament, Addressing the challenge of water scarcity and droughts in the European Union

[12] COM(2019) 640 Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions - The European Green Deal

[13] COM(2020) 381 Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions - A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system

[14] COM(2020) 98 Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions - A new Circular Economy Action Plan for a cleaner and more competitive Europe

[15] COM(2020) 380 Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions - EU Biodiversity Strategy for 2030 - bringing nature back into our lives

sustainable consumption and aiming to ensure that the resources used are kept in the EU economy for as long as possible. In relation to agriculture, the proposed Water Reuse Regulation[16] will encourage circular approaches to stimulate and facilitate water reuse in agricultural irrigation. It will facilitate the use of treated urban wastewater for agricultural irrigation. Furthermore, the Commission will develop an Integrated Nutrient Management Action Plan, with a view to ensuring more sustainable application of nutrients, stimulating the markets for recovered nutrients, addressing nutrient pollution at source and increasing the sustainability of the livestock sector. The Biodiversity Strategy will put Europe's biodiversity on the path towards recovery by 2030 by protecting minimum 30% of the EU's land and sea area and setting up ecological corridors, strictly protecting at least a third of the EU's protected areas and effectively managing all protected areas, defining clear conservation objectives and measures and monitoring them appropriately. To provide space for wild animals and plants, but also to help enhance carbon sequestration, prevent soil erosion and depletion, filter air and water, and support climate adaptation, there is an urgent need to bring back at least 10% of agricultural area under high-diversity landscape features. These include, inter alia, buffer strips, rotational or non-rotational fallow land, hedges, non-productive trees, terrace walls and ponds.

The EU Common Agricultural Policy[17,18] (CAP) provides a multi-pillar financing mechanism for farmers in EU member countries to ensure the sustainable development of agricultural and rural areas. It aims at supporting farmers and improving agricultural productivity, ensuring a stable supply of affordable food, safeguarding farmers to make a reasonable living, helping to tackle climate change and the sustainable management of natural resources (including water), maintaining rural areas and landscapes and keeping the rural economy alive.

The recent CAP subsidies consist of two main pillars. Direct payments (Pillar I, financed from European Agricultural Fund, EAGF) are linked to compliance with compulsory measures upon basic standards on environmental sustainability, animal health and welfare and food safety. The cross-compliance mechanism includes Statutory Management Requirements (SMR) and Good Agricultural and Environmental Conditions (GAEC). In addition., the so called "Greening" measures are part of the direct payments and related to environmental friendly farming practices including crop diversification, maintenance of permanent grassland and conservation of areas of ecological interest. Funds for voluntary measures (Pillar II, financed from the European Agriculture Funds for Rural Development, EAFRD) under the Rural Development Programmes (RDPs) aim at strengthening competitiveness, protecting environment, ensuring vitality of rural communities and modernising farms by innovations. Agri-environmental measures help farmers to overcome the challenges related to protecting soil and water quality, safeguarding biodiversity and adapting and mitigating against climate change impacts by supporting environmentally friendly practices, organic farming and sustainable innovations.

The impact of the CAP measures and instruments on water quantity and quality and the extent to which the objective of sustainable water management has been achieved was recently assessed by a specific EC study[19]. The evaluation report concluded that the EC should require MS to set ambitious targets for the CAP instruments and to achieve minimum mandatory results by the CAP implementation in order to guarantee that the objective of sustainable management of water is met and to effectively reduce the agricultural pressures on water. Any exemptions lowering the level of standards required under the water-relevant CAP schemes should be avoided or carefully examined to avoid negative effects on

[16] COM(2018) 337 Proposal for a Regulation of the European Parliament and of the Council on minimum requirements for water reuse

[17] Regulation (EU) No 1307/2013 of the European Parliament and of the Council of 17 December 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy

[18] Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

[19] Evaluation of the Impact of the CAP on Water, ISBN 978-92-76-10939-6, doi:10.2762/63371, European Union, 2020

water. Moreover, it is recommended that higher provisions in terms of minimum requirements are set and the share of budget allocated by MS to several water-relevant measures could be increased.

Within the pre-accession assistance of the EU for countries on their way to membership, the rural development section (Instrument for Pre-Accession Assistance in Rural Development, IPARD[20]) should be most interesting with regard to the implementation of the WFD and reduction of nutrient emissions into surface waters. IPARD includes 9 different measures, among others to prepare for implementation of actions relating to environment and the countryside.

Discussions on the post-2020 CAP have started with the proposed EC Regulation[21], which details the regulatory framework for a "future-proof" CAP. The suggested regulation comprehends increased ambitions towards environmental and climate protection in response to international commitments, EU environmental challenges and societal expectations. The Mission Letter outlines these expectations towards the new CAP for the years ahead: it must be ambitious in terms of food security, sustainable food system and environmental and climate objectives and must be instrumental in strengthening the efforts of European farmers to contribute to the EU's climate objectives and to protect the environment. In particular, CAP Specific Objectives SO 4 (Contribute to climate change mitigation and adaptation, as well as sustainable energy), SO 5 (Foster sustainable development and efficient management of natural resources such as water, soil and air) and SO 6 (Contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes) have high importance for environmental and climate protection. MS are obliged to make a greater overall contribution to the achievement of the climate- and environmental objectives compared to the previous programming period. In total, 40% of the CAP budget will have to be climate- and environment-relevant and support biodiversity objectives.

The proposal aims at strengthening the connection of CAP support to the compliance of farmers with obligations to protect the environment, public, animal and plant health as well as animal welfare established as conditions for area related payments. A new so-called "enhanced conditionality" is proposed as an integral part of the future CAP framework, which replaces the current "Greening" and cross-compliance by updating the former SMRs and GAECs and integrating the "Greening" practices into the new GAECs. The enhanced conditionality sets the baseline for more ambitious and sustainable agricultural commitments through the adoption of good farming practices and standards by farmers. The introduction of the WFD and the SPD into the conditionality would support their implementation and the achievement of their specific objectives. In addition, new GAECs could potentially have a positive impact on water quality and carbon dioxide sequestration in soils. Such an addition would bring a dedicated tool for optimizing on-farm nutrient management and would protect peatlands and wetlands. Moreover, on every farm at least 3% of arable land will be dedicated to biodiversity and non-productive elements. Enhanced conditionality is mandatory for MS to implement and must be respected by beneficiaries of direct payment.

The post-2020 CAP envisages requiring all MS to prepare a CAP Strategic Plan, where specific objectives would have to be achieved through targeted actions for improving the economic, social and environmental performance of the agricultural sector and rural areas. Also, CAP Strategic Plans at the national level should pay particular attention to the benchmarks and requirements on environment- and climate-related objectives. Furthermore, the Commission will scrutinize the national Strategic Plans against robust climate and environmental criteria to ensure that the respective specific objectives of the CAP are fulfilled and the targets of the Green Deal, the 'Farm to Fork' strategy and Biodiversity Strategy for 2030 are appropriately addressed.

[20] Regulation (EU) No 231/2014 of the European Parliament and of the Council of 11 March 2014 establishing an Instrument for Pre-accession Assistance (IPA II)

[21] COM/2018/392 Proposal for a Regulation of the European Parliament and of the Council establishing rules on support for strategic plans to be drawn up by Member States under the Common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD)

The Strategic Plans will combine a wide range of targeted interventions addressing specific needs at national level, therefore MS have to produce a thorough assessment of their needs based on a strengths, weaknesses, opportunities and threats (SWOT) analysis. In addition, MS need to prepare an intervention strategy for each of the nine specific objective including targets (result indicators) and the most appropriate interventions. Setting the targets and selecting and designing the interventions will be based on the needs assessment. At the same time, MS are requested to set explicit national values for the different Green Deal targets. The involvement of the EC at each stage of the CAP strategic planning, setting rules, assessing plans, monitoring progress and ensuring delivery is highly important and needs to be coupled with an ambitious national planning, targeted measures and appropriate knowledge and information sharing.

According to the proposal, the new conditionality would link farmers' income support to the application of environment- and climate-friendly farming practices. Moreover, agri-environment climate commitments and eco-schemes would also be important elements of the CAP Strategic Plans and would support farmers in maintaining and enhancing sustainable farming methods going beyond mandatory requirements and relevant conditions. In this context, the focus will be shifted from compliance to better environmental and climate performance, in terms of improved nutrient management, reduced emissions and storing carbon in soil. At least 35% of each rural development national allocation would have to be dedicated to environmental and climate measures with the possibility of higher EU contribution in the funding. The new eco-scheme measures, which are to be defined by the MS and to be funded from national direct payment allocations, would also address the environmental and climate objectives of the CAP. MS must allocate at least 25% of their income support budget to eco-schemes.

In June 2021, a provisional political agreement on the CAP reform has been reached at the EU level, paving the way for formally approving the necessary legislation in autumn 2021. The new CAP regulation shall enter into force on the 1st of January 2023, whereas a transitional regulation[22] was put in place for the period 2021-2022. This transitional regulation will extend most of the existing CAP rules but will also include new elements to make a stronger contribution to the Green Deal and to ensure a smooth transition to the future framework of the CAP Strategic Plans by enabling sufficient time for MS to design and prepare these plans.

Within the new multiannual financial framework (2021-2027) a budget of ca 385 billion EUR is allocated to the CAP. First pillar funding (income support and market measures) amounts to 290 billion EUR, whereas 95 billion EUR is assigned to second pillar payments (rural development programmes and 8 billion EUR Next Generation EU recovery funds helping rural areas make the structural changes necessary to achieve modernisation and digital transition). In order to better adapt national policies to the farming priorities, EU countries will have the option to transfer up to 25% of their CAP allocations between income support and rural development.

To further support MS in drafting the national Strategic Plans, the EC provided MS with tailor-made recommendations, accompanied by a communication[23]. The recommendations guide MS on how to implement the specific objectives of the CAP in order to jointly contribute to achieve the Green Deal's targets, identify key strategic issues that need to be tackled urgently for each MS and provide guidance on how to address them in the CAP Strategic Plans.

Since the Green Deal and its associated strategies largely address issues relevant to agriculture and rural areas, it is crucial that the new CAP and the Farm to Fork and the Biodiversity Strategy work in close coordination and synergy to support the long-term sustainability of natural resources and

[22] Regulation (EU) 2020/2220 of the European Parliament and of the Council of 23 December 2020 laying down certain transitional provisions for support from the EAFRD and from the EAGF in the years 2021 and 2022

[23] COM/2020/846 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Recommendations to the Member States as regards their strategic plan for the Common Agricultural Policy

farming. According to a current analysis of links between the CAP reform and the Green Deal[24], the CAP proposal is compatible with the Green Deal and its associated strategies and it has the potential to accommodate the Green Deal's ambitions. Nevertheless, certain proposed CAP provisions should be kept ambitious also in the final version, e.g. no-backsliding and ring-fenced spending for agri-environment and climate commitments, mandatory eco-schemes, ambitious enhanced conditionality for key standards. On the other hand, the final legislation may improve some elements (e.g. ring-fencing for eco-schemes, clarifying the scope of the eco-schemes) or may include new aspects (e.g. creating a structured dialogue for preparation of CAP strategic plans, publicly sharing documents, including sustainability indicators into the current data network and strengthening its links with advisory services).

In general, there is a need for better dialogue, coordination and alignment between water and agricultural policies to develop common strategies and joint actions. This has been recognised at the EU level[25] and aligning water and agricultural policies is high on the agenda of the EC. Currently, the EC has a strong priority to improve the implementation of existing policies and to ensure better integration across policy fields. Water has been identified as an important cross-cutting issue for environmental and agricultural policies. Both, the agriculture and environment and their multiple services highly depend on the long-term sustainable management of water. Therefore, the overall aim is to ensure that agricultural production can develop and grow while good status of water bodies as defined by the WFD is secured. Water and agricultural administration should establish a close dialogue, should develop a common understanding of joint objectives and should develop win-win strategies and joint actions. Recently, at the EU level a Task Force on Water and Agriculture has been established to strengthen cooperation between the two sectors and to facilitate coordinating the WFD and CAP implementation, boosting investments and promoting best practices in agriculture in order to achieve good water status. In addition, the European Environmental Agency published a report on water and agriculture[26], in which the need to manage environmental pressures on water in a broad societal context is emphasized and three key areas to be improved in strong connection to the Green Deal ambitions are highlighted: (1) more resilient management actions at basin and farm level (e.g. wider uptake of sustainable management practices based on agroecological principles, organic farming and nature-based solutions); (2) improved implementation and integration of EU policies (e.g. more ambitious CAP interventions promoting sustainable practices, synergy between the river basin management plans and the CAP Strategic Plans); and (3) more holistic and global approaches through systems thinking (e.g. systemic changes across water, agriculture and the food and energy policies).

1.3 Rationale

Sustainable nutrient and drought management are highly challenging issues in the Danube River Basin (DRB) and need to be addressed. Nutrient pressure from agricultural diffuse sources could increase and affect the status of surface waters, groundwater and the Black Sea. In the context of climate change, the duration and magnitude of drought events are forecast to be increasing in summer months associated with a significant change in the temporal distribution and intensity of rainfall in the cold season and in the two transition seasons. Such extreme weather conditions could trigger serious water scarcity issues and are relevant for designing cropping, sowing and fertilization strategies in specific soil-climatic conditions. Good status of all water bodies within the DRB is one of the basic keys for sustainable development, public health and social welfare in the region.

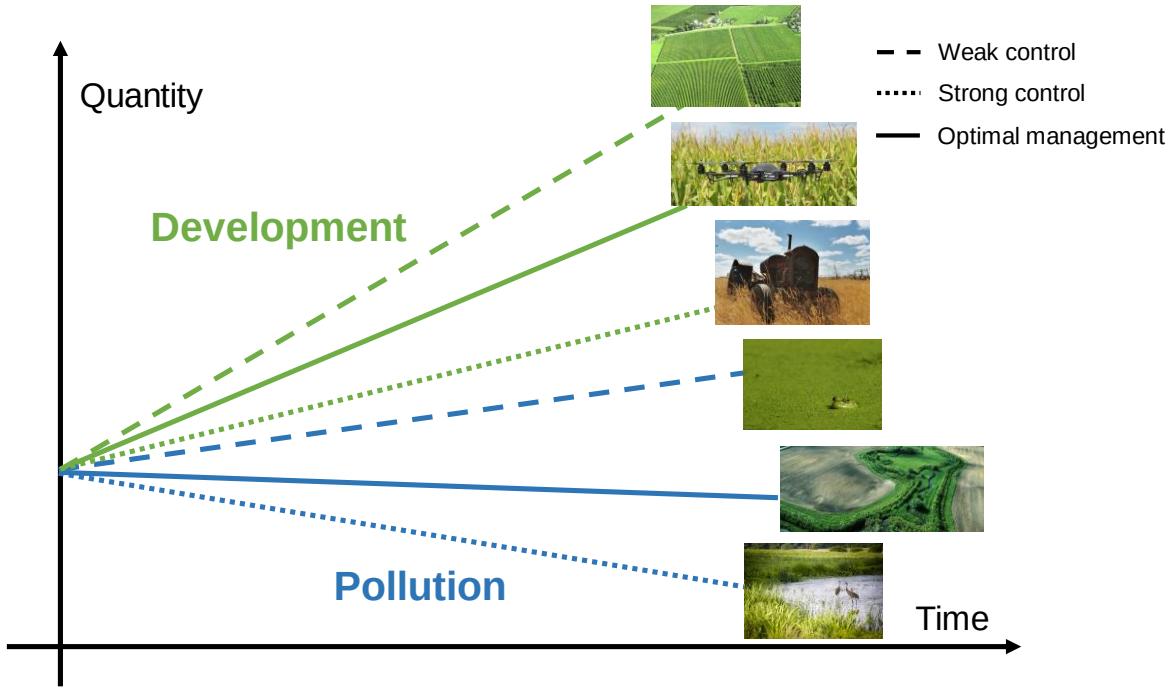
[24] SWD(2020) 93 Commission Staff Working Document - Analysis of links between CAP Reform and Green Deal

[25] SWD(2017) 153 Commission Staff Working Document on Agriculture and Sustainable Water Management in the EU

[26] Water and agriculture: towards sustainable solutions. European Environment Agency, 2021, ISBN 978-92-9480-359-7, doi: 10.2800/73735

At the regional scale of the DRB, a proper dialogue between the water and agricultural sector and coordinated policy tools have not been fully established yet. To address this shortcoming, the Danube countries agreed in 2016 to start in close cooperation with the agricultural sector a broad discussion process aiming at developing a sound guidance document on sustainable agriculture. The document will facilitate the sustainable development of agriculture in the DRB by carefully balancing the economic, ecologic and social aspects of agriculture and rural activities. The main objective of the guidance is to support decoupling future agricultural development from increasing nutrient pollution and water scarcity of surface and ground waters (Figure 1). Purely profit-driven policy would on one hand increase the intensity and profitability of agriculture but it would also cause excessive nutrient inputs to surface waters (dashed lines). Uniformly applied, strong pollution control would ensure high level protection of waters but would limit agricultural production that may not be competitive (dotted lines). Optimal management through a set of compromises and agreements and based on common understanding and careful aligning of policies could succeed to fulfil the needs of both sectors (solid lines).

Figure 1: Decoupling agricultural development from pollution



Targeting the optimal management, the guidance can contribute to creating synergy with the national agricultural policies that aim at strengthening the profitability of farmers, competitiveness of agriculture and vitality and socio-economic situation of rural areas. It shall also ensure the effective use of water resources and an effective protection of both, the DRB water bodies and the Black Sea coastal waters and their ecosystems against excess nutrient inputs, water scarcity and their significant adverse impacts. In this way, the guidance will contribute preserving the sustainability of agriculture by helping to uphold the increasing expectations of the society in terms of protection of the environment and socio-economic resources.

The initiative is driven by the recognition that improving the socio-economic situation in the agricultural sector is a prerequisite for a successful implementation of agro-environmental policies. Water and agricultural policies should be designed and harmonised in a way that income losses for the farmers are minimised or compensated when implementing measures to protect water bodies. Policies should seek win-win solutions wherever possible. However, finding the way towards these objectives needs to change the paradigm: policies should be shifted from the traditional, purely command-control type regulative enforcement to more balanced approaches, taking into account the perspective of farmers' economic benefits. This change should be based on open dialogue, mutual trust and common

understanding that is expected to result in willingness to make certain compromises by both sectors. The initiative is fully in line with the water-related objectives of the new CAP-proposal and the EC activities on better aligning water and agricultural policies. The political momentum at the EU level provides a great opportunity for complementary regional approaches to assist countries with designing their national CAP Strategic Plans in accordance with the River Basin Management Plans (RBMPs).

To achieve its ambitious goal the guidance paper recommends sound policy instruments, financial programs and cost-effective agricultural measures to protect aquatic environment for decision makers in the agro-environmental policy field. It offers Danube countries support for the preparation and implementation of their tailor-made national agro-environmental policies, CAP Strategic Plans and relevant strategies of the RBMPs in good synergy. The recommendations provide the Danube countries with a framework to adjust their national agro-environmental policies. They on one hand give specific advice on how to implement more efficiently existing legislation (e.g. ND, cross-compliance/conditionality of the CAP) and on the other hand help countries to better identify, target and finance additional measures going beyond legal obligations. Thus, the guidance will act as a strategic policy framework providing consistent approaches into which the Danube states are encouraged to integrate their individual national methods. It lays down the basis for designing cost-effective, targeted national measures according to national needs and conditions. The guidance highlights the potential of effective funding mechanisms and instruments for improving nutrient and drought management practices and transfers relevant knowledge and best practice examples to the Danube countries. The recommendations should be adoptable for the Danube countries in an "inclusive" way ensuring that the interests of the different groups of stakeholders and the regional differences in the basin in terms of both, the natural and socio-economic factors are considered.

The guidance outlines two land management categories according to soil productivity and land conditions. In areas favourable for intensive agriculture, a reasonable increase of crop production and animal numbers is to be expected due to market incentives and partial foreign investment. In an open economy and decreasing profits in other economic sectors agriculture and food production may become a profitable target for investors. The challenge in this case is to fully integrate environmental aspects right from the beginning (in EU terms: have a multifunctional agriculture) based on the principle of precaution and come to a sustainable development (i. e. a balance between economy, ecology and social aspects).

In areas with natural constraints and unfavourable social conditions (disadvantaged areas) the challenge is to keep up agriculture (very often traditional and extensive) and characteristic landscapes which may be in some aspects part of the socio-cultural heritage and national or local identity. However, at the same time sustainable development must open up economic perspectives for local people by an integrated rural development including sectors like soft tourism, wellness, relaxation and recreation or local handicraft and services. Thus, viable rural regions may develop and depopulation and land abandonment may be avoided or at least mitigated.

2. Agriculture in the DRB – an overview

The Danube region is characterized by a wide variety of landscapes and soil-climate regions with essential influence on the situation of agriculture. About 50% of the DRB territory (about 45 million ha) is under agricultural cultivation (Figure 2, source: EUROSTAT[27], FAOSTAT[28]). Some of the regions are among the most fertile in the Northern hemisphere. Generally the geographical and climatic conditions in large parts of Bulgaria, Romania, Hungary, Serbia and Croatia are favourable for agriculture; thus the sector is expected to be an important component of economic consolidation within the region. Growing demand on world markets, about 80 million consumers in the region and the EU-accession (Common Market, CAP subsidies) offer favourable opportunities to modernize and turn food production into a driving force for growth during the next years.

Figure 2: Proportion of agricultural land at NUTS2 level in 2017

The central part of the DRB, roughly the region between the cities of Budapest, Belgrade, Zagreb and Timisoara, is characterized by lowland plains, fertile czernosem soils and generally warm temperatures, i. e. excellent conditions for intensive agriculture if water is available in sufficient amount. Unfortunately, the latter is not always and everywhere guaranteed, making the risk of droughts one of the weak points of agronomical expectations. Climate change probably may exacerbate this problem, thus counter strategies should be elaborated to adapt to climate change in the future. Actual annual precipitations vary between roughly 700 mm in Belgrade and the Vojvodina and 500 mm in the Great Plain in central Hungary.

Agronomic conditions are especially favourable for maize (corn), soybeans, sunflowers and other thermophilic crops besides the ordinary cereals. Weather conditions are suitable for cultures such as peas, rapeseed, linseed, green corn, sugar beet, fodder beet, perennial legume crops, field vegetable crops (onion, tomato, eggplant, pepper, cabbage), especially in areas where water is available. Due to management shortcomings in the past, old and obsolete machinery and marketing problems during the transition time after the communist era, there is a huge potential for yield increases making the area attractive for foreign investors, especially once the legal situation for investments and property rights

[27] https://ec.europa.eu/eurostat/home

[28] http://www.fao.org/faostat/en/#home

have been clarified during the accession process to the EU and afterwards. Infrastructure and geographic situation alleviate transports of bulk cargo and goods to facilitate markets on one side in Austria, Germany and from there in Western Europe and on the other side towards the Black Sea and the world market.

2.1 Structural and economic features

The countries, which are part of the DRB, are at very different levels of economic development. Measured in Purchasing Power Parities (PPP), the value added per inhabitant ranges from 45 thousand US$ in Germany over 19 thousand US$ in Bulgaria and 12 thousand US$ in Bosnia-Herzegovina to 8 thousand US$ in Ukraine and 5 thousand US$ in Moldova in 2016.

Agriculture is an important economic activity in all the countries of the DRB. In the wealthier countries agriculture has only a small share in the Gross Value Added (GVA), e.g. around 1% in Germany and in Austria. Such a small share does not mean that agriculture is unproductive or a marginal economic activity. On the contrary, in these two countries agriculture is supplying the population to a high degree with domestically produced food. In the Eastern countries, the GVA share of agriculture is close to or larger than 10% in many regions (see Figure 3, source: EUROSTAT, FAOSTAT). In the Western regions agriculture is an important local supplier of commodities that are further transformed into food (mainly milk and meat products, fruits and vegetables). In the Eastern regions agriculture is one of the most important employers in rural regions and an important economic sector. However, its share in gross value added is declining there as well.

The production structure in the countries is very heterogeneous. In the Western regions of the DRB (Germany, Austria, Slovenia) livestock production is very important. A consequence is that livestock density, measured as Livestock Units (LSU) per hectare Utilized Agricultural Area (UAA), is relatively high there (0.2-1.4 LSU per hectare UAA, in many areas above 1.0 LSU per hectare UAA). However, compared to livestock intensive production regions in the rest of the EU (e.g. in France, Netherlands, Denmark with values higher than 1.5 LSU per hectare UAA and up to 8.0 LSU per hectare UAA) even in these regions livestock is produced not very intensive.

Figure 3: Contribution of agriculture, forestry and fishing to GVA at NUTS2 level in 2017

Livestock density in the DRB is relatively low on average (around 0.5 LSU per hectare UAA) and it shows a West to East gradient (see Figure 4, source: EUROSTAT, FAOSTAT). High densities are prevailing in Germany and Austria in the Danube valley but not so in the Alpine regions where extensive pastures prevail. In the middle-basin, the density varies between 0.3 and 0.6 LSU per hectare

UAA. In the regions close to the Black Sea, livestock densities are very low (less than 0.4 LSU per hectare UAA). During the last decades, production became less intensive in the Eastern part of DRB. The integration into the EU lead to livestock farming less profitable in many regions of the DRB.

Figure 4: Livestock density in LSU/ha at NUTS2 level in 2017

Regarding the irrigation intensity of agriculture, there are some regions close to the river Danube in Austria and Hungary, where irrigation plays a major role. The same is true in parts of Bulgaria and Romania. During the last decades, irrigation in the eastern countries has declined due to the lack of adequate equipment, low energy technologies for water distribution and investments. The increases in crop yields have not been high enough to make private investment there profitable. A lack of public support to make new investments is the main reason why irrigation is less important today than it was decades ago.

Farm structure, the number of farms, their size and their legal organisation are important elements as well. The average farm size (Figure 5, source: EUROSTAT, FAOSTAT) varies from a couple of hectares (Slovenia, Romania, Moldova, Montenegro, Serbia), over several ten hectares (Hungary, Croatia, Bosnia and Herzegovina, Bulgaria, Austria, Germany) and up to the order of magnitude of hundred hectares or more (Slovakia, Czech Republic, Ukraine). Farm structure and economic performance in many Danube states are characterized by a large number of (very)small or middle-size farms on one side and a small number of large farms on the other. However, in many countries the relative small amount of large holdings works on the majority of the agricultural land (Figure 6, source: EUROSTAT, FAOSTAT). In the West of the DRB small and middle size family farms are the predominant form of farm organisation. Farms in Baden-Württemberg and Bayern are relatively small compared to farms in other parts of Germany and comparable in size in Austria where commercial farms play almost no role. In the Czech Republic, Slovakia and the other countries along the Danube River, large farms run by a professional management are operating at a relatively large share of agricultural land. Moving to the East, the micro and (semi-)subsistence farming becomes more important. In all the regions to the East of Austria (except Ukraine), most farms are smaller than 5 hectares with a high number of farm owners. Many of them either do not produce for the market but use the resources of the farm to support the livelihood of the farm family or produce a little surplus output to be sold at the market. At present, the number of farms in the DRB is decreasing by about 2% per year (ca 25% in 10 years) and this trend will likely continue, while the total agricultural areas had a slight increase in the last decade.

Figure 5: Average farm size in ha at NUTS2 level in 2017

Figure 6: Share of the number of holdings with less than 5 ha UAA at NUTS2 level in 2017

One of the consequences is that agricultural productivity in the DRB is small by European standards. Gross value added per farmer or farm worker (measured as Annual Working Unit, AWU) is below 5,000 EUR in approximately half of the territory of the DRB and significantly lower in Moldova and Ukraine. This is due to very low market revenues per hectare land, which is below 1,000 EUR in regions of the Eastern fringe of DRB. Due to intensive vegetable and fruit production and livestock production in the Western part of DRB, the output per hectare is more than 3,000 EUR/ha in many regions in Germany and Austria. High differences in agricultural incomes mean that the costs of changing existing polluting practices vary widely across regions in the DRB.

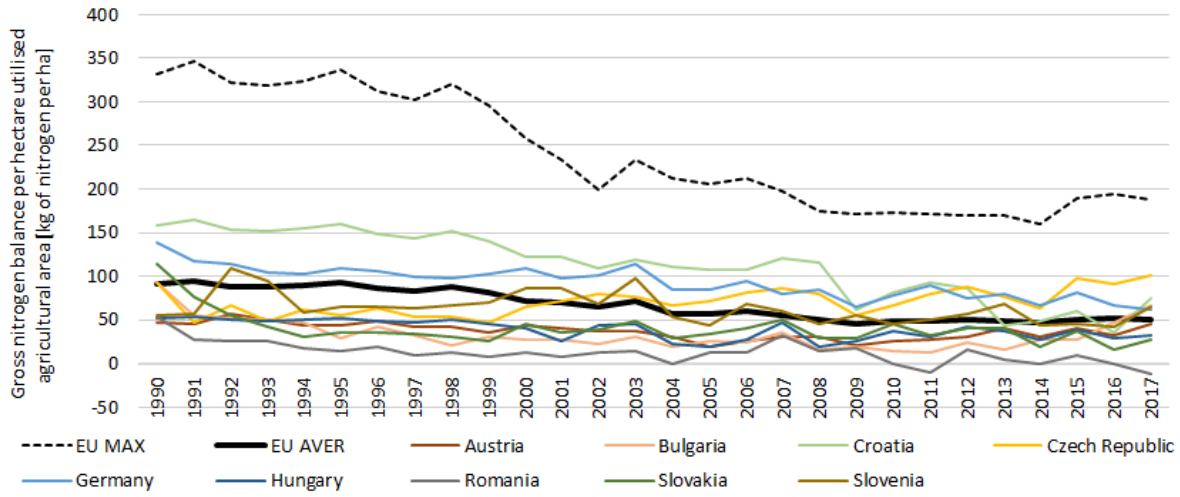
In many regions the intensity of agricultural production is low due to the less favourable economic situation. In areas where land productivity is low, farmers often are facing difficulties as agriculture in these regions may not be competitive at all. In many Danube countries, there is a significant number of

small farms working on a few hectares, which are highly dependent on EU or national subsidies but have limited capacity to comply with strict and ambitious cultivation provisions.

2.2 Measures implemented in agriculture to address nurient pollution

Nutrient surplus in agricultural areas is considered to be one of the key agri-environmental indicators that represents excess nutrients available for mobilization from the soil towards ground and surface waters. Figure 7 (source: EUROSTAT) shows the evolution of the specific nitrogen surplus (gross nitrogen balance per unit agricultural area) over the last two and a half decades in the Danube countries being EU MS along with the mean and maximum EU-wide values. A slowly decreasing trend can be recognised starting in the early 1990s. The current mean nitrogen surplus for the DRB is relatively low (about 21 kg per hectare and year) compared to the EU average (50 kg per hectare and year, 2015), but shows high regional differences. Danube countries are mainly around or below the EU mean value except Germany, Croatia and the Czech Republic and far from the EU maximum values. In most of the Danube countries the current values are below 50 kg nitrogen per hectare.

Figure 7: Nitrogen surplus time series in selected Danube countries



Thanks to measures, which have been implemented in agriculture, but also as consequence of the economic recession in many Danube countries, which resulted inter alia in low agricultural intensity, the nutrient surpluses (gross balance) of the agricultural fields are rather low, except some countries where still high amounts of manure and fertilizers are applied on agricultural soils. On the contrary, in countries with less economic power, the surplus values are very small or even negative indicating lack of nutrient inputs which is compensated by the soil stocks accumulated over the previous years. However, future river basin management activities should take into account scenarios that the economy and the agricultural sector might become strong again, which might lead to higher nutrient surplus values and water emissions that would need appropriate management.

Measures have been implemented in agriculture throughout the DRB. As of 2018, on more than 60% of the areas of the DRB NAPs with strict rules on manure and fertilizer application are being implemented (Figure 8, source: 2018 Interim Report on the Implementation of the Joint Programme of Measures in the Danube River Basin[29]). Out of the agricultural areas of the DRB, 70% receive direct support linked to cross-compliance and 20% receive additional subsidies for implementing environmentally friendly measures (only in EU MS). These financial mechanisms are linked to the EU CAP. Whereas participation rates in direct support are relatively high everywhere, proportions of agri-environmental measures are very low in some countries indicating a great potential for agri-

[29] 2018 Interim Report on the Implementation of the Joint Programme of Measures in the Danube River Basin. ICPDR, 2019

environmental interventions to be explored in the future. In the last decade, more than 70 billion EUR were spent to support farmers and to finance effective environmental measures and methods (best management practices, BMPs). Direct payments amounted to 50 billion EUR and support of agri-environmental measures from the RDPs reached 20 billion EUR. The percentage of these areas has increased substantially since 2006.

Figure 8: Proportions of country area with Nitrates Action Programmes and of agricultural areas determined for direct payment and receiving subsidies for agri-environmental measures (EU MS)

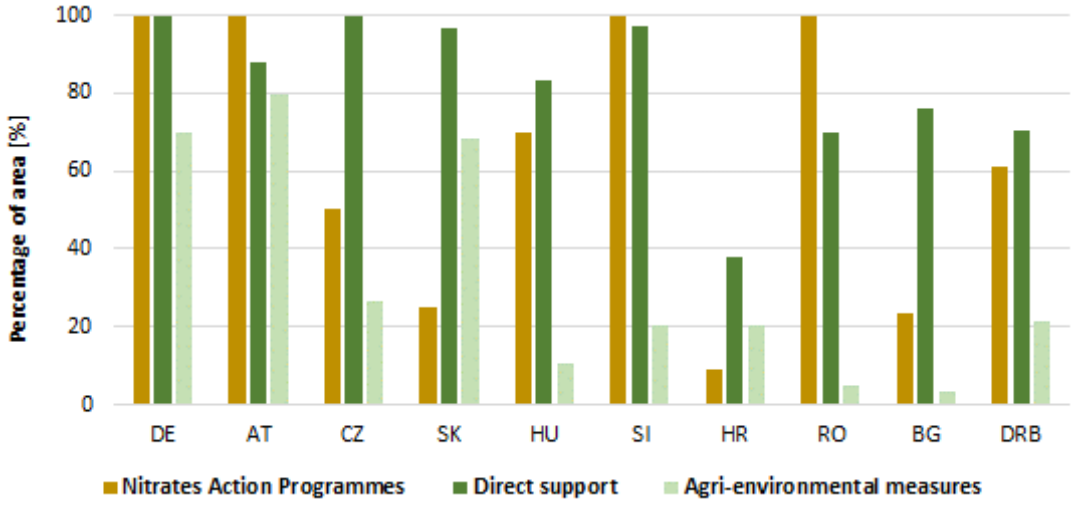


Table 1 (source: ICPDR Agricultural policy implementation study[30]) presents a general comparison of the implementation of water related agricultural measures in the Danube countries. The basic approaches to reduce the burden of agriculture on aquatic environment are very similar in all the countries. Regulatory instruments dominate and in the EU MS subsidies through agri-environmental programmes also play an important role. The ND as one of the key tools for reducing nitrogen pollution and for achieving good water status has a long and sometimes controversial history in the EU MS, and its implementation is still unsatisfactory[31]. Differences in implementation are visible in the spatial scope (NVZs or whole territory). Very similar specific regulations are in place to control nitrate pollution following the requirements of the directive although the detailed elements of the regulations vary from country to country. In the non-EU MS no such legislation is in place; however, several analogous regulatory elements are already available and several good management practices are implemented in agriculture.

Manure and fertiliser application is mainly regulated by the ND (also as part of the cross-compliance through SMR), but additional fertilizer laws or regulations are also in place in many countries. Planning and documentation of fertiliser application is a growing practice. Nutrient balances on national level are available for example in the EUROSTAT database; however, there is a lack of data on agricultural statistics and nutrient surplus on single farm level in most countries.

With regard to the big animal husbandry enterprises (intensive livestock farms), those falling under the scope of the IED must have a mandatory permit and must apply BAT. Pollution releases above a certain threshold (e.g. 10,000 kg of ammonia per year) have to be reported (E-PRTR Regulation[32]).

[30] Towards a Guidance Document on Sustainable Agriculture – to reduce nutrient pollution in the Danube River Basin. ICPDR, 2017

[31] COM(2018) 257 Report From the Commission to the Council and the European Parliament on the implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources based on Member State reports for the period 2012–2015

[32] Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register

Permitting is also mandatory in the non-EU MS. Manure handling is regulated everywhere but provisions for excess manure transportation have not been put in practice yet in several countries. Soil erosion control measures and buffer zone establishment are in practice mainly via basic measures under cross-compliance (GAEC and SMR), whilst fewer examples are reported for these measures from the second pillar funds. There is only limited information available about the extent to which these measures are included into the Greening. In non-EU MS these kinds of measures are less relevant (except Moldova).

Table 1: Comparison of the agricultural measures being implemented in the Danube countries

Nitrate pollution	DE-BAV	DE-BAD	AT	CZ	SK	HU	SI	HR	BA	RS	RO	BG	MD	UA
Whole territory	Y	Y	Y				Y				Y			
Designated NVZs				Y	Y	Y		Y	N	Y		Y	N	N
NAP/national regulations	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
GAP	na	na	na	Y	Y	Y	na	Y	N	N	na	Y	N	N
Fertilizer application	**DE-BAV**	**DE-BAD**	**AT**	**CZ**	**SK**	**HU**	**SI**	**HR**	**BA**	**RS**	**RO**	**BG**	**MD**	**UA**
Regulation beyond ND/national regulation	x		x	x		x			x	x		x	x	x
Fertilizer planning	x	x	x	x	x	x		x	x	x	x	x	x	x
Fertlizer documentation	x	x	x	x	x	x	x	x			x	x		x
National nutrient balances	x	x	x	x	x	x	x						x	x
Provision for manure spreading	x	x	x	x	x	x	x	x	x		x	x	x	x
Intensive livestock farms	**DE-BAV**	**DE-BAD**	**AT**	**CZ**	**SK**	**HU**	**SI**	**HR**	**BA**	**RS**	**RO**	**BG**	**MD**	**UA**
E-PRTR integration/registration	na	x	x	x	x	x	x			x	x	x		x
BAT/permits	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Regulation on cattle farms	x	x	x	x		x	x		x	x	x			
Manure transportation		x					x	x			x			
Provisions for manure handling	x	x	x	x	x	x	x	x	x		x		x	x
Buffer zones and erosion control	**DE-BAV**	**DE-BAD**	**AT**	**CZ**	**SK**	**HU**	**SI**	**HR**	**BA**	**RS**	**RO**	**BG**	**MD**	**UA**
Cross compliance/national law	x	x	x	x	x	x	x	x			x		x	
Greening	x				x	x			na	na	x	x	na	na
Second pillar/voluntary programs	x		x			x	x				x		x	
Soil erosion measures	x	x	x	x	x	x	x	x	x		x		x	x
Agri-environment programmes	**DE-BAV**	**DE-BAD**	**AT**	**CZ**	**SK**	**HU**	**SI**	**HR**	**BA**	**RS**	**RO**	**BG**	**MD**	**UA**
Agri-environment schemes%	58	59	80	25	45	8	31	Y	Y		13	Y	Y	
Grassland and natural landscape	x	x	x	x	x	x	x	x			x			
Organic farmig	x	x	x	x	x	x	x	x	x	x	x		x	x
Floodplain and wetland restoration	x	x	x		x	x	x				x	x		
Nutrient pollution reduction measures	x	x	x	x	x	x	x	x			x		x	
Voluntary programs	x		x			x					x		x	
Education and awareness	**DE-BAV**	**DE-BAD**	**AT**	**CZ**	**SK**	**HU**	**SI**	**HR**	**BA**	**RS**	**RO**	**BG**	**MD**	**UA**
Farm advisory services	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Environmental aspects in advisory services	x	x	x	x	x	x	x	x	x		x		x	
Obligatory participation for fund			x					x			x			
Environmental aspects in education	x	x	x	x	x	x	x	x	x	x	x		x	x
Lighthouse farms/demonstration	x	x	x	x	x				x		x		x	x

na: not applicable

Regarding the agri-environmental schemes under the CAP's second pillar high participation rates can be seen in Germany and Austria, with Czech Republic, Slovakia, Slovenia and Romania following a similar approach, and Hungary being in the process of discovering the opportunities and chances of these instruments and adapting them to their national situation. Grassland maintenance, organic farming and additional nutrient pollution reduction measures are often available. Floodplain and wetland restoration measures are supported mainly via flood and nature protection programs and to lesser extent by RDP measures. Generally little information is available on RDP funds targeted to less favoured areas (LFAs) and to alternative income sources like ecotourism or forestry. Voluntary bottom-up initiatives (EU LEADER program[33]) are in practice in some countries only.

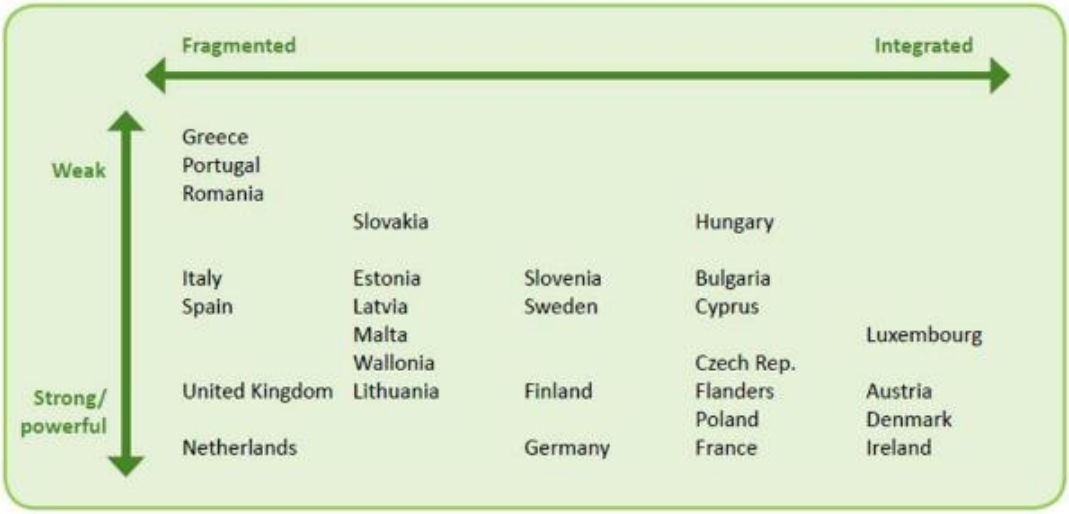
Farm Advisory Systems (FAS) are available in all countries and they usually involve environmental aspects. The participation in FAS trainings is voluntary in most of the countries. Almost everywhere, national education systems have integrated environmental aspects. Lighthouse farms and demonstration projects for awareness raising and propagating good practices have been established in several Danube countries. There might be more potential for increasing FAS efficiency in the future with growing "human resources" within the administration, i. e. specialized experts being more

[33] Liaison entre actions de développement de l'économie rurale – Links between actions for the development of the rural economy

familiar with the sometimes complicated bureaucratic procedures as well as a growing information exchange network between local initiatives.

It is widely acknowledged that not all FAS and agricultural knowledge and innovation systems (AKIS) currently in place are sufficiently up to the contemporary challenges facing European agriculture, including the very specific challenges of promoting more environmentally sustainable farming practices. Their performance varies greatly from one MS to another and sometimes from one region to another within the same MS. AKIS can be compared based on their level of strength and integration (see Figure 9, source: PRO AKIS Project[34]). In a strong AKIS, there are influential actors or organisations at national level that support the knowledge system. 'Strong' also indicates that dedicated resources are allocated to the AKIS to enhance advisory services, knowledge production and exchange. Farmers are generally being reached by and benefit from advisory services. An integrated AKIS features a coordinating structure and the system is supported by national policies on AKIS and advisory services that frame the knowledge network and actions of AKIS actors. In addition, in an integrated AKIS there are various linkages and cooperation between various actors.

Figure 9: Comparison of the strength and integration of Agricultural Knowledge and Innovation Systems in the EU countries



2.3 Measures addressing drought problems in agriculture

For decades, generations of farmers across the DRB have been developing agricultural practices connected with diverse climatic conditions in the region. Droughts have always been a challenge that farmers have to cope with. Climate change and unsustainable land management accelerated the drought problem. In general, irrigation helps to improve crop productivity during dry periods. However, the abstraction of large volumes of water from surface and groundwater bodies can affect their ecological status/potential and quantitative status.

Therefore, implementation of integrated land/water management with measures addressing drought is needed. The main CAP instruments promoting sustainable quantitative water management relate measures to supporting investments for improving the state of irrigation infrastructures or irrigation techniques and for ensuring abstractions of lower water volumes. In addition, the WFD requires ensuring that water-pricing policies provide adequate incentives for users to use water resources efficiently, including the water used in agriculture.

As a response to the serious droughts in 2003 and 2015, but also in 2017 in several regions and in 2018, various measures to mitigate or manage the impacts have been put in place in many Danube

[34] https://430a.uni-hohenheim.de/pro-akis

countries[35]. Measures range from legislative, operational and economic tools to monitoring, technical, scientific and environmental activities. Discussions on improved drought response activities are currently taking place in Slovenia. In Hungary, with the operationalization of a novel monitoring system drought management is currently being placed on new grounds. Additionally, the issue of droughts has been addressed in updated RBMPs and other management plans in Austria, Bulgaria, Croatia, the Czech Republic, Germany, Moldova, Romania, Serbia and the Slovak Republic.

Furthermore, the Climate Change Adaptation Strategy for the DRB[36] elaborated in 2012 and updated in 2018 has recommended adaptation measures for mitigating the impacts of droughts/low flows on agriculture.

Even though drought is not considered as a basin-wide water management issue, some Danube countries are addressing this issue in RBMPs and drought management plans on national and sub-basin level. In this respect, in the DRB countries specific measures are planned or already under implementation in agriculture (Table 2, source: The 2015 Droughts in the Danube River Basin[37]). These include measures to increase the efficiency of irrigation, natural water retention measures, wastewater recycling, rainwater harvesting, drought mapping/forecasting, education of farmers on water-saving measures, market-based or incentive instruments (e.g. user pays principle, penalties for over exploitation).

Advanced regional drought monitoring and forecasting in the Danube region has been improved with recently developed tools in DriDanube project[38], with special emphasis on an early drought detection platform called Drought Watch[39], in close cooperation with Drought Management Center for Southeastern Europe[40] (DMCSEE).

Table 2: Overview of measures related to 2015 droughts included in RBMPs or other management plans, with relevance to agriculture

Measures	AT	BA	BG	CZ	DE	HR	HU	RS	SI	SK	MD	ME	RO	UA
Increasing irrigation efficiency	x	/	x			x	x	x	x		x		x	/
Natural water retention measures	x	/	x	x		x	x	x	x	x			x	/
Wastewater recycling		/					x						x	/
Rainwater harvesting		/					x				x			/
Drought mapping/forecasting		/			x		x	x	x	x	x		x	/
Education on water-saving measures	x	/					x	x	x		x		x	/
Market-based or incentive instruments		/		x			x	x		x			x	/

(X – included; / – not relevant)

2.4 Outlook to the future

The future of agricultural nutrient emissions in the DRB and the costs to reduce them crucially depend on the development of international agricultural markets. Forecasts for the next decade to come are made annually by OECD and FAO[41]. In the most recent report the key messages are:

- Over the ten-year outlook period, agricultural markets are projected to remain weak.

[35] Labedzki, L. 2016. Actions and measures for mitigation drought and water scarcity in agriculture. Journal of Water and Land Development. DOI: 10.1515/jwld-2016-0007

[36] ICPDR Strategy on Adaptation to Climate Change. ICPDR, 2013

[37] The 2015 Droughts in the Danube River Basin. ICPDR, 2017

[38] http://www.interreg-danube.eu/approved-projects/dridanube

[39] https://droughtwatch.eu/

[40] http://www.dmcsee.org/

[41] OECD and FAO Agricultural Outlook 2017-2026. OECD, 2017

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

Low prices are usually a signal to reduce the intensity of production and to use less inputs. However, when farming becomes less profitable, investments in better equipment and more productive technologies are not made. Therefore, the environmental outcomes may be ambiguous and may depend on the current state of technology.

Recent scenario analyses carried out with the agricultural model CAPRI[42] confirm the judgement of OECD and FAO. Agriculture will play an important economic role in many regions of the DRB in the coming decades and the development observed so far will mainly continue. Agricultural production in the regions of the DRB is likely to become less intensive. This will also bring less emissions if the scenario assumptions (current policies remain unchanged, higher demand and higher productivity in agriculture will make a new equilibrium changing the prices) turn out to materialise in the reality. As a result, the environmental impact of agriculture is likely to decrease in the coming decades or at least will not increase further. One important reason for this is that agricultural prices of important crop products are currently expected to stagnate. This makes the increased use of yield-enhancing substances such as mineral fertilizers or pesticides uneconomical.

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

[42] https://www.capri-model.org/dokuwiki/doku.php?

3. Nutrient pollution and droughts in the DRB

3.1 Nutrient pollution

Nutrient pollution is caused by releases of nitrogen (N) and phosphorus (P) into the aquatic environment. Nutrient emissions can originate from both point and diffuse sources. Point sources of nutrient pollution are wastewater treatment plants, industrial facilities and big livestock farms. Diffuse pathways such as overland flow, urban runoff, soil erosion, agricultural tile drainage flow and groundwater flow can contribute significantly to the emissions into surface waters transporting nutrients from agriculture, urban areas, atmosphere and even from naturally covered areas. Impacts on water status caused by nutrient pollution can be recognized through substantial changes in water ecosystems. In case of nutrient enrichment, water bodies can reach a eutrophic state where the growth of algae and/or macrophytes is substantially accelerated. Eutrophication severely impairs water quality and ecosystem functioning (e.g. oxygen depletion, toxicity, overpopulation of species) and might limit or even hinder human water uses as well (e.g. recreation, fisheries, drinking water supply).

Environmental concerns have been raised in relation to agriculture in the past because nutrients were released from agricultural areas of the basin in significant amounts during the past decades. In the Danube River Basin District Management Plan (DRBMP) – Update 2015[43] nutrient pollution was identified as one of the significant water management issues in the DRB. According to the status assessment as of 2015, 75% of the total length of the surface water bodies do not achieve good ecological status or potential partly caused by nutrient pollution. Looking at the future, about 50% of the water bodies are assessed to be possibly at risk of failing good ecological status/potential by 2021. About half of them are associated with nutrient pollution, for which agriculture is one of the main sources alongside sources such urban areas and municipal wastewater. In many countries a significant proportion of water bodies are under agricultural pressure resulting in diffuse nutrient pollution of surface and ground waters and in many cases in failing good status.

Out of 11 transboundary groundwater bodies of basin-wide importance, which altogether consist of 23 national shares, poor chemical status was identified for three national parts. A risk of failure to achieve good chemical status by 2021 was identified for 6 national shares. In all cases, diffuse nitrates or ammonium pollution is the cause of the poor classification or of the risk. In the national groundwater bodies, Germany, Bulgaria and Romania have relatively high share of sampling points with high levels of nitrate concentrations[31]. In some countries, increasing trend in the share of monitoring sites with excessive levels of nitrates has been observed.

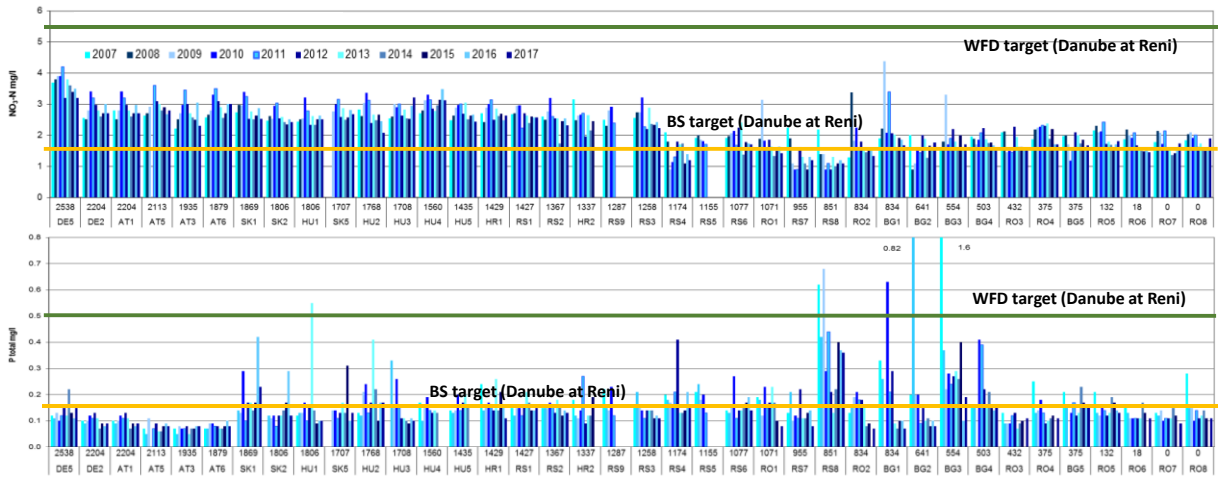
Long-term nutrient concentration data measured across the basin show a slightly decreasing or stagnant tendency (Figure 10, source: Transnational Monitoring Network, TNMN[44]). Annual values (90% percentiles) for the Danube are mainly in the range of 1-4 mg/l for nitrate-nitrogen (NO_3-N) and 0.05-0.5 mg/l for total phosphorus (TP). These values are much below the target values for good ecological status at the Danube mouth, defined by Romania in its national RBMP Update 2015[45] according to the WFD implementation (WFD target lines). However, particularly for nitrogen, they are still higher than those of the early 1960s, which represent water quality under low pressures and are considered in the DRBMPs as long-term targets to be achieved for the sake of the Black Sea (BS target lines).

[43] The Danube River Basin District Management Plan Update 2015. ICPDR, 2015

[44] Water Quality in the Danube River Basin. TNMN – Yearbook 2015. ICPDR, 2017

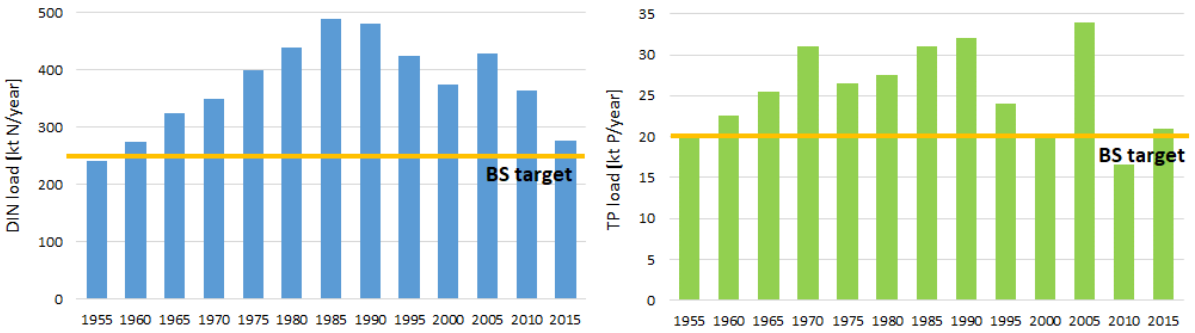
[45] https://rowater.ro/wp-content/uploads/2020/12/Planul-National-de-Management-actualizat.pdf

Figure 10: Annual NO_3-N and TP concentration data (90% percentiles) along the Danube in milligram per litre



The ultimate recipient water body of the Danube is the Black Sea, which is, being the world's most isolated sea, sensitive to eutrophication. The evolution of the nutrient loads transported by the Danube to the Black Sea (measured at Reni, Figure 11, source: TNMN) shows a clear increasing tendency from the early 1960s until the late 1980s, reaching its peak that was accompanied with a severe algae growth and eutrophication affecting the ecosystem of the north-western shelf of the Black Sea. Since then the loads have been decreasing in response to the measures implemented in the DRB but also to the declined intensity of agriculture resulted in closure of large animal farms and lower fertiliser application rates. However, the severe eutrophic conditions of the late 1980s might arise again if wastewater treatment and agriculture are not managed sustainably in the terrestrial catchment area. The recently (2005-2015) transported fluxes are 370,000 tons per year dissolved inorganic nitrogen (DIN) and 25,000 tons per year TP, which are still considerably higher than those of the early 1960s (BS target lines at 250,0000 tons per year DIN and 20,000 tons per year TP). This indicates a further load reduction potential that might be exploited for the benefit of the Black Sea (nitrogen: 35%, phosphorus: 20%). Taking into account potential impacts of climate change on hydrology (higher intensity of rainfall-runoff events, lower mean flow rates), these load reduction rates might be even higher. This would require a further decrease of both, the point source and diffuse emissions generated in the DRB.

Figure 11: Long-term annual nutrient (DIN and TP) discharges of the Danube to the Black Sea in kilotons per year



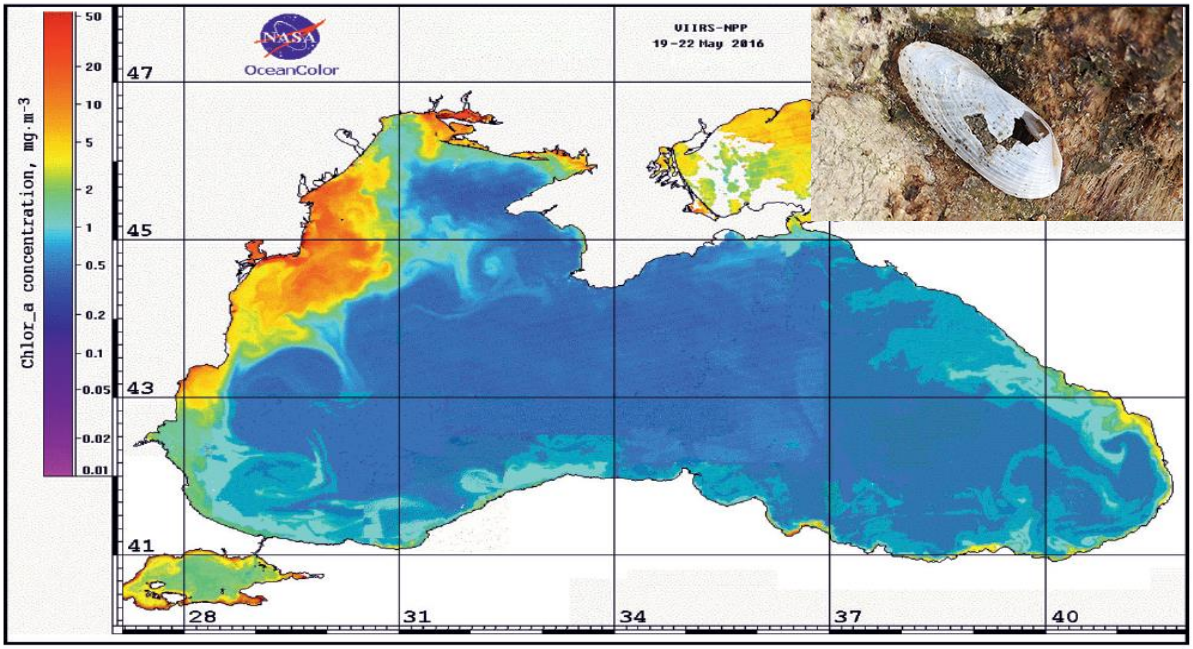
With regard to the Black Sea eutrophication status[46], a general trend of gradual chlorophyll-a concentration decrease for the entire north-western Black Sea shelf has been observed. Based on analyses of satellite images validated by field measurements within the Joint Black Sea Surveys[47], a

[46] http://emblasproject.org/

[47] Joint Black Sea Surveys 2016. EMBLAS, 2017

spatial reduction in the concentration of chlorophyll-a was observed with the increasing distance from the coast and increase of the chlorophyll-a concentration was recorded in areas under the influence of river inflow (Figure 12, source: EMBLAS). The Black Sea coastal and open waters are mostly in good environmental status with several special exclusions connected with intensive inflow from large rivers (including the Danube) and the Azov Sea. An ecological sentinel has also confirmed the positive development: the mollusc species "Angel Wings" (Figure 12, source: Institute of Marine Biology of the National Academy of Sciences of Ukraine) that is sensitive to pollution has reappeared after many years of absence. A general level of eutrophication of the Black Sea seems to get better, however, there are signs that the overall level of the oxygen-saturated layer is decreasing over the time.

Figure 12: Satellite image of the chlorophyll-a concentration in the Black, Azov and Marmara Seas on 19-22 of May 2016 in milligram per cubic meter and the Black Sea "Angel Wings" (in the upper right corner)



To assess the point and diffuse nutrient emissions from urban, agricultural and natural areas, the MONERIS model[48] has been applied for the entire DRB. The model application has a long story in the DRB resulted in a comprehensive database set up for the DRB and an enhanced model algorithm adjusted to specific regional conditions. MONERIS is an empirical, catchment scale, lumped parameter and long-term average water quality model calculating nitrogen and phosphorus emissions entering the surface waters from several point and diffuse sources and via different hydrological pathways. It also quantifies nutrient river loads at sub-catchment outlets taking into account in-stream retention processes. Scenarios for implementing control measures can be developed at the catchment scale and their effectiveness in terms of emission and river load reduction can be assessed.

The basin-wide nutrient emissions entering the surface water bodies are 605,000 tons per year total N (TN) and 38,500 tons per year TP for the reference period. Spatial distribution of the "rural" emissions (total emissions minus emissions from urban and industrial sources) is demonstrated in Figure 13 and Figure 14 (source: DRBMP – Update 2015).

[48] http://www.moneris.igb-berlin.de/index.php/homepage.html

Figure 13: Long-term average (2009-2012) area-specific TN emissions from rural sources into surface waters at sub-catchment scale in kg per hectare and year

Figure 14: Long-term average (2009-2012) area-specific TP emissions from rural sources into surface waters at sub-catchment scale in g per hectare and year

Pathway and source apportionment of the total emissions is presented in Figure 15 and Figure 16 (source: DRBMP – Update 2015). Diffuse pathways clearly dominate the total releases by 84% (TN) and 67% (TP). For TN, subsurface flow (all subsurface flow components including slow and fast base flow and interflow) is the most important diffuse pathway with a proportion of 54%. In case of TP, soil erosion (32%) and urban runoff (18%) generate the highest emissions. Regarding the sources, agriculture (TN: 42%, TP: 28%) and urban water management (TN: 25%, TP: 51%) are responsible for the majority of the nutrient emissions.

Figure 15: Share of sources in the overall TN emissions in the DRB for 2009–2012; on the left: pathways, on the right: sources

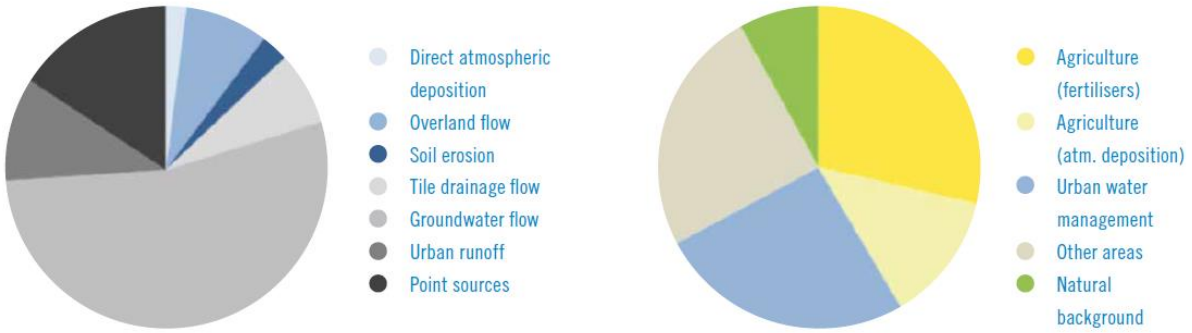
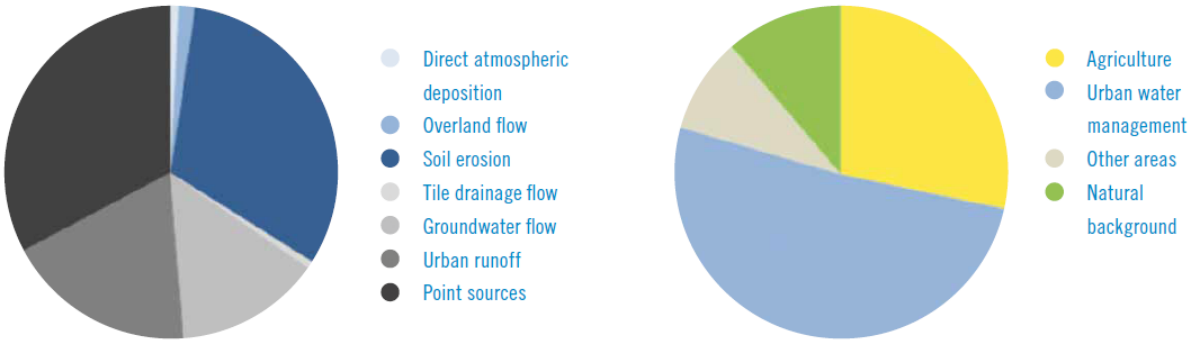
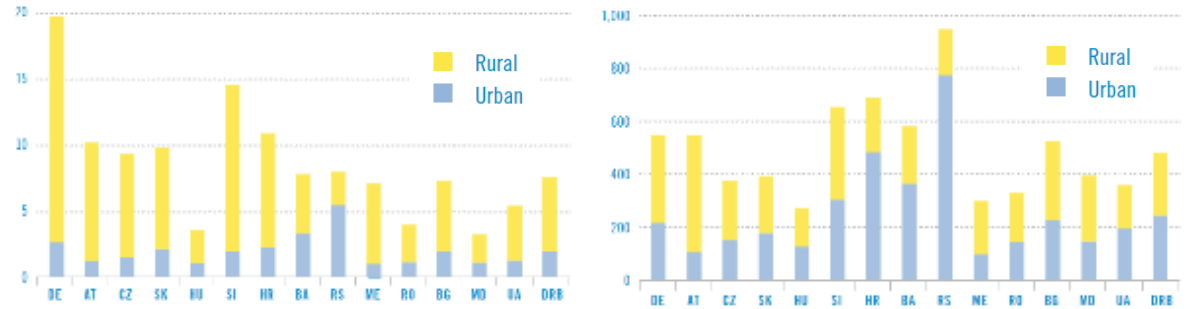


Figure 16: Share of sources in the overall TP emissions in the DRB for 2009–2012; on the left: pathways, on the right: sources



Country contributions can be seen in Figure 17 (source: DRBMP – Update 2015). Rural emissions have a principal role in nitrogen emission generation. In case of phosphorus, upstream countries show similar contribution of the urban and agricultural areas to the overall phosphorus emissions. Moving downstream in the basin, urban areas become more dominant indicating the high potential to improve wastewater treatment by introducing phosphorus removal.

Figure 17: Rural and urban specific nutrient emissions in the Danube countries for 2009–2012; on the left: TN in kg per hectare and year, on the right: TP in g per hectare and year



Future scenarios on projected nutrient emissions according to different management conditions were assessed in the DRBMP – Update 2015. Scenario results show a great potential of reducing nutrient river loads transported to the Black Sea towards the level of around the 1960s if nutrients are properly managed in the basin. According to the vision scenario describing a sustainable agricultural development and balanced nutrient management in the DRB (low long-term nutrient surplus and high utilization of good agricultural practices), the potential reduction of the basin-wide agricultural emissions and for nitrogen and phosphorus is about 20% and 40%, respectively. Nevertheless, countries with low current surplus values would show increasing emissions from agriculture due to the projected substantial intensification of agriculture in comparison to the current conditions with low intensity. On the other hand, an unsustainble intensification scenario (highly intensified agricultural activities with high long-term surpluses but without applying appropriate management practices) would increase the basin-wide agricultural emissions by 55% (TN) and 10% (TP).

3.2 Water scarcity and droughts

Water scarcity is a man-made phenomenon. A recurrent imbalance that arises from an overuse of water resources caused by consumption being significantly higher than the natural renewable availability. Water scarcity can be aggravated by water pollution (reducing the suitability for different water uses) and during drought episodes. Drought, on the other hand, is a natural phenomenon. A temporary, negative, and severe deviation along a significant time period and over a large region from average precipitation values (deficit in rainfall), which might lead to meteorological, agricultural, hydrological, and socio-economic drought, based on its severity and duration.

Drought may cause economic damage mostly in the peak spring or summer seasons when the irrigation demand is the highest and a time-limited (potentially significant) water shortage occurs. Water scarcity poses a permanent limit to the economic development of a region or to the ecological status of ecosystems. Drought may occur in different water-scarce conditions, droughts under high water scarcity require specific attention from a risk management perspective.

Attention to water scarcity and drought events in Europe has increased in the recent decade, particularly following the widespread droughts in 2003 that affected over 100 million people, a third of EU territory. Additional water scarcity and drought events have since affected portions of Northern, Southern, and Western Europe in 2007, 2011, and 2012 (see Figure 18, source: ETC/ICM[49]). These recent trends highlight the significance of growing imbalances in water supply and availability in Europe, specifically in the context of climate change

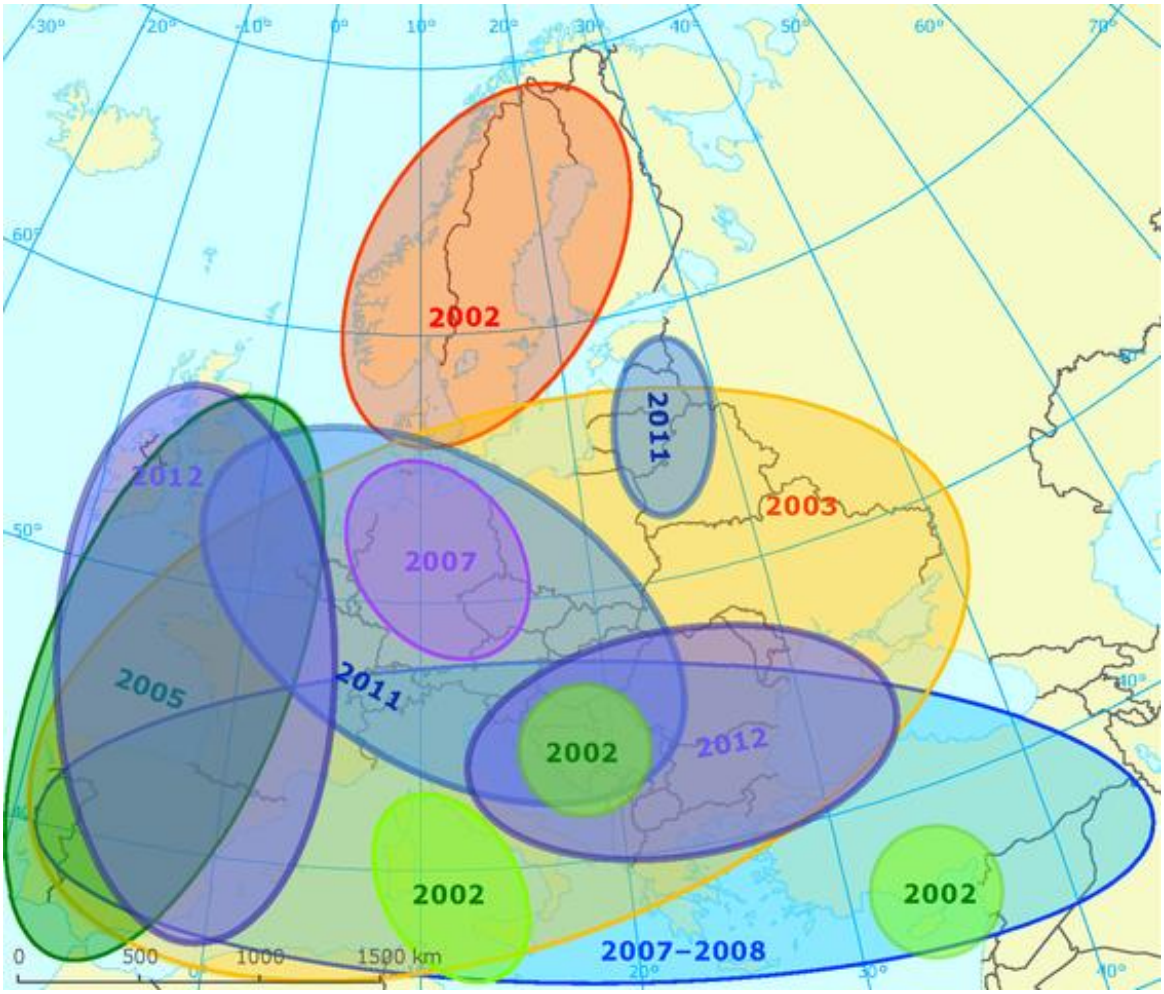
Similarly to the summer of 2003, a large part of continental Europe was affected by a severe drought in summer 2015, as a consequence of the combination of rain shortages and very high temperatures which resulted in high plant water requirement (evapotranspiration) levels. Significant parts of the DRB were concerned by the 2015 droughts, which negatively impacted different water-dependent economic sectors, vegetation and the aquatic environment.

Significant drought phenomena were experienced in Austria, Bosnia and Herzegovina, Croatia, the Czech Republic, Germany, Hungary, Moldova, Serbia, the Slovak Republic, Slovenia and Ukraine. Bulgaria and Romania did not report significant droughts phenomena in 2015.

In almost all regions of Austria and in Bavaria, deficits in precipitation were observed between February and August 2015 compared to the long-term average. As for the Czech Republic, the summer of 2015 ranked among its most serious historical drought episodes. In Hungary in particular the Southern and Eastern part of the country were affected by the drought; for the Slovak Republic the significant drought phenomena did not occur on the whole territory of the country but only in some regions.

[49] European Topic Centre on Inland, Coastal and Marine Waters, http://www.eea.europa.eu/data-and-maps/figures/main-drought-events-in-europe

Figure 18: Water scarcity and drought events in Europe in the period 2002 – 2012



The largest precipitation deficit noticed in the Ukraine referred to areas in the north-west part of the country with traditionally sufficient rainfall. In summer, countries of the Balkan Peninsula also faced a heat wave. The majority of the Peninsula faced extreme high air temperatures. In some places, absolute maximum air temperature records were observed, together with water balance deficits. This was in particular the case for Slovenia (from June to August 2015), the northern and eastern part of Bosnia and Herzegovina, the lower central and southern part of Moldova, Croatia and Serbia.

For those Danube countries, which experienced a significant drought phenomena during 2015, agriculture was by far the most impacted economic sector. Austria, Bosnia and Herzegovina, Czech Republic, Croatia, Hungary, Serbia, the Slovak Republic and Moldova reported high impacts on agriculture. In areas with periodical irrigation in Austria, such as the Marchfeld region, water demand was significantly above the long-term average due to precipitation deficits starting with March/April and continuing in June/July 2015. The most significant impact was on corn production (Austria, Croatia, Serbia, Slovak Republic). Other countries observed also lower yields at later harvested plants like soya, sugar beet or rape seed.

High impacts on the ecology were reported by the Czech Republic and Moldova; lower but still relevant impacts were described for Austria, Bosnia and Herzegovina, Germany, Croatia, Hungary, Serbia and the Slovak Republic. Many small water courses were reported as completely dry in the Slovak Republic, mainly in the Morava River Basin. In Austria, in the most affected regions were side arms of larger rivers or headwater of some small streams which suffered from extremely low water levels or even fell dry, e.g. side arms of the Danube river east of Vienna (Lobau). In few areas in Bavaria, eutrophication in small rivers with low flow velocity was observed. As for Moldova, large

scale fires of dried vegetation were reported. Impacts of the drought 2015 were observed in the forestry sector (Croatia) and fish farming (Czech Republic).

In 2017, significant parts of the Danube region were hit by drought that affected different water-dependent economic sectors, vegetation and water resources and caused significant economic losses (Figure 19 and Figure 20, source: DriDanube Project):

- Austria: 140 million EUR in agriculture (crop failure), fish mortality;
- Bosnia and Herzegovina: 126 million EUR in agriculture, 40 % losses in energy production;
- Croatia: 125 million EUR in agriculture, >4,000 fires over 86 500 ha of the Adriatic coast, water supply shortages at islands;
- Czech Republic: 120 million EUR in agriculture;
- Hungary: 51,000 ha of agricultural land damaged;
- Montenegro: 50% lower yield in viticulture, >40% losses in energy production, fish mortality;
- Romania: reduction of Danube flow of 60 %, higher electricity prices;
- Serbia: substantial losses in agriculture, water shortage, dried-up lakes, disturbed energy production, >1 billion EUR/all sectors;
- Slovakia: 20-40% lower crop yields, dried-up rivers, hydrological drought;
- Slovenia: 65 million EUR in agriculture.

Figure 19: Damaged crop field due to the 2017 drought in the DRB

Figure 20: Extreme low flow due to the 2017 drought in the DRB

In subsequent years (2018, 2019 and 2020), serious summer droughts were observed in the northern and eastern parts of the DRB resulting in rainfall and soil moisture deficit, vegetation stress and prolonged low flow periods.

According to the DRB Climate Change Adaptation Strategy, drought and water scarcity situations are likely to become more intense, longer and more frequent in the future. As a consequence, water demand for livestock and irrigation can become higher. The most affected rivers will likely be the smaller tributaries in the Southern and Eastern part of the DRB during summer time.

Part B – Strategy

4. Policy recommendations for implementing good agricultural practices in the DRB

There is clearly a huge potential and opportunity in the current post-2020 CAP legislative proposals for MS that wish to focus more on raising the level of environmental and climate ambition to do so. The 'enhanced conditionality' that forms the foundation of the new green architecture of the CAP is especially notable as a significant advance on the current combination of 'cross-compliance' and 'greening rules'.

With respect to expenditure on environment and climate, the proposed text of Article 92 is very important. It states that all EU MS "shall aim" to make a greater overall contribution to achieving the specific agri-environment and climate objectives in their CAP Strategic Plans as compared to the contribution to the sustainable management of natural resources and climate action through support in the current programming period. With smaller rural development budgets available for all MS, this ensures that the 35% minimum obligation for spending on agri-environment-climate interventions will not lead to back-sliding and to a reduction in absolute spending on environment and climate. However, in view of the need to address the environmental and sustainability challenges of agricultural production in the DRB, MS and neighbouring countries in the DRB are encouraged to strengthen their ambitions.

The ICPDR strongly supports the efforts to be made in both, the EU and non-EU MS for achieving sustainable agriculture thus ensuring the profitability of agriculture and the vitality of rural areas, to safeguard water resources and to achieve and maintain good status of ground- and surface water resources. The ICPDR is willing to contribute to the national CAP Strategic Plans of the EU MS and to similar strategies/programs/plans of the non-EU MS in the DRB by highlighting the potential of effective funding mechanisms and instruments for improving nutrient and drought management practices and by transferring relevant knowledge and best practice examples to the Danube countries.

4.1 Guiding principles for agro-environmental policy making

From the water management perspective, the national agro-environmental policies, while providing socio-economic support for the farmers, should contribute to the achievement of two main objectives of the water sector in line with the WFD requirements:

1) protection of surface and groundwater bodies of the DRB, especially reduction of nutrient pollution originating from agriculture;
2) increasing the efficiency of agricultural water use, especially concerning irrigation of agricultural land.

National agri-environmental policies should be based on an **appropriate combination** of three fundamental pillars:

- compulsory measures to ensure minimum standards for good agricultural practices also complying with basic water management and environmental obligations;
- economic incentives (voluntary measures), going beyond legal requirements by making additional environmental commitments and compensated by public money (e.g. via subsidies) and/or sponsored by private initiatives or public private partnerships (Non-Governmental Organisations, NGOs);
- advisory services and platforms for knowledge sharing, innovation and cooperation, building on agricultural research and technology development.

Countries are encouraged to undertake an assessment on the existing gap to good water status to understand how much work needs to be done by implementing agri-environmental policies. A certain amount of it is to be achieved by compulsory actions, the focus should be on effective policy implementation and inspection procedures to ensure compliance. This could allow designing the

correct structure and set of voluntary measures to achieve WFD objectives accompanied with appropriate advice and knowledge exchange.

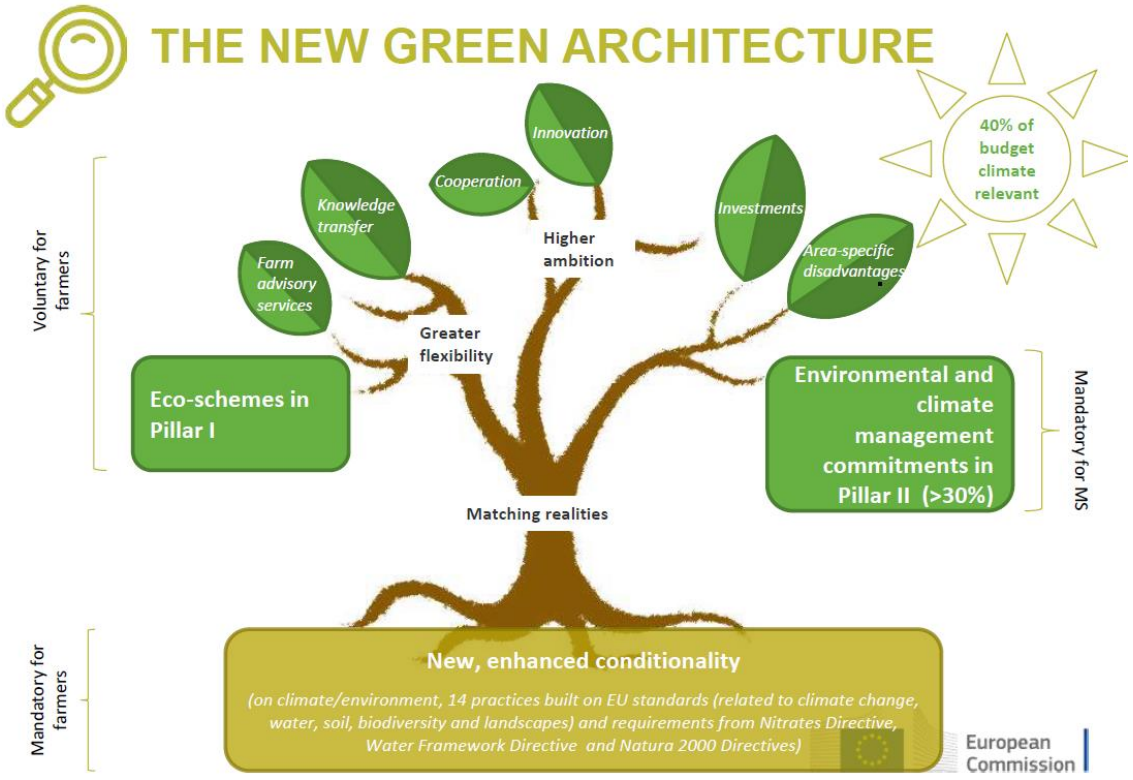
In economic terms, agro-environmental policies usually apply two basic principles:

- polluter pays principle: actors responsible for environmental problems (e.g. pollution) are economically burdened with the aim of reducing emissions or environmental impacts (e.g. obligatory measures);
- beneficiary pays principle: in accordance with this principle, the group of people who benefit from an improvement make contributions to compensate the issuers for reducing the environmental burden (e.g. voluntary measures).

All these pillars and principles are relevant for EU MS as they are key elements of the CAP but they could be applicable also in non-EU MS in the course of their national policy reforms and preparation to EU-accession.

With the new CAP-proposal the EC aims to give MS the support, flexibility and evidence-based tools they need to be as ambitious as possible in tailoring the design and funding of environmental and climate schemes while fostering smart and competitive agriculture, ensuring food security and strengthening socio-economic situation of the rural areas. The EC has proposed a new post-2020 '**green architecture**' for interventions that must be included in the post-2020 national CAP Strategic Plans (Figure 21, source: EC).

Figure 21: The "green infrastructure" of the new CAP proposal



The key elements of the post-2020 CAP green architecture are:

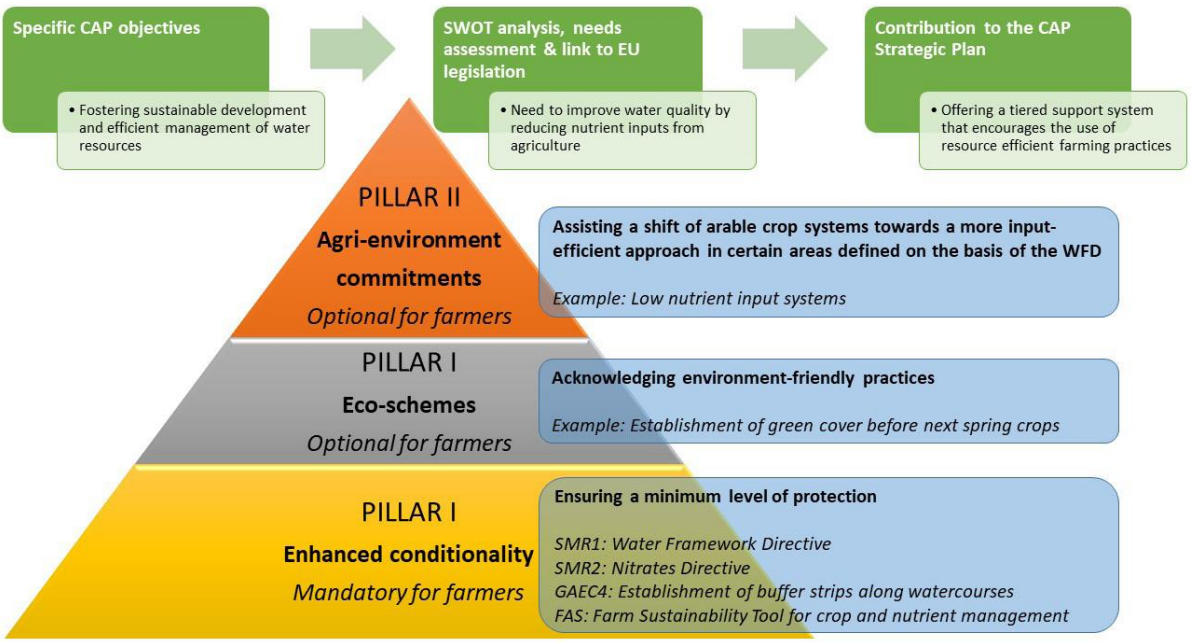
- An improved system of 'enhanced conditionality' that will merge and streamline two existing elements – 'greening' and 'cross-compliance' – from the current 2014-2020 CAP and will be mandatory for all farmers to comply with in order to receive area- and animal-based CAP support payments (whether in Pillar I or Pillar II). It will integrate elements from the WFD (controlling diffuse phosphorus pollution, abstractions and impoundments), the ND and SPD (certification of users and equipment, restriction on the use in protected areas, pesticide

handling, storage and disposal rules). MS will have to set out how conditionality will be implemented in practice within their CAP Strategic Plans.

- A new way of funding for the environment and climate in the form of so-called 'eco-schemes' for farmers, with funds from the CAP's direct payments budget (Pillar I). At least 25% of the budget for direct payments will be allocated to eco-schemes. To receive the full payment under Pillar I, farmers will need to opt into the eco-schemes and implement their measures. These eco-schemes will be mandatory for MS to design and implement, but voluntary for farmers to adopt.
- Continued support from the CAP's rural development budget (Pillar II) for environment- and climate-relevant management practices, investments, knowledge building, innovation and cooperation while also promoting sustainable use and efficient management of natural resources. This will offer an on-going wide range of support possibilities. MS will be obliged to programme at least 35% of their CAP rural development budget on interventions of most direct value for the environment and climate. Moreover, they will be able to transfer extra funds from Pillar I to Pillar II for environmental purposes.
- Enhanced advisory services, support for knowledge transfer and fostering of innovation, investments and cooperation within strengthened national / regional AKIS.

MS need to choose and combine the different CAP green architecture tools and define their content so that they can deliver tangible results on environment and climate protection. Figure 22 (adapted figure, taken from: EC Report on CAP environmental benefits[50]) demonstrates a hypothetical example of how countries might decide to use elements of the CAP's future green architecture in drawing up their CAP strategic plan in order to improve water quality. The MS identify their needs related to a particular specific objective and design a general method for addressing those needs. The method comprises of implementing the related obligations of the conditionality system, one (or more) Pillar I eco-scheme(s) and Pillar II support for environment and climate-related management commitments.

Figure 22: An example for implementing the CAP green infrastructure



[50] https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/key_policies/documents/cap-post-2020-environ-benefits-simplification_en.pdf

The increased environmental and climate ambitions of the CAP proposal have several implications to the CAP Strategic Plan preparation process[51]. Environmental and climate actions should be result-driven and each MS will have to show how its CAP Strategic Plan is contributing to the achievement of EU environmental and climate objectives. While the Strategic Plans will provide high level of discretion and choice granted to MS in terms of content and approach, they also have to ensure:

- consistency and coherence between Pillar I and Pillar II support;
- consistency with existing environmental legislation;
- simplification and decreased administrative burden on farmers;
- appropriately reflected specific circumstances of the MS.

Developing effective and sustainable management options allowing to meet the objectives of both, the agriculture and water management requires strong involvement and cooperation of the agricultural and water sectors. Therefore, it is crucial to establish a proper **partnership-dialogue** between the agricultural and water sector to develop a cross-sectoral and mutual understanding of needs, expectations and constraints of the two areas. This desirable dialogue can lead to joint actions, which can be beneficial for water and the aquatic environment leading to sustainable water management, while keeping the needs of the agricultural sector in mind.

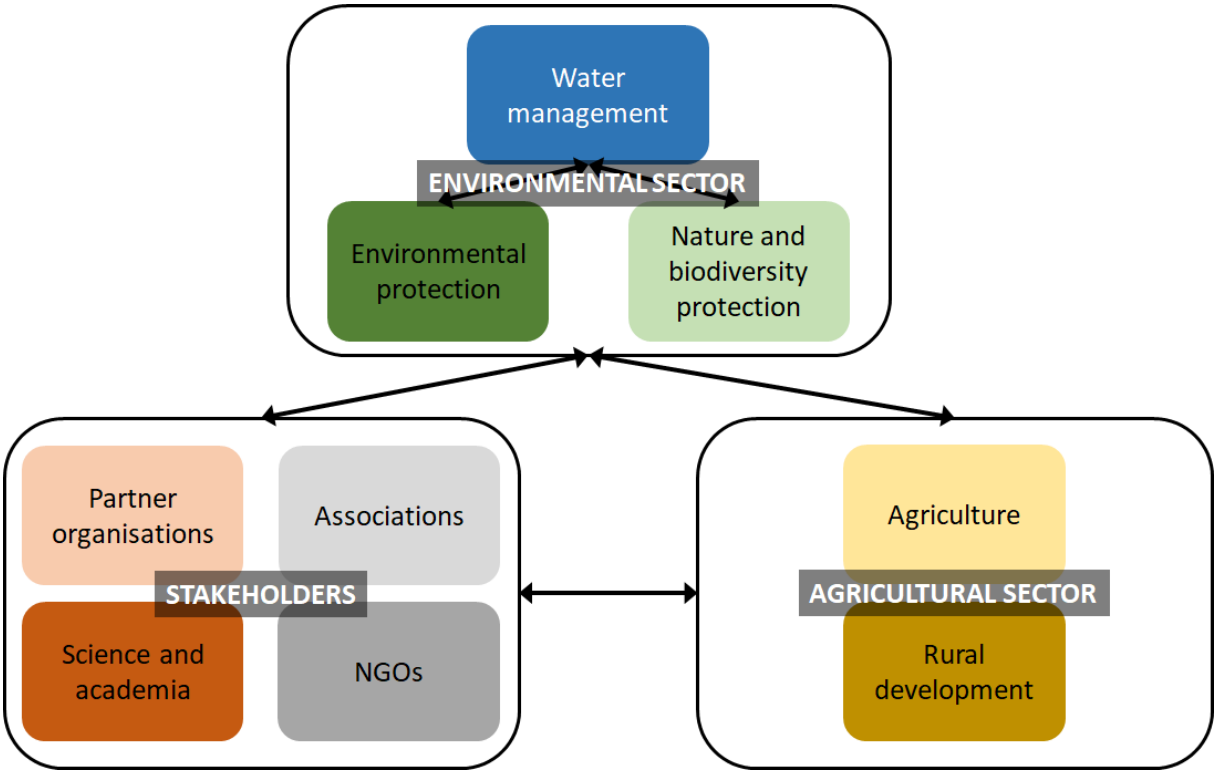
There is a huge need for finding synergies between the CAP interventions and the measures identified in the RBMPs in order to trigger efficient nutrient management, to avoid water scarcity and to contribute to the achievement of the environmental objectives of the WFD. Therefore, **active and early involvement** of environmental authorities in EU MS in all relevant CAP strategic planning processes is necessary using transparent procedures. This includes taking environmental knowledge and planning tools (e.g. RBMPs) into closer consideration to support the design of relevant and effective CAP Strategic Plans at national level. Table 3 summarizes the most important phases of the CAP Strategic Plan preparation, where water management expertise is expected to be provided by the water sector, therefore close cooperation of the agricultural and water administration are desirable. Partnership should be developed with other environmental departments/administration bodies (nature protection, environmental protection, climate change adaptation), the agricultural sector, economic and social partners, other relevant stakeholders as well as the civil society in order to jointly and effectively work on the CAP Strategic Plan elaboration (three-tier cooperation, Figure 23). This diverse national CAP network can enhance the contribution of the Strategic Plans to the achievement of the Green Deal targets and the CAP environmental ambitions and can facilitate efficient exchange between various actors involved.

Table 3: Water expertise to be provided for the development of CAP Strategic Plans

CAP Strategic Plan preparation	Water expertise
Performing a SWOT (strengths, weaknesses, opportunities and threats) analysis and an assessment of needs	Make available or use the data provided for Article 5 of the WFD (river basin analysis), monitoring data, data from the RBMPs and other evidence from academia or stakeholder
Developing an intervention strategy	Link the strategy to water legislation and show how the CAP Strategic Plan will help achieving water-related targets
Describing the direct payments, sectoral and rural development interventions specified in the strategy	Translate measures under the RBMPs into interventions under the CAP and design relevant measures in the next RBMPs in a sufficiently detailed/targeted way that they can be readily uptaken in the CAP Strategic Plans

[51] European Parliamentary Research Service report on CAP strategic planning - Operational perspectives, PE 640.139

Figure 23: Three-tier cooperation for the CAP Strategic Plan development



Efforts have to be made to strengthen coordination, consistency and complementarity between all relevant EU policies and funds to ensure that they work in an integrated way and in good synergy and double funding or financing practices with adverse environmental impacts is avoided. Countries should ensure sufficient time for strategic planning how to fully utilise the green architecture under the CAP and to effectively contribute to the Green Deal objectives. Moreover, measuring and assessing the performance and results of the environmental and climate interventions will likely require significant investment in electronic information systems for data collection.

Targeted information should be provided to the policy makers on what is behind the existing (environmental) problems, what objectives need to be achieved, what specific actions and cost-effective measures may be considered from the CAP portfolio or even beyond it for national planning that can work in different sites/conditions and what indicators should be defined to measure implementation progress. This should be ensured also for the advisory services to help farmers choosing concrete measures (e.g. which nutrient, which form of the nutrient, which place, which form of transport pathway is to be managed).

Compliance with the WFD and achieving its objectives require a wide range of **result indicators** (e.g. measures in place, areas with management commitments for environment and climate) but also need to define certain **environmental targets** and **impact indicators** that might be beyond the farm borders (e.g. nutrient concentrations in ground and surface waters, nutrient surplus in a catchment area). In the CAP Strategic Plan context, a key element is a shift from a one-size-fits-all approach towards a greater focus on performance. The progress of the implementation of the plans will be monitored and evaluated by the EC using output, result and impact indicators within the Performance Monitoring and Evaluation Framework. MS should assess how the Strategic Plans will contribute to the achievement of the targets and should harmonise the national WFD-related indicators with those of the CAP evaluation system.

Recently, a vade mecum (handbook) was published by the EC[52] to provide support for public authorities in ensuring that farmers and other rural land-managers comply with their environmental obligations. The handbook provides national administrations with guiding principles and recommendations on environmental compliance assurance in rural areas, i.e. all kind of interventions of public authorities to make sure that obligations are fulfilled by duty-holders (e.g. farmers, foresters). Environmental compliance assurance is provided by the appropriate combination of compliance monitoring, enforcement and

4.1.1 Guiding principles for obligatory measures

Obligatory measures within the enhanced conditionality have to include several provisions of the relevant **water legislation**, particularly those of the WFD, ND and SPD in order to enhance the environmental and climate performance of agriculture. Including certain WFD and SPD obligations as new SMRs will provide further benefits for water management. Moreover, new GAECs have been proposed including peatland and wetland preservation, grassland preservation in NATURA 2000 sites and integrating and updating several elements of the "greening" such as maintenance of permanent pastures, crop diversification and ecological focus areas (EFAs). Countries should ensure that the relevant requirements of the water legislation are appropriately translated into CAP interventions and the measures of the RBMPs and CAP Strategic Plans are coordinated.

Tailor-made design of obligatory measures according to specific needs and objectives within the CAP Strategic Plans or in similar equivalent programs in non-EU MS should have a priority. Individual MS should define a **national standard** for each of the GAECs and SMRs, but have considerable flexibility to tailor the implementation of these standards to the particular situations of their farmers based on their specific local needs and characteristics. This flexibility can even extend to implementing individual standards differently for different regions. Countries are encouraged to take into account their agricultural structures, favourable and disadvantaged areas, crop rotation, environmental impacts and potential administrative burden when designing and implementing measures. In relation to the CAP Strategic Plans, the approach adopted by each MS will have to be consistent with its SWOT analysis and needs assessment results. The role of farm advisory services will be critical in helping to improve the sustainable management of agricultural holdings, with particular focus on the relationship between farm/land management and certain standards.

Measures controlling nutrient pollution should be **targeted** especially though not exclusively at emission hot-spots. Hot-spots are areas where excess nutrients accumulate (e.g. large animal farms), fertilisers and/or manure are applied over large areas and potentially in considerable amounts (e.g. intensified agriculture) and areas which are effectively connected to surface water bodies (high transport rate of nutrients from field to water). SMR and GAEC measures related to nutrient pollution control should also be targeted at areas where there is a significant risk of local resource loss (e.g. via soil erosion or leaching) or water pollution (in ecologically vulnerable or sensitive areas or fields with high nutrient transfer rates). The requirements should be adjusted to the risks accordingly (i.e. basic standards everywhere but more advanced measures required in hot-spot/vulnerable zones) but also to the main problems causing nutrient pollution. Identifying the pollution hot-spots and vulnerable/sensitive areas would require certain knowledge of hydrological and water quality related processes or at least of several relevant parameters such as slope, soil type, crop types, distance to and sensitivity of water bodies, etc.

Specific attention should be paid to the **farming structure** in the countries. Direct support should be transformed to a fairer and more targeted instrument. The needs of smaller and medium sized farms should be better addressed by reducing income gaps between different farm sizes by using more effective redistribution mechanisms. In many countries, there is a relatively small number of large farms (especially animal farms) and agro-industrial holdings which may represent or develop into

[52] Environmental compliance assurance in rural areas - Vade mecum. EC, 2021, ISBN 978-92-76-27246-5, https://op.europa.eu/en/publication-detail/-/publication/278dd7f1-69bb-11eb-aeb5-01aa75ed71a1

potential pollution hot-spots if mobilisation of nutrients via precipitation, runoff or leaching occurs. For large pig and poultry farms a revised reference document on best available techniques was recently released by the EC[53], which is binding for EU MS and may serve as a source of knowledge for the others. On the other side, too demanding new challenges and requirements for the large number of small-scale farms might be difficult to meet without appropriate financial support and might need appropriate transition periods for implementation. Generally, certain environmental standards and targets should be achieved everywhere, whereas the standards might differ for different regions or for different farm structures. Public funding and the duration of transition periods can also be kept flexible. This is extremely important for small farms, which are frequently subsistence farms facing economic difficulties and for which compliance with demanding regulations can be a huge challenge.

Countries need to establish appropriate and effective **control mechanisms** to check whether farming practices comply with obligations for receiving support. Strict controlling of a huge number of small farms is rather challenging, it should focus on those agro-industrial holdings, which potentially generate more pollution or are located in pollution-sensitive areas. Checking the compliance with basic standards should be ensured with as little administrative burden as possible on both, the authorities and the farmers, whereas the more demanding control schemes should be targeted at the larger holdings and pollution hot-spots.

Compliance monitoring should focus on helping farmers to identify implementation gaps and appropriate measures rather than simply issuing penalties against farmers. A flexible control system with warnings and assistance would give farmers a chance to deal with the problem without receiving a penalty but would also penalise those who do not implement the required measures in a certain amount of time.

4.1.2 Guiding principles for voluntary measures

Countries should examine closely the potential of the new and innovative payment system of **Pillar I** called '**eco-schemes**' that will pay farmers to protect the environment and the climate. Eco-schemes are expected to address broad environmental and climate issues, to cover a wide range of measures related to these issues and to tackle key environmental hotspots. MS will be obliged to make one or more eco-schemes available, but participation in the schemes will be voluntary for farmers. MS will be free to design the extent and content of the eco-schemes depending upon national targets and ambitions as well as on local needs and circumstances and will decide at national level how much money to spend on them. This might include agricultural practices such as enhanced management of permanent pastures and landscapes, nutrient management, food and nesting packages for pollinating species, agro-ecology and organic farming etc. The requirements of the eco-schemes must go beyond those of the baseline of 'enhanced conditionality', must be consistent with the CAP Strategic Plan and the schemes must not pay for commitments by farmers, which are paid for by other CAP tools. Moreover, they shall contribute to reach the EU Green Deal targets.

Eco-schemes will be funded from MS' direct payment budgets based on an annual payment per eligible hectare. They can be offered as "top-up" to farmers' direct payments providing an incentive for additional income support or remunerating the provision of public goods by agricultural practices beneficial to the environment and climate, or as stand-alone schemes with environmental payments compensating income losses and extra costs incurred by farmers. They are hugely flexible and the fact that the schemes can involve annual ("one-year-at-a-time") rather than multi-annual commitments could make them particularly attractive to farmers. Since MS will also be free to set the schemes' content and budget (within their CAP Strategic Plan), they should make sure that the schemes accurately match the particular needs of their farmers and territories and that they do not add a major administrative burden for national and regional authorities. Nor should they make life complicated for farmers. Budgets for the eco-schemes should be carefully planned. On one hand, they should offer

[53] https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-available-techniques-bat-reference-document-intensive-rearing-poultry-or-pigs

sufficient funds to ensure potential contribution to environmental targets. MS will have the option to dedicate a large percentage of the Pillar I budget to eco-schemes without the need for co-financing so that direct payments can be partly transformed to payments for ecosystem services. On the other hand, substantial lowering of basic direct payments in favour of the "top-ups" might trigger concerns on how to ensure fair income support for the farmers.

Overall, the eco-schemes are a unique opportunity for MS to invest in, incentivise and reward their farmers for going beyond the mandatory and baseline requirements of conditionality and enhance environmental and climate performance based on local needs and conditions.

Several agricultural practices could be supported by eco-schemes[54]. In particular, practices of organic farming (conversion, maintenance), agro-ecology (crop rotation, cover crops, winter crops, climate resilient crops, mixed grassland species), agro-forestry (establishment and maintenance of natural landscape features and silvo-pastures), high nature value farming (enhancing semi-natural habitat, biodiversity areas, low intensity agriculture, mixed cropland-pasture systems), carbon farming (soil conservation, peatland and wetland rewetting, crop residue application, grassland management, extensive grasslands), precision farming (nutrient management planning, optimizing fertilizer amounts, increasing irrigation efficiency), enhanced nutrient management (soil sampling, more stringent nitrate pollution prevention), managing crop water demand (switching to less water intensive crops, changing planting dates, optimised irrigation schedules) and erosion control (contour buffer strips, strip-cropping, terracing) may receive eco-scheme funding. Detailed guidelines on which practices could be supported through eco-schemes, how to avoid double funding with second-pillar measures, what kind of measures are the most appropriate and how to choose the payment model are available in the report[55] of the European umbrella organisation for organic food and farming (IFOAM Organics Europe).

Countries should commit to the development of DRB-specific approaches for **voluntary agri-environment-climate interventions** supported by **Pillar II**. These offer a wide range of tools for compensating farmers that adopt the best possible environmental and climate practices. It remains important that all measures put in place by MS support specific national, regional, and local needs regarding the environment and the climate – with the additional requirement that, in certain cases where appropriate, they also build upon those actions funded in the new 'eco-schemes'. The interventions remain mandatory for all MS to design and offer, but are voluntary for farmers and other eligible beneficiaries to join and adopt. Payments will be granted to those who voluntarily go beyond the baseline mandatory standards (the 'enhanced conditionality') for several years to maximise their actions for the environment and the climate. The multi-annual payments will be calculated as compensation for additional costs / income foregone as a result of the commitments concerned. Pillar II funds also offer the possibility to compensate certain difficulties and constraints (e.g. natural disadvantages, constraints related to WFD implementation and NATURA 2000[56] sites) in order to ensure that farming can continue. Countries should make use of these instruments to compensate farmers taking measures to implement the WFD. Moreover, Pillar II payments should also be used to support knowledge building, investments, innovation and cooperation. Table 4 (source: EC Report on CAP environmental benefits) shows the main features of the agri-environment-climate interventions in comparison to those of the eco-schemes.

Increasing experience is available around Europe regarding how to tailor and implement more efficient and effective agri-environment-climate measures in accordance with local and national needs and conditions, with increased emphasis upon collective/cooperative approaches and results-based payment schemes for more sustainable soil and water management. These can deliver actions by farmers that are

[54] EC Brochure List of potential agricultural practices that eco-schemes could support, https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/key_policies/documents/factsheet-agri-practices-under-ecoscheme_en.pdf

[55] Lampkin N, Stolze M, Meredith S, de Porras M, Haller L, Mészáros D (2020) Using Eco-schemes in the new CAP: a guide for managing authorities. IFOAM EU, FIBL and IEEP, Brussels

[56] http://ec.europa.eu/environment/nature/natura2000/

significantly more effective for the environment and the climate than some of the more traditional approaches that have been rolled out in many DRB countries. Whilst there may be capacity issues in some countries regarding their development, there are forums already developed for sharing experience and recommendations, notably via the European Network for Rural Development[57].

Table 4: Comparison of Eco-schemes and Agri-environment-climate interventions

Aspect	Eco-schemes	Agri-environment-climate commitments
Source of funding	Pillar I budget – without co-financing by Member States	Pillar II budget – with co-financing by Member States
Possible beneficiaries	Farmers	Farmers, other land managers (e.g. environmental NGOs)
Payments' link to land	Payment per hectare Land concerned must be eligible for direct payments	Payment per hectare Land concerned need not be eligible for direct payments
Obligatory/voluntary	Member States must make provision for them Participation voluntary for farmers	Member States must make provision for them Participation voluntary for farmers and other potential beneficiaries
Nature of commitments	Annual (i.e. "one year at a time")	Multi-annual contracts (usually of 5-7 years)
Calculation of premia	Compensation for additional costs / income losses arising from commitments concerned OR Additional payment to basic income support (no particular rules over premium level)	Compensation for additional costs / income losses arising from commitments concerned

Collective or cooperative approaches to agri-environmental land management by farmers are increasingly seen as important, not just for achieving environmental objectives, but also for social and economic reasons. The main added value of promoting collective action is that a much larger area potentially benefits compared to actions by single farmers. Collective approaches can take many varied forms depending on the issue to be addressed and the situation locally. They can be bottom up initiatives (the initiative coming from farmers or other local actors); community-led (bringing a variety of stakeholders together to generate action); top down (the initiative coming from public authorities); or a combination of these (where actions are coordinated between practitioners and authorities).

A **result-based payment scheme** (RBPS) is an agri-environmental or similar scheme in which the payment depends on achieving a threshold value of one or more environmental indicators (the 'result indicators'), which are clearly linked to specific environmental objectives. In most cases, the result indicators are verified each year by the farmer and controlled by the Paying Agency, using the same methodology. Choosing the right result indicators is a critical part in developing an effective RBPS, but once selected, farmers are free to choose how to achieve the required result. RBPS are increasingly being used as an alternative or addition to traditional management-based payment schemes (MBPS) and a well-designed RBPS is significantly more 'environmentally cost-effective' since support is paid against the delivery of results, not the implementation of prescribed management practices. A RBPS also encourages farmers to take greater ownership of environmental resource management (e.g. improving soil and water management on their land) and, with appropriate advisory support, also

[57] https://enrd.ec.europa.eu/home-page_en

develop a better understanding of the long-term benefits of good environmental management for productivity and overall profitability.

The result indicators should be carefully selected and developed from a set of discrete and measurable features and a fair evaluation system of the achievements is required for reasonable time periods. This can ensure that the progress achieved as a result of a public investment is properly recorded and that farmers are not left alone with the costs of a sustainable farming practice when the implementation is not successful for reasons beyond the farmers' control or responsibility. The methodology for measuring the result indicators must be described clearly within the legal agri-environment-climate contract, to enable verification by farmers and control agencies, using the same methods. Moreover, the threshold value of the result indicator to be reached for payment should be reasonably set to achieve the desired environmental objectives or improved resource management. In this respect, more threshold values may be more effective rather than a single threshold system.

Bearing in mind that finding methods of measuring the incremental improvements in soil and water condition during an RDP programming period is a significant challenge, a 'hybrid' MBPS/RBPS approach to soil and water schemes seems to be the best way forward[58]. In this scheme, management-based requirements are verified and paid for annually and farmers are offered a 'bonus' results-based payment where the intended results are achieved. In addition, RBPS should include compulsory training requirements for participating farmers. For controlling diffuse nutrient pollution from farmland or in a catchment, RBPS may be effectively linked to on-farm nutrient management planning or a cooperative approach of different land managers.

Voluntary measures should be **financially attractive**, practicable and acceptable for farmers. Many of the existing measures in agri-environmental schemas are already very effective at reaching the objectives, but not sufficiently well rounded and financially attractive to farmers. Some of these measures can be economically beneficial for farmers (e.g. effective use of fertilisers and manure) so the economic interest of the farmers should be clearly demonstrated by advisory services. However, other measures would bring additional costs (e.g. erosion control measures) or income losses (e.g. landuse conversation) for the farmers when adopting and implementing them. These should be reasonably incentivised to make them attractive for farmers.

The concept of **Smart Villages**[59] should be promoted as an emerging opportunity for rural communities. The Smart Village is a relatively new concept, which could be particularly attractive for the DRB region. It brings renewed attention to the needs and potential of rural areas, offers the opportunity to channel multiple resources to rural communities without excessive bureaucratic burden. Smart Villages are communities in rural areas that use innovative solutions to improve their resilience, economic, social and/or environmental conditions, in particular by mobilizing solutions offered by digital technologies and by building on local strengths and opportunities.

4.1.3 Guiding principles for advisory services

Within the CAP Strategic Plans countries should encourage **FAS** to support farmers in improving the overall sustainable management of their holdings by ensuring knowledge transfer to farmers and thereby supporting adherence to environmental standards and commitments. The strengthened advisory services should provide appropriate education, trainings and information system to improve the economic and ecological performance of land managers especially in the context of an efficient nutrient and water management and of sustainable farm and land management. They also have to help familiarise farmers with the obligations deriving from the SMRs of the conditionality system (e.g. ND, WFD, SPD) and could help farmers to implement eco-schemes and environment and climate interventions more effectively.

[58] Result-based payment schemes (RBPS) for Soil and Water in Europe. Report of the European Network for Rural Development (ENRD) Thematic Group (TG) on sustainable management of water and soils. ENRD, 2018

[59] https://enrd.ec.europa.eu/enrd-thematic-work/smart-and-competitive-rural-areas/smart-villages_en

Advisory services should be accompanied and supported by proper education and curricula. High-level education institutes (universities, colleges) should organise and offer education in the field of agricultural water management, integrating knowledge of traditional water management, agricultural sciences and environmental engineering. FAS should recommend to consult agricultural water management experts for specific farming activities (e.g. intensive irrigation, drainage, runoff control, water retention and storage). Countries may consider to make the involvement of agricultural water management experts compulsory for particular activities or in case certain farm size or used water amount thresholds are exceeded.

Moreover, advisory services should facilitate to transfer the results of agricultural research and innovation into day to day farming practice and should be able to deliver up-to-date technological and scientific information to farmers. This can be ensured by integrating farm advisory services into the **AKIS**. Countries should make a significant investment in building an AKIS for sustainable agriculture in the DRB. Besides the immediate obligation to strengthen farm advisory services, it is important to keep in mind the wider objective of strengthening the AKIS. They integrate all of the people and organisations that generate, share and use knowledge and innovation for agriculture in all interrelated fields (value chains, environment, society, consumers, etc.). AKIS should enhance knowledge flows and strengthen links between research and practice and should upgrade the technological, farm management, interactive and digital knowledge and skills of the farm advisors. They should provide sufficient capacity to more effectively link researchers, advisors and farmers and should incentivise researchers to produce outputs that are understandable by practitioners. They should organise specific training sessions for researchers in cooperation with farmers and farm advisers and should make better use of on-farm demonstrations for researchers to present their results and exchange informally with farmers and advisers.

Much greater attention should be paid on fostering and disseminating innovation and building the capacity of all actors (farmers, advisers, researchers, small and medium-sized enterprises etc.) to engage with the **European Innovation Partnership** for Agricultural Productivity and Sustainability (EIP-AGRI)[60]. The EIP-AGRI aims to bring together all relevant actors working in agriculture as partners in agricultural innovation. They support cooperation between research and innovation partners so that they can achieve better and faster innovative solutions and research results that can more easily be put into practice. Cooperation can be ensured by RDP funds for setting up Operational Groups to work on pilot projects, develop new products, involve actors from different regions, promote activities. RDPs can also offer support for knowledge transfer, establishing networks, funding Innovation Support Services. Another possibility is to implement Horizon Europe[61] multinational and multi-actor innovation and research projects, particularly in the mission areas ‘Adaptation to climate change including societal transformation’ and ‘Soil health and food’. Opportunities presented by LIFE funding[62] should also be explored.

Advisory services and AKIS should support the **digital transition in agriculture**. Agriculture and rural areas are and will be changing significantly with the availability and advancement of modern technologies, accompanied by smart devices, solutions and specialization strategies as well as digitised supporting tools, their increased "intelligence", autonomous behaviour and connectivity (e.g. satellite observation, precision farming, geolocation services, autonomous farm machinery, drones). This trend will become more and more relevant for the AKIS. Farmers need to be supported with the digital transformation process (technologies and data) since many farmers may be unable to keep up with new technologies. Moreover, the AKIS itself will become more and more “digitised” with new models and decision support tools becoming rapidly available. AKIS should be linked to the Knowledge Hub on

[60] https://ec.europa.eu/eip/agriculture/en

[61] https://ec.europa.eu/info/horizon-europe_en

[62] https://cinea.ec.europa.eu/life_en

Water and Agriculture[63], which has been established by the Joint Research Centre of the EC and will ensure access to relevant EU-wide data on water and agriculture. In strong connection to the digitalization, rural areas and farmers need to be provided with the accessibility to fast and reliable internet connection and the possibility to develop digital skills.

Advisory services should strongly and actively recommend and promote **nutrient management planning** in farming. Targeted instruments and tools to assist farmers in an efficient use of fertilizers at field level adjusted to crop nutrient demand and soil nutrient content are highly beneficial. Nutrient management plans go beyond simple/classical fertiliser application recommendations by tailoring nutrient management by the farmer to the specificities of the cropping system and local context of the farm. Such plans are particularly valuable for raising awareness amongst farmers about resource efficiency and the implications of excessive or inappropriate use of chemical fertilisers or organic manures for the environment, rather than just focusing on crop requirements and yield optimisation. Nutrient management plans are to be primarily prepared at the field level within a farm or holding and may have a result indicator of reaching a certain level of nutrient surplus. However, the plans can apply to broader areas where collective action may be needed or where nutrient management is critical to achieving water quality objectives in a particular area, such as a catchment or NVZs.

The CAP proposal introduced a new digital tool called **Farm Sustainability Tool for Nutrients (FaST)** that has been developed with the aim of facilitating more sustainable use of fertilisers by all farmers in the EU by providing recommendations / alerts concerning fertiliser/manure application, whilst also boosting the digitisation of the agricultural sector. Using the tool as an obligatory measure in the post-2020 CAP (originally planned as GAEC) is ambitious and potentially very challenging in the context of the small and medium-sized farms and the age structure of farm holders in the DRB. However, the principle of nutrient management planning remains fundamentally important and should be promoted more actively to farmers via information, knowledge exchange and advisory activities funded in the new CAP Strategic Plans. Where appropriate, due consideration should also be given to supporting their development and implementation via agri-environment-climate interventions and/or other funding sources (e.g. LIFE).

Advisory services should also put emphasis on **soil management** and should support farmers to properly implement erosion control, soil conservation and natural water retention measures. Maintaining the soil structure, preserving its humus and water content and reducing surface run-off are key management activities that help minimise nutrient losses and hold water in the soil.

4.2 Key policy recommendations for the DRB countries

In its Position Paper on CAP and water management[64], the ICPDR has greatly welcomed the efforts of the EC to improve the environmental and climate performance of EU agriculture and emphasises the importance of post-2020 CAP support for:

a) the achievement of the objectives of the WFD, the ND and other related environmental legislation in the DRB and;
b) the broader pursuit of equitable and sustainable development of rural communities, including farmers, farming households and agricultural workers, in the DRB region.

The ICPDR has also emphasised the need for well-balanced and tailor-made measures, including enhanced mandatory and voluntary requirements on the national level within the CAP Strategic Plans, to ensure both efficient nutrient management and the vitality of rural areas, whilst at the same time avoiding water scarcity.

[63] https://water.jrc.ec.europa.eu/

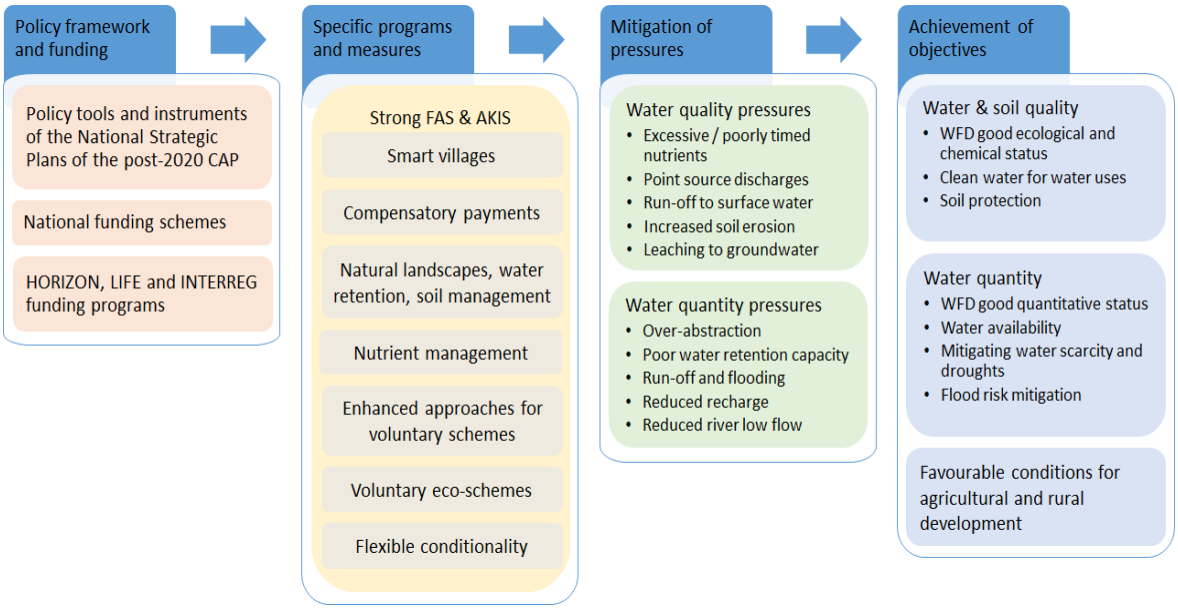
[64] The post-2020 Common Agricultural Policy and Water Management in the Danube River Basin. ICPDR, 2019

With respect to these ambitions, the post-2020 CAP could significantly contribute towards the realization of the ICPDR vision for sustainable agriculture in the DRB[65] by decoupling agricultural production from nutrient pollution and water scarcity in a cost-effective way. In order to address the environmental and sustainability challenges of agricultural production in the DRB with higher ambitions and to effectively contribute to the objectives of the Green Deal, Danube countries are particularly encouraged to (details for each recommended action can be found in Chapter 4.1):

1) Design flexibly the obligatory measures under the enhanced conditionality;
2) Examine closely the potential of the new, flexible and potentially very effective voluntary 'eco-schemes', in particular for supporting agro-eonomy, agro-forestry, organic farming, precision farming and carbon farming practices;
3) Commit to the development of DRB-specific approaches for voluntary agri-environment-climate interventions with particular focus on development and implementation of collective / cooperative approaches and result-based payment schemes for more sustainable soil and water management;
4) Make a significant investment in strengthening FAS and building an AKIS for sustainable agriculture in the DRB and pay much greater attention to capacity building of all actors (farmers, advisers, researchers, small and medium-sized enterprises etc.);
5) Strongly and actively recommend and promote applying nutrient management planning in the farming practices to assist farmers in an efficient use of fertilizers at field level adjusted to crop nutrient demand and soil nutrient content via information, knowledge exchange and advisory activities funded in the new CAP Strategic Plans;
6) Put emphasis on soil management practices and support farmers to properly implement erosion control, soil conservation and natural water retention measures;
7) Make use of the funding instruments to compensate certain difficulties and constraints (e.g. natural disadvantages, constraints related to WFD implementation and NATURA 2000 sites).
8) Promote community-led local developments under the LEADER programme and the concept of Smart Villages as an emerging and potentially well-suited opportunity for rural communities in the DRB making the best use of technology and social innovation.

The available policy tools, recommended actions and measures, the possible pressure mitigation and the achievable environmental, social and economic objectives are summarized in Figure 24.

Figure 24: Agri-environmental policy implementation scheme



[65] ICPDR Guidance Document on Sustainable Agriculture - Introduction, Context & Opportunities. ICPDR, 2019

4.3 Synergy between agricultural policies and river basin management

Bearing in mind that there is a need for integrated implementation of the agricultural and water management strategies and programs, finding linkages between the interventions of the relevant agricultural policies and the measures identified in the RBMPs is highly beneficial. Table 5 represents potential synergies between measures to reduce agricultural pressures to reach goals of the RBMPs (WFD) and actions in agriculture (current and proposed CAP).

Table 5: Synergies between interventions of the CAP and measures of the RBM Plans

Corresponding synergies for agriculture sector	RBMP – water management sector	
	Basic measures (art. 11.3.a-l, Annex VI A of the WFD)	**Supplementary measures (art. 11.3.a-l, Annex VI B of the WFD)**
CAP 1st and 2nd pillar (under CAP 2014-2020)	• **ND – SMR1** (Water protection against pollution of nitrates from agriculture sources) • **Buffer strips – GAEC1** (creation / maintenance of buffer strips along water courses • **Groundwater Directive – GAEC3** (Protection of groundwater against pollution) • **SPD** – SMR10 • **Plant Protection Products** – SMR10 • **Biocidal products** – SMR10 • **Water management regulation, inspection and control – GAEC 2** (compliance with authorization procedures, in case of use of waters for irrigations in agriculture) • **Drinking water protection**	• **Reduction of soil erosion** - GAEC 4 (Providing minimum soil cover), GAEC 5 (Minimizing soil erosion) • **Arable land conversion** into pastures and pastures conservation - GAEC 7 • **Organic agriculture** • **Crop rotation and diversification** • **Application of good practices** (GAP, GP in Farms, GP for PPP) and best agricultural practices and techniques • **Advising and training farmers** • **Ensuring efficiency in water use** (i.e. irrigations) • **Natural water retention** • **Biodiversity and landscape** – GAEC 7 (retention of landscape features, a ban of cutting hedges and trees during the bird breeding and nesting season, and as an option, measures for avoiding invasive plant species) • **Other measures (beyond the legislation)**
New CAP proposal (2021-2027)	• **CAP Strategic Plans (or similar equivalent programs in non-EU MS), i.e.** - **Climate change** – GAEC 1 (Maintenance of permanent grassland), GAEC 2 (Protection of carbon-rich soils trough appropriate protection of the peatland and wetland), GAEC 3 (Ban on burning arable stubble) - **Water** – SMR1 (WFD Article 11(3)(e) and Article 11(3)(h) as regards mandatory requirements to control diffuse sources of pollution by phosphates), SMR2 (ND Articles 4 and 5), GAEC 4	• **CAP Strategic Plans (or similar equivalent programs in non-EU MS)** - **Water** – Farm Sustainability Tool for Nutrients (FaST), within Farm Advisory Systems, facilitating more sustainable use of fertilizers by all farmers (including the digitization of the agricultural sector) - **Biodiversity and landscape** – GAEC 9 (Maintenance of non-productive features and area, including a minimum share of agricultural area devoted to non-productive features or areas, retention of landscape features, a ban of cutting hedges and trees during the bird breeding and nesting season, and as a option, measures for avoiding invasive plant species); GAEC 10

Corresponding synergies for agriculture sector	RBMP – water management sector	
	Basic measures (art. 11.3.a-l, Annex VI A of the WFD)	**Supplementary measures (art. 11.3.a-l, Annex VI B of the WFD)**
	(Establishment of buffer strips along the water courses), - **Soil protection and quality** – GAEC 6 (Minimum land management under tillage to reduce risk of soil degradation including on slopes), GAEC 7 (No bare soil in most sensitive period), GAEC 8 (Crop rotation) - Plant protection products – SMR12 (PPP Regulation), SMR13 (SPD) • **Environment and climate management commitments in Pillar II (for MS)** - implementation of the program of actions for reduction of nitrates pollution from agriculture sources - applying the recommendations of the Code of Good Agriculture Practice - control mechanisms to check whether farming practices comply with obligations for receiving support	(Ban on converting or ploughing permanent grassland in Natura 2000 sites • **Eco-schemes in Pillar I** (go beyond the baseline requirements of conditionality) - direct payment budgets and based on an annual payment per eligible hectare - Certain budget of Pillar I funding should be made available for eco-schemes at the beginning of the funding period - i.e. enhanced management of permanent pastures and landscapes nutrient management agro-ecology and organic farming • **Voluntary agri – environment - climate interventions supported by Pillar II (for farmers)** - compensating farmers that adopt the best possible environmental and climate practices for: - the additional costs / income foregone arising from the commitments concerned - certain constraints (e.g. natural disadvantages, constraints related to WFD implementation and NATURA 2000 sites) • **Collective or cooperative approaches** to agri-environmental land management by farmers • **Result-based payment schemes** for more sustainable soil and water management • **Farm advisory services** - to support farmers by appropriate education, trainings and information system in improving the overall sustainable management of their holdings by ensuring knowledge transfer to farmers • **Agricultural research and innovation to practice** by Agricultural Knowledge and Innovation Systems (AKIS)

Also the inter-linkages of the measures under CAP and RBMPs need to be harmonised regarding the impact and result indicators to ensure greater environmental ambition in the CAP Strategic Plan and the achievement of the environmental objectives of the WFD (see Table 6). Development needs and local interests might lead to further considerations such as the inclusion of additional result indicators related to specific objectives.

Table 6: Impact and results indicators for environmental objectives

CAP Strategic Plan		RBMP	
Impact indicators	**Results indicators**	**Impact indicators**	**Results indicators**
I. Foster sustainable development and efficient management of natural resources such as water and soil		**I. Ecological and chemical status of the surface water and groundwater bodies**	
Reducing soil erosion: Percentage of land in moderate and severe soil erosion on agricultural land	**Improving soils**: Share of agricultural land under management commitments beneficial for soil management	Concentration of nutrient in surface water bodies	Number of surface water bodies in good ecological status / potential
Improving water quality: Gross nutrient balance on agricultural land	**Protecting water quality:** Share of agricultural land under management commitments for water quality	Concentration of nutrients and pesticides in surface water and groundwater bodies	Number of surface water and groundwater bodies in good ecological and chemical status
Reducing nutrient leakage: Nitrate in groundwater - Percentage of groundwater stations with N concentration over 50 mg/l as in the ND	**Sustainable nutrient management:** Share of agricultural land under commitments related to improved nutrient management	Concentration of nitrate in surface and groundwater bodies	Number of surface water and groundwater bodies in good ecological and chemical status
Reducing pressure on water resource: Water Exploitation Index Plus (WEI+)	**Sustainable water use:** Share of irrigated land under commitments to improve water balance	**Reducing pressure on water resource:** Water Exploitation Index Plus (WEI+)	Number of groundwater bodies in good quantitative status Number of surface water bodies in good ecological status/potential (from hydrological point of view)
II. Contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes		**II. Conservation of the natural habitats, wild flora and fauna species and all bird species related to water bodies (including Natura 2000 sites)**	
Increasing farmland bird populations: Farmland Bird Index	**Supporting sustainable forest management:** Share of forest land under management commitments to support.	**Reduction of the pressures from agriculture on natural habitats, wild flora and fauna species and all bird species related to water bodies** and which are located in	Number of water bodies for which specific objectives are reached for the protection of water-dependent species and habitats

CAP Strategic Plan		RBMP	
Impact indicators	**Results indicators**	**Impact indicators**	**Results indicators**
		wild status on the national territory	
Enhanced biodiversity protection: Percentage of species and habitats of Community interest related to agriculture with stable or increasing trends	**Protecting forest ecosystems:** Share of forest land under management commitments for supporting landscape, biodiversity and ecosystem services		
Enhanced provision of ecosystem services: Share of utilized agricultural area covered with landscape features	**Preserving habitats and species:** Share of agricultural land under management commitments Supporting biodiversity conservation or restoration		
	Supporting Natura 2000: Area in Natura 2000 sites under commitments for protection, maintenance and restoration	Ban on converting or ploughing permanent grassland in Natura 2000 sites	Surface of permanent grassland in Natura 2000 sites
III. Contribute to climate change mitigation and adaptation		**III. Climate change mitigation and adaptation**	
Improving farm resilience: Index	**Adaptation to climate change:** Share of agricultural land under commitments to improve climate adaptation	**Reduce the impact of the drought** on agriculture land Ensuring minimum ecological flow	Number of water bodies to be preserved as good quantitative status when there are using in irrigation for agriculture Specific measures to reduce the water consumption (i.e. area of land where there is applying the crop rotation, etc.)
Contribute to climate change mitigation: Reducing GHG emissions from agriculture	**Reducing emissions in the livestock sector:** Share of livestock units under support to reduce GHG emissions and/or ammonia, including manure management	**Manure management** operating under Code of GAP	Share of livestock farms applying GAP

4.4 Guiding principles for managing droughts

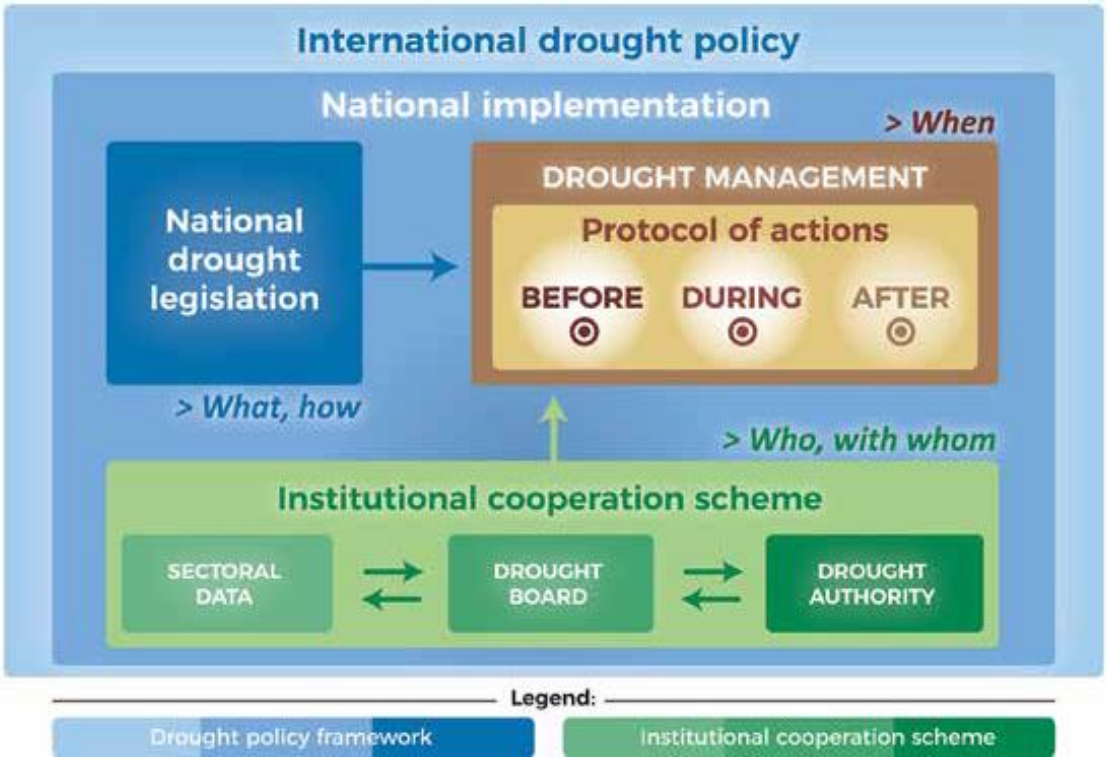
4.4.1 Danube Drought Strategy

Knowing the actual stage of drought conditions at any time is the basic prerequisite of successful drought management but knowing who is doing what and when at each respective stage is an equally important condition of success. In recent decades, great progress has been made in drought monitoring while drought management part has, unfortunately, not improved accordingly. Due to missing legislation in DRB countries that would specifically address the drought issue and give guidance on its holistic management, cooperation among relevant institutions is weak resulting in drought primarily being managed in "crisis-mode", when its intensity is already alarming.

With a further DriDanube outcome, a Drought Strategy proposing framework for improved drought management in the Danube region, national authorities have been provided with clear guidance on becoming more efficient and comprehensively tackling drought management issues. The Strategy is based on an optimal drought management model (ODMM), a concept that organizes already-existing legislation and institutional roles in a country in an optimal way of cooperating and reacting in different stages of drought. The model was built on existing knowledge and recommendations on integrated drought management that encourages drought resilience, mitigates drought risk, and addresses disaster risk reduction, climate adaptation strategies and national water policies.

The first of the three elements of the model is drought policy framework, which consists of all sectoral documentation that in any way addresses drought issues and outlines a country's objectives related to drought. As its second element, the model proposes a structure of competent institutions and their cooperation, through which existing national drought policies are implemented. This structure should define who is involved in the implementation of drought policies as well as their roles, responsibilities and inter-institutional connections (Figure 25, source: DriDanube Project).

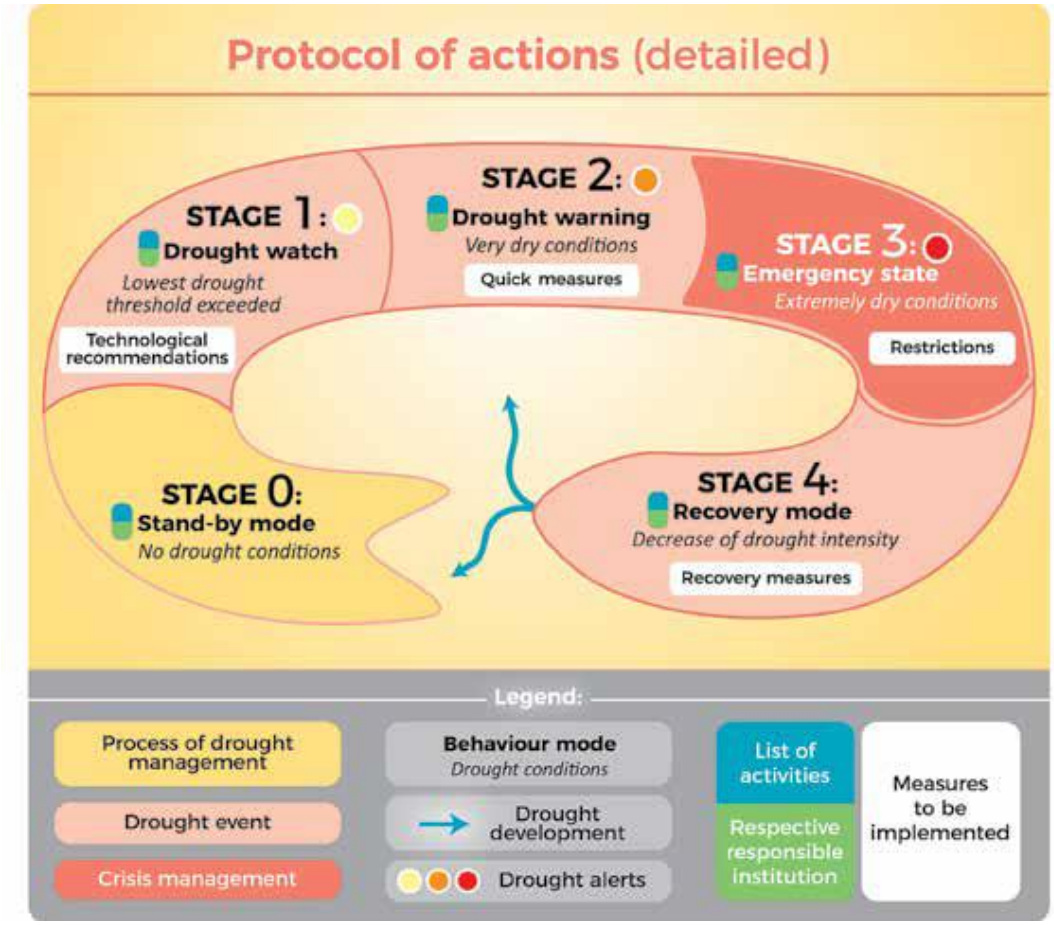
Figure 25: Optimal drought management model



Finally, the model's driving force is a proposed protocol of action, which comprises the previous two elements regarding the process, i.e. when the respective activities are carried out, depending on changing drought conditions. It uses a 5-stage drought scale and specifies the corresponding actions

and behaviour that institutions should adopt. Drought stages in the protocol are separated by thresholds, which are freely defined by the individual country, taking into account their national specificities and characteristics (Figure 26, source: DriDanube Project).

Figure 26: Protocol of action with 5-stage drought scale



This way, the model acts as a tool for institutional capacity building in terms of their strengthened cooperation and support in the decision-making process. It encourages holistic drought management by linking outcomes of national drought monitoring with a cooperative response, according to the changing drought conditions. It was conceptually developed so that it can be adopted by any country, regardless of its internal organisations of national bodies.

The Drought Strategy and the ODMM model provide a proactive drought management framework as a foundation for boosting collaboration among responsible institutions, water-related sectors and countries in the Danube region. It allows practitioners on the ground to design ODMM according to national circumstances. All the efforts need to be directed towards the sustainability of the developed proactive management and further strengthening the international cooperation to tackle drought in the Danube region.

4.4.2 Policy recommendations

The DriDanube Project developed several general recommendations for the implementation of the Danube Drought Strategy specifying how to enhance capability of the society to better cope with droughts on the long run:

- Initiate political will and call for coordinated legal approach. Policy coherence related to drought on the regional/national level is one of the key guiding principles for successful drought management. Countries are encouraged to acknowledge drought as a national priority.

- Encourage collaboration and partnerships. Strengthen existing partnerships between organizations and stakeholders and connect with other institutions and initiatives to gain extra knowledge and good practices.
- Provide sufficient resources. Countries are advised to make national efforts ensuring sustainable drought management, such as investing in data, products and tools and building human capacity.
- Develop and adopt a national strategic document on drought management. It shall provide a strategic view on the drought issue, set long-term goals and a manner of achieving them and define a matrix of drought timeline and corresponding course of institutional actions.
- Form a drought impact inventory to be managed by national authorities. Creation of regular, sectoral and centralized impact inventories enables the national authorities to have an insight into drought events and their damages and presents a basis for any further legal steps.
- Put results into practice. It is necessary to introduce available tools into daily work routine (i.e. using national data sets, operational use of tools in institutions, etc.).
- Share knowledge and help raise awareness. Continue searching for good practices to guide drought management activities, with emphasis on learning process and preventive actions.
- Establish water-related learning curriculums at all levels, especially in elementary education.

5. Recommendations on sustainable and cost-effective agricultural measures in the DRB

5.1 Toolbox for measures to mitigate nutrient pollution

As agriculture is far from homogenous in the Danube region, two basic management types can be identified:

- Favourable areas with high soil productivity and good climate conditions may attract investments and experience sustainable intensification to increase competitiveness. This constellation would lead to a desirable sustainable development to improve the economic situation in rural areas, would give perspectives to people to stay and live there but would also fully integrate natural resources protection. A clear legal framework and an efficient implementation of cross-compliance/conditionality and "greening"/eco-schemes should be in the focus here, backed up by appropriate control schemes.
- On the other hand, disadvantaged areas, i.e. areas with natural constraints and unfavourable social conditions, quite often with a considerable part of high value natural land, are threatened by depopulation and land abandonment, which need to be counteracted by integrated RDPs including an economic basis for site-specific, traditionally extensive agricultural systems. In these regions but also in areas of high ecologic interest (e.g. riparian zones, floodplains and wetlands) agri-environmental programmes and compensations for ecosystem services (e.g. biodiversity, landscape maintenance and biotope management) and other income options for the agricultural sector like sustainable tourism are necessary.

In both cases, competent advisory services need to be made available.

The following measures have been identified and recommended for further consideration to reduce nutrient emissions from agriculture into water bodies. They should be further discussed especially with representatives from the agricultural sector and should provide a toolbox to help governments develop tailor-made programmes within the respective national framework and put funding schemes, targeted measures and actions in place in accordance with national and local needs and goals.

To allow the most efficient use of (mostly limited) available financial resources the cost-effectiveness of measures should be taken into account, which may also require additional research according to local conditions and constraints, which vary considerably in the DRB and thus do not allow generalized "one size fits all" recommendations. Other crucial issues are improved advisory services and better and faster connections between scientific research and practical farming. Thus, agriculture should ultimately be able to provide valuable contributions towards the implementation of the DRBMPs as well as towards meeting the targets of the WFD and the EU Floods Directive.

5.1.1 Favourable areas

In areas favourable for intensive agriculture the efficiency and sustainability of water, soil and nutrient management need to be enhanced. Since here agricultural production will play an important role, it is crucial to avoid high nutrient losses and significant nutrient emissions into surface waters. Measures can be grouped into source control and transport control type interventions. While source control measures reduce nutrients excess and prevent their mobilisation via precipitation, runoff and leaching, transport control measures intercept and reduce the transfer of nutrients from agricultural land into surface waters. Usually, an appropriate suite of measures is needed to reduce the risk of nutrient pollution that combines different measures according to local circumstances and needs. Many of these measures are part of the ND Action Programmes, the provisions of the Codes of Good Agricultural Practices.

Fertilizer application should only be permitted within clear and efficient regulations (e.g. ND provisions, national regulations). Correct timing and placement, the right fertilisers and their amounts

should be ensured by appropriate rules and careful planning thereby avoiding application under unfortunate weather, topography and soil conditions or in vulnerable or sensitive areas. Modern and calibrated fertiliser spreaders should be promoted in order to ensure appropriate and accurate application to crops.

Animal husbandry and the necessary manure storage capacity should be correlated with the available area for manure uptake. Cooperation between neighbouring farms in manure distribution should be promoted. On the other hand, unrealistic (uneconomic) distances for manure transport that potentially increase the risk of good agricultural practices being undermined should be avoided. The correlation (stocking rate) could be specified at the municipal or sub-regional level. In regions with excess manure, transport to regions with lower stocking rates might be necessary in some cases though it is regarded as a "second best" solution. Large animal farms should need a permit for manure management related measures in order to ensure that environmental standards are met. BAT (or equally ambitious provisions) should be applied throughout the whole region (regardless whether EU-member or not), especially for facilities located within areas prone to nutrient losses. Storage of manure should be safe and the storage capacity should be enough to overcome closed periods (periods when application is not allowed) and times when application is not possible (e.g. in case of maize). Application should occur based on plant needs and allow a high nutrient efficiency to minimize losses to the environment. Spreading devices should meet high and regularly controlled technical standards and spreading practice should minimize ammonia emissions and odours.

Nutrient balancing and management that estimates the required optimal fertilizer application rates taking into account the available soil nutrient content, the crop uptake and potential nutrient inputs into soil via atmospheric fixation and deposition, nutrients available in manure, soil organic matter mineralisation and crop residue recycling should be supported. In case of P, legacy aspects (available P soil content at field level) should also be taken into account. Also, local climate conditions should be considered for fertilizer application (i.e. drought periods and heavy rainfalls). Precision farming techniques suitable for more accurate determination of fertiliser needs should be promoted.

Crop rotation, selection of suitable crops, growing post-harvest green manures and autumn-sown crops should be applied to protect soil surfaces, safeguard soil organic matter, water retention capacity and stability of soil structure as well as prevent nitrate leaching to ground water during autumn and winter months.

Soil management & erosion control practices such as conservation tillage, contouring, contour strip-cropping, terracing, crop cover, crop restriction on sensitive fields, crop residue mulching are important measures to reduce soil loss from the fields. They provide protection for soils against the erosivity of rainfall and runoff and also reduce the soils surface's erodibility. Moreover, they help maintaining soil structure and infiltration rate. Establishing grass cover on bare soil (e.g. between plantation rows) surfaces and avoiding over-grazing of pastures should be considered to maintain soil protection.

Buffer strips with natural perennial vegetation (trees, bushes and/or grass) and without fertilizing should be introduced along water courses to act as a filtering barrier especially against phosphate emissions via soil erosion and surface runoff; at the same time additional actions are needed at upland erosion hot-spots (field buffers) to prevent and minimise soil (and nutrient) losses. Buffer strips may provide other ecosystem services like acting as habitats or increase the aesthetic value of landscapes. They may be regarded as EFAs, meeting the commitments of the CAP. In some circumstances, fences may be necessary to avoid riverbank erosion and damages in soil cover caused by grazed livestock.

Green and high diversity natural landscape elements that reduce evaporation losses from soils and increase infiltration into soils (vegetation barriers and field borders from trees and/or bushes, grass cover on bare soil surfaces) offer favourable interventions to improve water-holding capacity of the soil and to preserve local water balance and available soil moisture. In addition, they contribute to restore biodiversity, prevent soil erosion and depletion, filter air and water, support climate adaptation and represent carbon sinks.

Grassed depressions, vegetated waterways, inundation/sedimentation ponds, storm water reservoirs and constructed wetlands represent **transport controlling and water storing measures** that capture runoff and sediment transport. In this way, they can temporarily store excess water of wet periods for periods with lack of precipitation to compensate water deficit, retain sediment and nutrients before entering water bodies and reduce downstream soil erosion and nutrient washout.

5.1.2 Disadvantaged areas

In the disadvantaged areas (land with limited productivity, natural constraints or unfavourable social conditions) integrated rural development approaches should combine all relevant available resources in an overarching and coherent manner (e. g. integrated RDPs) to counteract depopulation of rural regions and land abandonment. Viable rural communities with economic perspectives (based on both agriculture as well as other possible income sources like small enterprises, tourism and recreation combined with innovative regional marketing strategies) should open perspectives for young people and safeguard sustainable agriculture, aesthetic landscapes, high nature value and biodiversity.

Danube states should support of preservation and development of 'natural' farming and traditional agricultural methods in their voluntary agri-environment schemes, e. g. **extensive grassland management and low-input agriculture**.

Land use conversions (e.g. cropland to grassland, shrub land and or forest) should be taken into account in order to optimize land use so that making rural land management better adaptable to climate change impacts, counteracting environmental degradation of water bodies and to supporting nature protection.

Organic farming should be introduced and promoted especially in areas important for drinking water supply, as organic farming in many cases has been proved as a powerful and efficient tool to safeguard groundwater quality. Organic farmers do not apply soluble mineral fertilizers and synthetic pesticides. Multiannual crop rotation and closed nutrient cycles are typical features. In organic farms nutrient balance surpluses normally are considerably lower than on comparable nearby conventional farms. Organic livestock farming should respect high animal welfare standards. Animals should have, whenever possible, access to open air or grazing areas. Promotion strategies should act along the whole food chain “from field to fork”, i. e. include processing and retail.

Wetlands and flood plains should be protected, restored and/or reconstructed where possible to increase natural water retention capacity of landscapes (which is at the same time a measure to mitigate floods and to adapt to climate change impacts) and to promote natural resilience and assimilative capacity of water bodies against eutrophication. They also sequester considerable amounts of carbon and are habitats for a number of endangered species. They may act as rest areas for migratory birds. Thus the remaining wetlands are often protected areas, part of NATURA 2000 networks, biosphere reserves or areas under the RAMSAR Convention[66].

Land care initiatives to maintain traditional forms of agriculture and its characteristic cultural landscape should be promoted (e. g. via the LEADER method engaging local actors to design strategies and allocate resources for developing their rural areas) and integrated into rural development and WFD-implementation, based on dialogue and cooperation. Land care initiatives are grassroots (bottom up) approaches against land abandonment, land degradation and in favour of characteristic landscapes and natural resources conservation, in many cases by keeping up traditional land use patterns in agriculture.

Market-linked **eco-tourism** and low impact recreation should be promoted that provides effective economic incentives for conserving and enhancing bio-cultural diversity, helps protect the natural and cultural heritage of the rural areas and ensures long-term perspectives for local communities.

[66] https://www.ramsar.org/

5.1.3 Measure effectiveness and multi-beneficial measures

Table 7 (source: ICPDR agro-economic study[67], adapted table, taken from the Lower Saxon State Department for Waterway, Coastal and Nature Conservation) shows a detailed qualitative overview of measures and measure combinations that are considered to be effective and useful in practical situations on a farm. Different measures (first column) are listed with their expected potential benefits in terms of reducing negative impacts on surface water, groundwater and soil.

Table 7: Overview on qualitative impacts of agricultural measures

	Surface waters					Groundwater				Soil		
Assessment	Reduction of nitrate emission	Reduction of phosphate emission	Reduction of sediment dischage	Reduction of plant protection substances emission	Overall assessment	Autumn N_{min} / N-load	N-Balance	Overall assessment	Reduction of plant protection substances emission	Erosion	Humus balance	Overall assessment
Measures	-/0/+/++/n.a.											
I. A) Limitation of the application of livestock manure	++	++	0	0	+	+	+	+	0	0	0	0
I. B) Renunciation of the use of livestock manure	+	+	0	0	+	+	+	+	0	0	-	-
I. C) Water-friendly application of agricultural fertilizers	+	+	0	0	+	0	+	+	0	0	0	0
I. D) Farm fertiliser and soil analyses	0	0	0	0	0	0	+	+	0	0	0	0
I. E a) Active greening: Intermediate crop cultivation, underseeds	+	++	++	0	+	++	0	+	0	++	+	++
I. E b) Active greening: Greenery on fallow land	++	++	++	++	++	++	++	++	++	++	+	++
I. F) Seed rotation design that is gentle to the aquatic environment	++	+	+	+	+	++	+	++	+	+	+	+
I. G) Extensive management of grassland	++	+	0	+	+	+	+	+	+	0	0	0
I. H) Unprecedented grassland renewal	++	+	++	0	+	++	+	++	0	+	+	+
I. I) Reduced N-fertilization	+	n.a.	n.a.	0	+	+	++	++	0	0	0	0
I. J) Reduced tillage	+	+	+	-	+	+	0	+	-	+	0	+
I. K) Corn Seed	0	+	+	0	0	0	0	0	0	+	0	+
I. L) Underfoot fertilization (purely mineral)	+	+	0	0	+	+	+	+	0	0	0	0
I. M) Use of stabilized N-fertilizer	+	0	0	0	0	+	+	+	0	0	0	0
I. N) Reduced use of herbicides	n.a.	n.a.	n.a.	+	+	0	0	0	++	0	0	0
I. O) Organic farming	++	+	0	++	+	++	++	++	++	0	+	+
II) Conversion of farmland to extensive grassland/extensive	++	++	++	++	++	++	++	++	++	++	++	++
III) Conversion of farmland to wetland/natural floodplain	++	++	++	++	++	++	++	++	++	++	++	++
IV) Forest erosion protection	+	+	++	+	+	n.a.	n.a.	n.a.	n.a.	++	+	++
V) Forest conversion	+	+	+	n.a.	+	+	+	+	n.a.	+	+	+

++ very positive; + positive; 0 neutral; - negative; n.a. not applicable

The scope of measures is considerable and even low cost options are likely to achieve good results. However, the assessments provided are only indications of expected effects and there is no guarantee that these effects will actually materialize and to what extent. Conditions are very site specific and expert knowledge is needed to properly design coherent approaches and the best possible combination of measures in a given situation. Nevertheless, the assessments can be considered as reliable qualitative evaluations because they build on the expertise of practitioners with many years of experience in water quality management practices as well as hundreds of field experiments.

[67] Agro-Economic Study for the Danube River Basin. Synthesis Report. ICPDR, 2017

Besides effective pollution controlling interventions, multi-beneficial measures should be promoted which can ensure that relevant aspects other than nutrient pollution (e.g. water scarcity and droughts, hydromorphology and biodiversity) are also addressed. These measures offer win-win solutions to mitigate multiple pressures. Precision irrigation, soil conservation, natural water retention enhancement, managing and operating reservoirs to mitigate excess water via runoff, floods and inland inundation, artificial groundwater recharge, riparian buffer zones, controlled and restored wetlands and floodplain restoration are examples for these interventions.

5.1.4 Cost-effectiveness of measures

Measures can have positive impacts regarding nutrient losses on both, local and regional/catchment scale. Local effectiveness of measures, i.e. how much they can reduce nutrient mobilization or losses provides important information on the technical potential of the measures on field scale. This can be helpful to achieve better resource efficiency and to optimize fertiliser application and reduce costs.

With respect to the catchment scale, the regional effectiveness of the measures depends on several catchment properties and circumstances to be considered (e.g. connectivity, distance, landscape elements, other measures already implemented). Not all of the source areas effectively contribute to the river loads and the extent of their contribution depends on the transport rate of the emitted pollutants within the catchment and towards the outlet. Thus, management efforts to reduce water pollution should be targeted to ensure cost-effectiveness. Emission reduction could conceivably be implemented with one and the same rate in the whole catchment, focussed on areas with local emissions over a certain threshold value or, alternatively targeted to the fields with the highest contribution to water pollution. It is likely that in most cases the latter would provide a more cost-effective management with respect to river water quality, though case-by-case analysis may be necessary i.e. regarding sensitivity of water bodies to nutrient pollution.

Cost-effective interventions should be concentrated on the critical source and/or transfer areas where the highest fluxes to the river net come from and/or where significant direct transfers of pollutants from land to water probably occur. Therefore, only a transport-based management approach can be environmentally and economically effective. Besides this, convincing local stakeholders of the necessity of the management actions, the practical implementation of the management plans including adequate technical skills and securing sufficient financial support can probably be realized more easily by targeting a smaller proportion of the catchment area.

Before applying measures, an analysis is necessary to determine what the main problem is in the particular area (e.g. intensive livestock production, point source pollution, diffuse pollution due to the fertilization of arable land, dense network of drainage systems, etc.). Catchment scale water quality modelling can support the efforts of identifying emission hot-spots, assessing potential impacts of measures and elaborating cost-effective management strategies. A high number of modelling tools and case studies able to support catchment and water resources management are available in the scientific literature. In addition, detailed information is needed on the local technical effectiveness and the implementation cost of the individual measures, e.g. how much nutrient emission reduction (kg/ha) can be achieved by applying a measure and how much costs the implementation of this measure would have (EUR/ha). Policy-making should make better use of these tools and information when designing and implementing river basin management plans.

Besides identifying the hot-spots and effectively contributing areas, the farmers' participation quota and the technical implementation quality are decisive factors for achieving cost-efficient nutrient management in catchments. Farmers need to be engaged to contribute to achieving environmental objectives and to appreciate and endorse the proposed measures. Interventions should be economically attractive and should not cause excessive administrative burdens for those who apply them. Advisory services should provide appropriate information on the measures, should support farmers in the administrative processes and should provide training and consultancy for implementation to strengthen capacity and to build appropriate skills.

5.2 Measures addressing water scarcity and droughts

From a risk management perspective, specific attention is required also for water scarcity and droughts as outlined in Chapter 3.2. In view of climate change, simultaneous air temperature increase and unfavourable precipitation distribution, among other factors, contribute to an increased risk of drought occurrence and thus reduced water availability. This has been observed in the last decades across the whole of Europe, also in the DRB where drought is becoming a regular companion of agricultural production. Its increasing impacts on vulnerable sectors of the economy means that DRB countries are progressively considering drought as a significant water management issue with its crosscutting integration component. In order to support agriculture also in times of drought conditions without increasing pressure on water bodies, sustainable agriculture requires sustainable water management. Since drought has large temporal and spatial characteristic, affecting areas that go beyond the scope of individual farms, drought measures are a matter of national level – they first-most address national authorities, hand-in-hand with farmers.

To replace costly and less effective ex-post-relief measures, national authorities are advised to adopt drought-smart land management practices, which aim at building resilience to drought. Such practices can be applied by preparing measures specifically in the context of water scarcity and droughts, which are further subdivided into short-term and long-term options. However, they can only be put in place appropriately only once we link them with favourable or disadvantaged climatological characteristics of the areas, so that implementation of a certain measure does not further increase pressure on water bodies but maintains the best possible status of water and land. The first measure to be taken at national level is therefore to gain knowledge on areas across the country whose climatological and pedological characteristics make them particularly prone to drought.

5.2.1 Drought Watch as support for technical measures

Effective drought management begins with timely drought monitoring which in the DRB has been shown to be either not in place, as shown in Table 2, or not consistent across borders. Support in early detection of drought signals can be provided by the Drought Watch tool, developed within the DriDanube project. It is a web-based interactive tool that provides spatial and temporal information on soil moisture and vegetation using various drought indices. They are based on satellite and modelled data, updated daily, weekly or 10-daily, and therefore enable a harmonized view on changing drought conditions in near real-time across the whole Danube region. It was designed as an open, user-friendly yet feature-rich tool mainly for national authorities and drought experts to strengthen their operational work in drought characterisation and early warning. It is further supported by a User Manual, which gives an overview of the tool and its functionalities but also an extensive description of the methodology behind each dataset. Danube countries are highly encouraged to ensure the long-term operability and maintenance of the Danube Watch at the basin-wide scale.

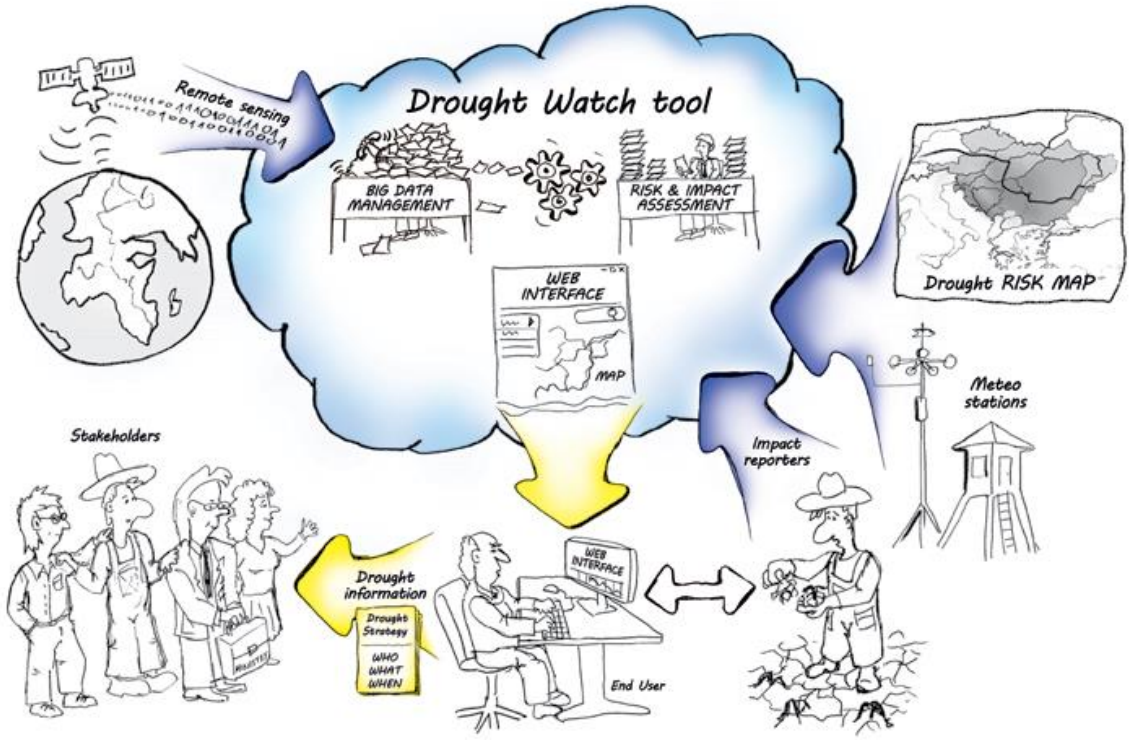
In addition to regularly updated drought indices, Drought Watch also offers informative drought risk maps, prepared according to a harmonized approach across the Danube region. Based on combining meteorological data with historic information on crop yield loss, one set of risk maps indicates areas where risk for yield loss for 4 main agricultural crops (maize, wheat, rape and barley) can be considered high, medium or low. Climatological characteristics of the observed area are represented in the form of a second set of risk maps showing the longest expected rainless period during the summer half-year.

An independent source of drought information is provided by national reporting networks (NRNs) whose purpose is to validate and complement drought indices using information on the exact drought impacts in the field. Reporting networks consist of “interested” individuals, mostly farmers and technicians with agricultural and forestry backgrounds, who report their observations on soil moisture and drought damage to vegetation or even loss of yield on their specific location on a weekly basis. To allow cross-border comparison, the observations are processed using an online questionnaire with selected single-choice questions. Aggregated data per administrative units is then regularly made available in Drought Watch. National reporting networks provide valuable information on exact drought stress and damages in the field which helps to fully characterize current drought conditions. At

the same time, they greatly contribute to the systematic collection of data on drought impacts on agricultural land and crops, with the added value of regular collection rather than post-drought assessment. Joining national reporting networks could also be a part of volunteering measures. Data collection is also a learning process for farmers who witness how their input is used in further processes of preparation of early warning, forecasts, etc. In the second half of 2019, the network of active reporters in the region counted around 1,000 reporters and it is still growing.

Drought Watch represents an advanced regional tool for drought monitoring as it combines information on drought risk areas in the historical and climatological sense, regular monitoring through drought indices and weekly information on drought impacts as detected in the field (Figure 27, source: DriDanube Project). Its additional added value lies in allowing a harmonised cross-border view on drought situations all across the DRB at high resolution, from 1 km to 9 km, rather than point-value display. National authorities and expert services can also benefit from the possibility it provides to integrate national datasets.

Figure 27: Simplified scheme of Drought Watch



The implementation of the regional tool Drought Watch benefits from the monitoring support on the national level, including more detailed in-situ data of land, water and meteorology, modelled data and current status of drought impacts on the ground (NRNs). Recent efforts focused especially on the characterization of agricultural drought, and furthermore initiated development and integration of some hydrological drought indices. The continued development and use of the tool will be ensured through further upgrades and added functionalities on national level.

5.2.2 Toolbox for technical measures to mitigate water scarcity and droughts

Because of possible increase of water shortage in agriculture due to droughts and unfavourable climate change effects, the following strategic aims need to be achieved:

- increase of local water resources and their availability,
- increase of water use efficiency,
- decrease of crop water need of,
- sustainable intensification of irrigation over large soil surfaces.

To achieve these goals, five main actions can be identified:

- increasing water retention on the field and in surface waters,
- increasing soil water retention and water availability for plants,
- maintaining existing drainage systems,
- modernising water use and irrigation technologies applied on field,
- applying modern and smart technologies, enhanced monitoring and digital data.

Measures **increasing surface water retention** on the field and in open waters includes construction of small water retention reservoirs on streams, establishment of hydraulic structures to regulate water outflow from fields and application of different small water retention measures. They help adapting the potentially available water resources to the requirements of agriculture by ensuring more water available in reservoirs for irrigation and capturing and storing runoff water in local depressions and field reservoirs during wet periods. Countries may consider to use recycled wastewater for irrigation purposes instead of discharging it to surface water bodies.

Increasing soil water retention and its availability for plants can be achieved by soil conservation technologies (e.g. soil loosening, deep ploughing, manure application), growing selected plant species in crop rotation (e.g. drought resistance plants, plants with a shorter vegetative period and lower water requirements) and introducing deep-rooted plants with low water requirements. These measures improve the soil structure and the physical and hydrologic properties of the top soil layers, increase the infiltration rate, enlarge the active root zone with water uptake, increase soil moisture and the amount of water available for plants and increase water use efficiency of the plants.

Drainage systems must be in line with the WFD objectives, i.e. they should not jeopardise the quantitative status of groundwater bodies and the ecological status/potential of surface water bodies. Where they are necessary, existing systems deployed to control groundwater level and soil moisture of agricultural soils with poor draining conditions should be renovated, upgraded and well maintained to ensure that the water retention and draining capacity of these soils are functioning. Nutrient concentrations in drainage water at the outlets to recipient waters should be minimized by e.g. sedimentation traps where possible. To avoid unnecessary water and nutrient losses, new drainage systems should be applied smartly, targeted to soils with draining problems and combined with natural water retention measures.

Irrigation of crops constitutes a considerable use of water, especially in southern Danube states. Irrigation practices have to be in line with the WFD, i.e. groundwater abstraction for irrigation purposes should not put good quantitative status of groundwater bodies in jeopardy and surface water abstractions do not deteriorate the ecological status. Irrigation and water distribution systems, their operation and management should be modern, efficient and sustainable. Irrigation timing and the irrigated water amounts should be adjusted to crop water demand and soil moisture deficit. In addition, water and energy saving methods and precision techniques should be used for water distribution and irrigation. Water saving in agriculture will become increasingly important as climate change effects become more pronounced, increasing the risk of water scarcity and droughts in parts of Central and Eastern Europe. Properly scheduled and efficient irrigation schemes also increase nutrient efficiency and thus minimize the risk of leaching. Irrigation should be part of a catchment-scale, dynamic and flexible water resources management system that is based on multi-criteria optimization of water uses, adjusted to climate change effects and linked to automatized monitoring and forecasting systems. In this respect, greater emphasis should be put on conjunctive use of groundwater and surface water resources and artificial and controlled aquifer recharge, closely linked to monitoring of groundwater and surface water levels. Promoting the reuse of treated wastewater for irrigation, in particular during severe droughts, is an option, which can reduce the risk of water shortages for irrigated crops and contribute to reaching and maintaining good status of water bodies.

Smart **digital technologies** and devices, meteorological, soil moisture and hydrological **monitoring data**, drought mapping and forecasting, remote sensing information and GIS data should support in practice the sustainable irrigation systems.

5.3 Soft measures

Advisory services, **knowledge exchange** and other "soft" instruments should be made available for all farmers. A farmer receiving personal advice is more likely to understand e. g. the cross-compliance/conditionality obligations, and will thus more readily comply with them. In the same way farmers might be more open to opportunities and possible advantages of (voluntary) agri-environment programmes and thus will more readily participate in them. Advisory services should work in the sense of cooperation with farmers and in an overarching manner, i. e. improve both the farmer's professional skills and economic performance as well as (among others) aim at improve nutrient management and efficiency, minimize emissions to the environment and safeguard water quality. Establishing an appropriate advisory system may help farmers to make management decisions, to understand environmental aspects and to adjust the production technologies to the special local conditions of each individual farm. Appropriate combination of top-down (consultation with advisors or facilitators) and bottom-up (exchange of practices among farmers and cooperation) systems should be developed and supported.

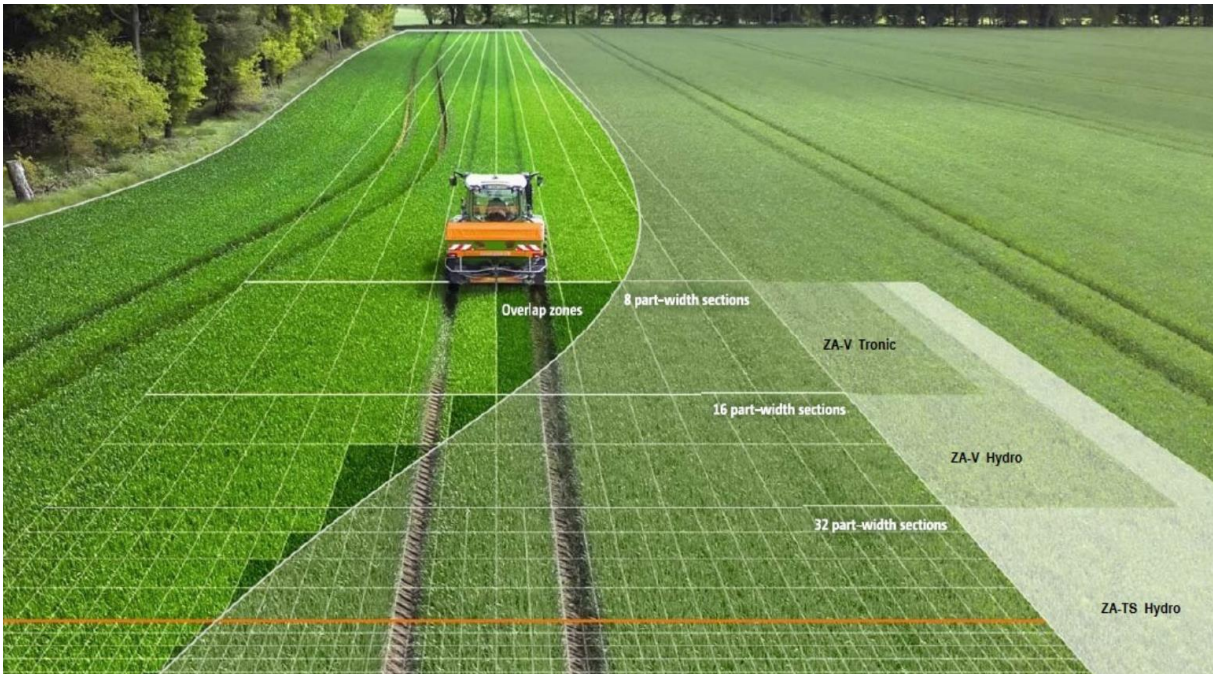
Knowledge transfer among decision making authorities to present and exchange up-to-date knowledge and experiences should be organized on annual basis. Tailored international workshops/conferences might be a good platform to stimulate knowledge transfers among the Danube countries.

Research and development to provide solutions for agri-environmental problems should play an important role in the implementation of the WFD. Enhanced and accelerated dissemination of results and knowledge among farmers as well as other stakeholders should be facilitated efficiently and use all available modern technologies (including internet and digital technologies). Best practice examples could be communicated e.g. by demonstration farms and/or regional and local "field days".

Advisory services should be accompanied and supported by proper **education and curricula**. Professional education should integrate agri-environmental aspects in an appropriate manner. High-level education institutes (universities, colleges) should organise and offer education in the field of agricultural water management, integrating knowledge of traditional water management, agricultural sciences and environmental engineering.

Awareness raising and public dialogues should be fostered and pave the way to acceptable solutions and necessary compromises in the spirit of cooperation.

Part C – Implementation



6. Measure implementation - how to make it work

The following chapters highlight the results and experiences of selected pilot projects and best practice implementation from Europe. They show good examples for aligning water and agricultural policies, for effective collaboration of the two sectors and for implementing best management practices in agriculture and rural areas.

A number of projects has been supported by the HORIZON 2020 research and innovation funding instrument of the EC[68] or has been implemented as an EIP-AGRI operational group project[69].

6.1 Good examples for aligning water and agricultural policies

6.1.1 Collective / cooperative approaches for soil and water management

Collaborative agri-environmental project aiming to reduce the flow of nutrients into the Baltic Sea (Tullstorp Stream project, Sweden)
Funded by Swedish Rural Development Programme 2007-2013 (Measures 216, 214 and 421)
The Tullstorp Stream project was developed during the 2007-2013 CAP programming period as an example of a collaborative agri-environment project. It aimed to decrease the flow of nutrients into the Baltic Sea and to reduce erosion by water and flooding, whilst creating wetlands and restoring the stream. The stream flows through one of the most intensive agricultural areas of Sweden and is located in an NVZ. The Tullstorp Stream Association (TSA) was founded in 2009. It consists of 45 landowners located along the stream with the aim of proposing and implementing actions beneficial to water quality. More specifically, all the landowners along the stream signed an agreement giving the TSA the right to make use of a stretch of adjacent land bordering the stream to pilot new approaches to land management. This joint initiative benefited from the fact that the landowners already knew each other as well as the presence of a facilitator who knew the local actors and secured financial resources for running the project. Upfront funding for the restoration project was provided by the municipality of Trelleborg, while funding for creating wetlands was provided by the national Marine Environment Grant and the RDP. Non-productive investments were used to outsource planning and implementation of physical investments (such as wetland creation/restoration). This was coupled with funding from the agri-environment scheme for the maintenance of the area and from a LEADER Local Action Group for the installation of a permanent tourist/visitor path, and research studies to increase tourism in the area. Since 2009, 35 wetlands have been created and restoration of 9 km of the riverine systems has taken place, while several inventories have been carried out, reports on possible actions have been produced and many other activities connected to the project have taken place. Key to the success of this project was the financing of a Coordinator who has a developed network within the area. In the 2014-2020 programming period, the TSA has collectively applied to the current agri-environmental scheme to maintain the land along the Tullstorp watercourse.

[68] https://ec.europa.eu/programmes/horizon2020/en/h2020-sections-projects

[69] https://ec.europa.eu/eip/agriculture/en/eip-agri-projects

Collaborative local contract to decrease water usage for irrigation in south-west France ('Coop de l'eau 79')

Funded by Nouvelle-Aquitaine (France) Rural Development Programme 2014-2020 (Measures 4.3 and 10)

In France, capital investments (M4.3) and the agri-environment-climate scheme (M10) have been used in combination to finance the setting up and implementation of a local contract (2012-2016) to decrease the use of water for irrigation within the region and increase water storage.

The rural area of Sèvre Niortaise and Marais Poitevin (Nouvelle Aquitaine) is characterised by hilly landscapes and mixed farming systems, mainly for cattle breeding and cultivation of cereal crops. Pressure on water resources is strong in the local area, due to competition linked to agricultural irrigation, aquaculture, consumption of drinking water, and leisure activities. Out of 300 farmers located in the catchment area, 75% are members of the local water cooperative ('Coop de l'eau 79') that manages the water reservoirs.

In order to achieve an overall reduction of water abstracted for irrigation of 2 million cubic metres (out of 9.3) by 2021, in compliance with the WFD, a local contract for quantitative water management was designed. It had a preliminary consultation process involving all relevant stakeholders (farming community, environmental NGOs and citizens) and was steered by a board including over 40 local organisations. It involved a four-year study (2012-2016) for the identification of 19 reservoirs to be used for irrigation, a series of diversification activities for farmers (including young farmers' set-up and supply of feed for livestock), and an on-farm trial to measure the water savings. Alongside the contract, information exchange and awareness raising campaigns were organised among the farmers located around the catchment, with facilitation provided by the Chamber of Agriculture.

Since 2005, water savings of 24 million cubic meters have been achieved. Annual water abstraction for irrigation had reduced to 9.3 million cubic meters (in 2017). Note that the regional authorities used a similar combination of measures in the 2007-2013 RDP, including M125 and the agri-environment scheme.

Collaborative agri-environmental agreement for water protection in the Aso Valley, eastern Italy

Funded by Marche (Italy) Rural Development Programme 2014-2020 (Measures 1, 10, 11, 16.2 and 16.5)

The agri-environmental agreements (AEAs) put in place in the Marche region (Italy) is one example of a collaborative approach using a package of RDP measures. The Aso Valley is highly specialised in fruit production (peaches, plums, apples and pears) and traditionally cultivated with a high use of chemical inputs and associated negative impacts upon soil and water quality.

Launched in 2016, the AEA for water protection in the valley supports coordinated action among more than 100 farmers in 19 municipalities. The purpose is to increase water protection and soil quality by establishing integrated/advanced agriculture and/or organic farming across 9,000 ha. The AEA is underpinned by a package of measures that include the agri-environment-climate scheme (M10) and organic farming (M11), supported by knowledge transfer, information and advice to farmers (M1) and cooperation (M16). The latter is used in the form of pilot projects to assess the economic and environmental sustainability of farming techniques required in the AEA (M16.2), and to support the role of a facilitator (M16.5).

Based on the project objectives, the AEA expects to achieve:

- Soil and water quality protection at river basin level;
- Proactive engagement and participation of the beneficiaries in the design of the activities;

- Stronger relationships between local stakeholders (farmers, local communities, associations and local government); and
- Joint production of knowledge and exchange of sustainable farming practices in the local area.

The Water and Integrated Local Delivery (WILD) project, western England

Funded by the Environment Agency (UK) with implementation costs covered by various measures of the England Rural Development Programme 2014-2018

The Water and Integrated Local Delivery (WILD) project is a three-year project covering about 26,000 ha within the Cotswold Water Park, in England, UK. The area contains a wide variety of habitats and landscapes and provides high quality game and coarse angling in both rivers and still waters.

The central objective of WILD is to improve the water environment to meet the requirements of the WFD with regard to water quality and flow, biodiversity and flood protection. In particular, the project aims at finding solutions to minimise the impacts of potential floods in the area, achieve good ecological status of surface water as well as good chemical status of groundwater to counter the effects of long-term trends towards more intensive arable production in the area. RDP funding, alongside many other funding sources, are used to support some of the solutions with respect to land management and investments.

In order to do so, the project has built a lasting multi-stakeholder partnership, bringing farmers and local communities together to provide economic and social benefits. Coordinated by the Farming and Wildlife Advisory Group (FWAG), the partnership brings together farmers and landowners, 3 local NGOs, 4 regional wildlife groups, water trusts and partnerships, 18 local communities, local councils, the University of Gloucestershire and the Thames Water company. Critical to the success of the partnership is the presence of a specialist facilitator, provided by the FWAG, who has enabled the application of a similar process to each water body linked to WFD failures.

The partnership is developed through local meetings in which businesses and communities can reconnect and engage with national organisations, like Natural England, on common issues. Central to the involvement of local communities is the involvement of the Gloucestershire Rural Community Council, which helps rural communities in developing and delivering cross cutting environmentally sustainable parish and local plans. The project connects up the landscape through contact with local authorities, those with statutory responsibilities and farmers and communities across the catchment.

More information on the project can be accessed here: https://www.fwagsw.org.uk/wild-project

6.1.2 Result-based payment schemes for soil and water management

Hybrid RBPS / MBPS water quality agri-environment-climate scheme in Flanders, Belgium

Funded by the Flanders Rural Development Programme 2014-2020 (Measure 10)

This agri-environment-climate scheme in the 2014-20 RDP replaces a ‘management-based’ payment scheme for water quality in the 2007-13 RDP which simply required reductions on fertiliser use. This scheme had to be discontinued because farmers were a) finding it difficult to fulfil the administrative requirements for record keeping and b) it did not satisfy the increasingly stringent EC verification requirements.

The aim of the new scheme has been widened to include two specific soil related objectives as follows:

- Safeguard and improve water quality by reducing the risk of nitrates leaching from arable land;

- Reduce the risk of soil erosion; and
- Encourage farmers to improve the levels of organic matter in their soil.

The RBPS result indicator is the residual soil nitrogen at the end of each growing season in ***all*** the fields on the farm, and the threshold for payment is a residual soil nitrogen level on all fields (grassland and arable) which is at least 4 kg N/ha/year ***below*** the lowest threshold value set by Flemish regulations for permissible soil nitrogen levels on farmland. The indicator is measured by the farmer (and controlled by the Paying Agency) in soil samples taken by the farmer from each field, which are analysed by an approved laboratory.

Some MBPS requirements are still included, but only those that are easy to verify and control. Since the types of field crop greatly influence the risk of nitrate leaching, as well as soil erosion (e.g. potatoes are a much higher risky crop than cereals), farmers in the scheme must grow no less than four main crops, of which three must be low-risk crops other than grassland, and the low-risk crops must occupy at least 90% of their arable land each year.

There are also compulsory technical advice and soil testing requirements. Before signing the agri-environment-climate contract, the farmer must have on-site advice from a specialist farm adviser, who will explain the requirements of the scheme and discuss how these will fit with the farm's crop rotation system and nutrient management planning. In the first year of the contract, the farmer also has to carry out a soil analysis for carbon content (organic matter) and pH (acidity). These data are useful for the farm's nutrient management planning but are not part of the result indicator.

The payment of 245/ha/year EUR applies to the total area of low-risk arable crops on the farm each year (the precise area varies a little from year to year because of the crop rotation), but the result indicator must be achieved on ***all*** fields, not just these arable fields. This ensures that the farmer does not 'compensate for' reducing nutrient inputs on one part of the farm by increasing inputs elsewhere.

Hybrid RBPS / MBPS water efficiency agri-environment-climate scheme in Portugal

Funded by the Portugal Rural Development Programme 2014-2020 (Measure 10)

The aim of this agri-environment-climate scheme is to improve efficiency of water use and to reduce water consumption compared to a reference level.

The RBPS result indicator is the measured water consumption of the irrigated area of the farm, and the required threshold value is at least 7.5% below a reference scenario established by the National Irrigation Authority for the different irrigated crops and methods of irrigation under pressure for the three main Portuguese agro-climatic regions.

The MBPS requirements include:

- Use only sprinkler, localised (micro sprinkler, drip irrigation) or below ground irrigation systems;
- Implement an irrigation plan based on recommendations made on the basis of the weekly water balance, using a rain gauge and taking into consideration the type of irrigation equipment, soil type, climate and vegetative phase of the crop to be irrigated;
- Define and implement a fertilisation plan; and
- In the first, third and fifth years of the contract, ensure that the irrigation equipment is inspected by an accredited authority and implement the recommendations of the inspections.

Issues with delivery of the scheme have included the need to train technicians (this was done through specialised courses in the first phase of implementation). Farmers have improved their efficiency of water use, but the equipment to measure the water consumption at farm level is expensive and the paying agency controls focused on administrative issues rather than on results. However, the large data sets generated will be useful in drawing technical conclusions on water productivity.

6.1.3 Nutrient Management Plans

Use of agri-environment-climate support to create nutrient management plans in Hungary
Funded by the Hungary Rural Development Programme 2014-2020 (Measure 10)
In Hungary, RDP funding has been made available under the agri-environment-climate measure (M10) to support the development of farm-level nutrient management plans (NMPs) in a 280 ha micro-region suffering from soil and landscape degradation due to intensive arable cropping. The farms targeted by the scheme focus specifically on corn, wheat, barley and sunflower production. Each NMP is developed by a consultant with information on field size and location provided by the farmer. The consultant creates a GIS database from the information provided combined with multi-year satellite imagery and, if available, soil scanning results and/or yield maps and other available spatial information. This is used to develop a management zone-based soil sampling approach, where the average size of a zone is 3 ha. This detailed design is then provided to the sampling technicians equipped with automated soil samplers on 4x4 vehicles. Soil laboratory analysis is performed for 14 soil chemical and physical parameters according to local country-specific standards. The sample results form the basis of the nutrient management plan that is calculated for the farmer for selected fertilisers. In some cases, a better fertiliser combination is recommended by the consultant, but the farmer makes the final selection decision.

Training and information support for nutrient management in Sweden
*Funded by Sweden Rural Development Programmes **2007-2013 (Measure 111) and 2014-2020 (Measure 1)***
The vocational training and information measure (M111) of the Swedish RDP 2007-2013 was used to finance a free, national advisory programme for farmers called 'Greppa Näringen' ('Catch the nutrient') that sought to decrease nutrient runoff / leaching from agriculture and to raise awareness amongst farmers about reducing greenhouse gas emissions. The programme was managed regionally by the county agricultural boards and included training courses, one-to-one and group advisory sessions, field excursions, newsletters, exhibitions, information meetings and cooperation with projects in other counties. All activities proved very popular with farmers and significantly more events were organised than originally planned. A national evaluation has shown a strong connection between the project and reduced losses of nitrogen and phosphorous into the Baltic Sea from farmland in Sweden. The programme was a particular success on the island of Gotland (Sweden's biggest island and an important agricultural area) and has been continued in the RDP 2014-2020 under M1 (Knowledge transfer).

6.1.4 Fostering innovation and knowledge exchange for sustainable agriculture

Farm systems that produce good water quality for drinking water supplies (Fairway)
Funded by the EU Horizon 2020 research and innovation framework programme
https://www.fairway-project.eu/ Safe drinking water is vital for human health. Diffuse pollution of nitrogen and pesticides from agriculture is the main obstacle to meet drinking water quality targets. Policies to protect drinking water resources have not achieved a consistent effectiveness in all member states. The objective of FAIRWAY is to review policy, governance and farm water management approaches to protect drinking water resources in the EU and to identify and further develop innovative measures and

governance approaches which will simultaneously increase the sustainability of agriculture. The FAIRWAY partners form a unique blend of researchers, farm advisers and consultancies and is built on 13 case studies ('living labs') in 11 different EU countries, which will form the core of a multi-actor platform, underpinning all FAIRWAY work packages. Equally important is the upscaling of successful practices from case studies to the regional, national, and EU scales, emphasising the role of effective communication and extension tools developed in FAIRWAY. The outputs will provide a blueprint for multi-actor engagement across different scales, which will allow agriculture and water policies to be addressed in a more integrated way. FAIRWAY will i) increase the scientific understanding of the relationship between agriculture and drinking water protection, ii) increase the understanding for the social, technical and economic barriers to practical implementing of measures (iii) deliver innovative measures and tools to overcome these barriers, iv) develop protocols and data-sets for monitoring of farming practices and water quality, v) develop effective governance approaches for small to large water supplies, and vi) increase awareness and involvement of farmers and other citizens in the monitoring and governance of water supplies. The FAIRWAY results will be widely disseminated to a range of targeted audiences using state-of-the-art technologies, social media and workshops.

Farming Tools for external nutrient Inputs and water MAanagement (FATIMA)

Funded by the EU Horizon 2020 research and innovation framework programme

http://fatima-h2020.eu/

FATIMA addresses effective and efficient monitoring and management of agricultural resources to achieve optimum crop yield and quality in a sustainable environment. It covers both ends of the scale relevant for food production, viz., precision farming and the perspective of a sustainable agriculture in the context of integrated agri-environment management. It aims at developing innovative and new farm capacities that help the intensive farm sector optimize their external input (nutrients, water) management and use, with the vision of bridging sustainable crop production with fair economic competitiveness.

FATIMA addresses and works with user communities (farmers, managers, decision makers in the farm and agribusiness sector) at scales ranging from farm, over irrigation scheme or aquifer, to river-basins. It will provide them with maps of fertilizer and water requirements (to feed into precision farming machinery), crop water consumption and a range of further products for sustainable cropping management supported with innovative water-energy footprint frameworks. All information will be integrated in leading-edge participatory spatial online decision-support systems. The innovative FATIMA service concept considers the economic, environmental, technical, social, and political dimensions in an integrated way.

FATIMA will be implemented and demonstrated in 8 pilot areas representative of key European intensive crop production systems in Spain, Italy, Greece, Netherlands, Czech Republic, Austria, France, Turkey.

Agricultural practices to prevent nitrate pollution in Emilia-Romagna, Italy (NITRATI FERRARA)

Funded by the Emilia-Romagna Rural Development Programme 2014-2020 (Measure 16)

https://ec.europa.eu/eip/agriculture/en/find-connect/projects/nitrati-ferrara-tecniche-agronomiche-la

The main objective of the project is to develop agronomical practices that reduce nitrates losses in vulnerable zone (Ferrara Province), by increasing the organic matter and reduce the water leaching and runoff in soils representative of the area. These effects will be achieved making use of organic soil improvers (compost) and/or through the application of conservation agriculture techniques, on demonstrative fields. The hypothesis that will be tested is that the increase of soil organic matter:

1) decreases the leaching and runoff of water with loss of nitrates;
2) determines conditions for denitrification.

Activities will include study of the soils on which the tests are carried out; planning and implementation of the agricultural techniques aimed at increasing organic matter in soils and reducing nitrate leaching and run-off; monitoring of organic matter and the nitrogen cycle in the agronomic systems compared; assessment of economic and environmental sustainability of the proposed innovative practices, compared with the traditional ones; training, technical-scientific and educational dissemination, including through the EIP-AGRI network.

Nitrogen efficient crop production for better water management in Portugal (NEP)
Funded by the Mainland Portugal Rural Development Programme 2014-2020 (Measure 16)
https://ec.europa.eu/eip/agriculture/en/find-connect/projects/nep-high-nitrogen-efficient-crop-production-better The objective of the project is 1) to develop two new low-nitrogen agricultural products, tomato for industry and grape for wine production, which do not currently exist in national and international markets; and 2) the development of new production processes with a view to obtain these new products and to condition the behaviour of agricultural operators in order to mitigate nitrogen (N) losses to their ecosystems. For this purpose, new production processes will be developed to change agricultural practices of the producers. It is planned to obtain distinct commodities produced with defined and marked concerns to mitigate N emissions during their production process. Changes in the primary production of fresh grapes and processing tomato (e.g. fertilization and irrigation) will be conducted in order to obtain low N-footprint production. The reduction of N losses will be monitored by the N footprint calculation tool built in this project.

Practical actions for reduced nutrient inflow to Baltic Sea (NUTRINFLOW)
Funded by Central Baltic INTERREG
http://nutrinflow.eu/ The idea is to take practical actions for holistic drainage management for reduced nutrient inflow to the sea. This is done by implementing, demonstrating and increasing the recognition of innovative water management measures in agricultural areas. To achieve our goals, we search for practical and low-cost innovations that can be used for flow and nutrient management. These can be innovations for environmentally friendly ditch clearing, two-stage ditches, bottom dams, sedimentation ponds, wetlands, adapted and integrated buffer zones, controlled drainage as well as new ways to target measures to make them more cost effective. By utilising the existing drainage system structures and improving drainage technologies as well as production on fields, we can reach better nutrient balance – less nutrient losses to waters.

Achieving good water quality status in intensive animal production areas (AQUA) in Northern Italy
Funded by LIFE Plus Programme 2010-2014
The aim of the LIFE Plus AQUA project was to help reduce water pollution from nutrients in the Po river-basin in northern Italy where a great majority of Italian milk (40%), beef (60%) and pork (85%) is produced. The project set out to **demonstrate** to local farmers that through the **innovative use of existing equipment and techniques** – and simply by altering daily routines - it is possible to reduce

pollution of surface and underground water resources whilst also generating economic benefits for the farm.

Specific objectives included to:

- to reduce nitrogen in manure, using feeding techniques based on low-protein diets for pigs and high levels of efficiency in nitrogen intake for dairy and beef cattle;
- to improve efficiency of fertilisation with slurry, by applying innovative spreading techniques to crop rotations characterised by long growing season and high uptakes;
- to reduce nutrient losses from agricultural land to water through agro-environmental measures designed to reduce nutrient losses;
- to reduce pressures and impacts in agricultural catchments with intensive livestock rearing by separating and transferring the solid fraction from manure;
- to improve and simplify recordings and controls on farming practices by implementing a tool for the traceability and certification of good practices in nutrients management (from animal feeding to manure production and utilisation on land).

A network of demonstration farms was set up in four Italian regions – Piemonte, Lombardia, Veneto and Emilia-Romagna – including a total of nine intensive livestock farms (dairy and pigs) plus numerous arable farmers involved in piloting and monitoring the different slurry application techniques and land management options (buffer strips etc.) for reducing nutrient run-off to local watercourses. For the participating dairy farms, the solid-liquid separation of the slurry was undertaken using a mobile separator. The separated solid fraction of slurry was used by arable farms for fertilising land under cereals that normally did not receive organic input, and to produce energy through anaerobic digestion.

The demonstration farms continue applying the innovative techniques identified by the project on a voluntary basis and these same practices have been used to design the 2007-2013 and 2014-2020 RDP measures in the four Italian regions involved.

More information here: http://aqua.crpa.it.

ViWA: Virtual Water Values

Funded by the program "Global Resource Water (GROW)" in the framework program FONA (Research for Sustainability) of the German Ministry for Education and Research (BMBF)

Partnership: 7 partners led by Ludwig-Maximilians-Universität Munich, Germany

Duration: 3 years starting from May, 2nd 2017

More infromation on: https://viwa.geographie-muenchen.de/

ViWA Virtual Water Values

ViWA project is developing and using a global, high-spatial and -temporal resolution, remote sensing based management and monitoring system for the efficiency and sustainability of water use in agriculture and competing sectors.

To achieve its goals the project aims at the following targets:

- Identify and quantify the current use of scarce water resources, the water use efficiency and the agricultural yields on an annual and global level and with high spatial and temporal resolution through a new combined monitoring and modeling approach based on Copernicus satellite remote sensing data.
- Assess and evaluate the economic consequences and (in-)efficiency of the current water use and water allocation, including trade in virtual water for agriculture, industry and water management based on the monitored data.
- Investigate consequences of moving towards a sustainable and efficient water use for the regional welfare of water rich and water poor countries both with respect to locally sustainable water use as with respect to global virtual water trade.

- Assess the vulnerability of agriculture and ecosystems to climate variability with special emphasis on water availability.
- Identify regional hot-spots of unsustainable water use in order to describe institutional obstacles for a sustainable and efficient water use.
- Identify trade-offs between the commercial water use and protection of ecosystem services.
- Develop solution options for sustainable water management with the help of scenarios and their trade-offs investigated for selected use-cases.

In the Romanian Plain the factors which determine yields and water use efficiency have been studied. Based on satellite images and crop growth modelling the relation between yield and water use efficiency for different scenarios was investigated. The simulations covered dry, wet and normal years. The assessment showed that complex relations exist between crop type, irrigation requirements, fertilizers demand and water use efficiency. Actual crop yields and water use efficiency were compared to their potentials which were determined by assuming optimal fertilization for both rain-fed and optimal irrigated agriculture. The winter wheat simulations showed that, under rain-fed conditions, optimal fertilization can significantly increase yields and maximize water use efficiency, whereas irrigation do not influent yield. Also, maize is more affected by water stress in the Romanian Plain, optimal fertilization can significantly increase yields and maximize water use efficiency but only under irrigation. The expansion of irrigation has large economic potential and can reduce fertilizer surplus accordingto crops needs, but can affect summer discharge of the rivers.

DriDanube: Drought Risk in the Danube Region

Funded by the INTERREG Danube Transnational Program

Partnership: 15 partners and 8 Associated Strategic Partners from 10 Danube countries

Duration: January 2017 – September 2019

More infromation on: www.interreg-danube.eu/dridanube

"Be prepared. Know the risks. Take action."

Better prepared for drought with:

- **Drought Watch** - a web-based tool enabling more accurate and efficient drought monitoring and early warning across the entire Danube region;
- **Drought impacts reporting networks** - near-real-time observations of drought impacts by more than 1,000 reporters (farmers, agriculture and forestry experts) across 10 Danube countries;
- **Drought risk maps** - a unified drought risk assessment comparable among countries of the Danube region;
- **Drought Strategy** - a document proposing a framework for improved drought management in the Danube region.

FramWat: Framework for improving water balance and nutrient mitigation by applying small water retention measures

Funded by the Interreg CENTRAL EUROPE Program

Partnership: 8 partners and 6 associated partners from 6 countries

Duration: July 2017 – June 2020

More information: https://www.interreg-central.eu/Content.Node/FramWat.html

Main objective: to establish a common regional framework for flood, drought and pollution mitigation by using Natural (Small) Water Retention Measures (N(S)WRM) in a systematic way that are able to increase the buffer capacity of the landscape and improve water and nutrient balance of catchments.

TOOLS

FroGIS - A publicly available web application to analyse the needs and possibilities of water retention, the result of which is the valorisation map supporting the N(S)WRM planning process. Available at https://WaterRetention.sggw.pl, it is a free software, its development is conducted at https://gitlab.com/framwat.

STATIC tool *(Landscape Valorisation Method)* – A tool that allows the assessment and comparison of different variants of N(S)WRM. Uses a simplified approach to assess the effect of implemented measures. The core element is a set of relationships between measures intensity and expected change in water retention properties of a catchment.

Cost Analysis – Methodology to calculate the costs of selected measures. Allows to choose the most suitable financing resources and instruments for the NSWRM and prepare a financial plan for implementation of the measures.

Multicriteria analysis – Tool meant to simplify the selection process of the most appropriate N(S)WRM based on predefined criteria. It relies on AHP method (Analytic hierarchy Process) and is designed as an interactive web application freely available for all interested parties, accessible both from DSS tool or directly through http://ahp.framwat.apps.vokas.si/.

Decision Support System for Planning of Natural (Small) Water Retention Measures – The web application https://planning.waterretention.sggw.pl introduces and integrates access to the above-mentioned tools. It was created for people involved in planning water retention measures to mitigate the effects of drought, floods, and surface contamination by biogenes. The goal of the application is to familiarize the user with the catalog of NSWRM and the planning process as well as to survey their preferences for their area of interest. Part of the DSS is aslo **N(S)WRM planner** which helps with facilitation of local stakeholders preferences for planning measures in the field of water retention. It is helpful for preparing data, necessary for developing a concept plan and estimating the investment risk.

PILOT CATCHMENT ACTIONS

In **6 pilot river basins** the NSWRM approach was tested with the use of the new FramWat tools. Selected measures combinations aiming at mitigating catchment specific problems were also modelled with the help of dynamic models (SWAT, HecRAS). The catchment results are provided in a form of **Action Plans**.

STRATEGIC OUTCOMES

Manual "on How to asses effectiveness of the system of measures in the river basin" – It provides a set of procedures for evaluation of direct or cumulative effects of measures.

Guidelines on how to improve water balance and nutrient mitigation by applying N(S)WRM – It is a step-by-step guide to the application of N(S)WRM in the river basins. It addresses the current gaps and problems of integration of N(S)WRMs in water management plans to fulfil the Water Framework Directive (WFD) obligations, especially during the preparation of third RBMP. Supported by the Decision Support System (DSS) which helps the user in making the best decision at each step.

Precision irrigation for crop production in Brandenburg, Germany
Funded by the Brandenburg and Berlin Rural Development Programme 2014-2020 (Measure 16)
http://eip-pi-bb.de/de/ In the federal state of Brandenburg (Germany), irrigation of arable land is a measure to maintain agricultural value despite decreasing summer rainfalls. To avoid over-using the available water resources, however, a precise irrigation control needs to be developed and tested under local conditions. The project seeks for a user-friendly solution for site-specific irrigation, which takes into account the actual water need of the crops. The potential of infrared thermography for precision irrigation control is evaluated in addition to traditional soil-based approaches. Cost-benefit analyses will reveal the economic feasibility of precision irrigation in our region.

Sensor supported irrigation control for potatoes in Lower Saxony, Germany (SeBeK)
Funded by the Lower Saxony and Bremin Rural Development Programme 2014-2020 (Measure 16)
https://wasser-suderburg.de/sebek/ Increasing demand and competition for water access requires a sustainable utilisation concept to avoid future water scarcity. An innovative sensor-based irrigation control system will lower the amount of water for agricultural use. Due to sandy soils in the northeast region of Lower Saxony, irrigation infrastructure covers more than 90% of the agricultural area where potatoes and sugar beets are the predominant crops. The approach is to exactly determine the demand for irrigation timing and duration by using thermal sensors measuring the crop temperature. This leads to data about the transpiration rate indicating drought stress (Crop Water Stress Index (CWSI)). The goal is to increase the efficiency of irrigation and enhance the quality of potatoes. The concept will be assessed for regional farms first, later the potential for different regions and crops will be evaluated.

Water and Irrigated agriculture Resilient Europe (WIRE)
Funded by the European Innovation Partnership (EIP Water)
The big challenge of sustainable irrigation in Europe is addressed by the WIRE Action Group under the European Innovation Partnership on Water. WIRE is committed to unlocking the potential and accelerating uptake of innovative irrigation technology and improving agricultural water management in line with the objectives of the Water Framework Directive, promoting the EU green economy while preserving and increasing the employment in agriculture and related sectors. WIRE currently has 56 partners from nearly all the sectors involved in irrigated agriculture, ranging from science, companies dealing with irrigation technology and management, representatives of the farming sector at European and national level, advisory services, as well as water managers. Together they cover over 90 % of irrigated area in Europe. WIRE promotes the involvement of end-users into the development of hard and soft innovative products and concepts, allowing their customisation, focusing on practical solutions to overcome operational and structural farming problems, increasing performances of cropping systems and techniques, creating new job and business opportunities in rural areas.

6.2 Best case examples for measure implementation

6.2.1 Drinking water supply of the City of Munich and the contribution of eco-farming

The Mangfall valley, from where the drinking water for the City of Munich is abstracted, is situated near the Alps, about 40 km south of Munich. The Mangfall River is a tributary to the Inn and thus part of the Danube region. Since 1883, the Mangfall valley supplies the City of Munich with drinking water. To safeguard good water quality, the Munich Water Authority buys and rents agricultural land within the drinking water sanctuary. Tenants are obliged to do ecological farming (according to EU-Regulation as minimum standard but the Munich Water Authority closely cooperates with the ecofarming associations Demeter, Bioland and Naturland). Mineral fertilizers, manure from conventional animal production and pesticides are excluded. Upper limits for fertilizer input per hectare are controlled.

As a result of this water protection initiative started in 1992 by the Munich Water Authority the largest coherent ecofarming area in Germany was created, currently about 2250 ha managed by more than 100 farmers families. Another 368 ha are still managed conventionally, 2900 ha are forests. As a result the drinking water of Munich is of constant high quality. Also this cooperation between agriculture and water supply guarantees “good status“ of groundwater according to the WFD, and also emissions of nutrient and hazardous substances into surface waters have been significantly reduced.

The water authority remunerates ecofarmers for their contribution to water protection and compensates for their yield decrease and investments during the transition period. Currently about 230 EUR/ha are granted. The necessary funds are collected with the ordinary price for water and contribute 0.5 EUR Cent/cubic meter to the water price. On the other hand drinking water can be prepared without complicated (and expensive) treatments like chlorination, demineralization or adding chemical substances.

6.2.2 Landcare and rural development in the Carpathian Mountains of Romania

Disadvantaged areas like the Carpathian Mountains are often characterized by traditional extensive agriculture, in many parts based on grassland, as climate, soil and terrain conditions are unsuitable for intensive crop production. Due to unfavourable economic conditions a considerable proportion of young people in these regions see no perspective for a satisfactory life and thus leave the countryside. Depopulation and land abandonment destabilize not only agriculture but also social life in such regions.

Traditional agriculture in disadvantaged areas did not only create a cultural landscape attractive for tourism, rest and recreation, which also contribute to local identity; a considerable proportion of European biodiversity depends on habitat provided by low-intensity farming practices in Central and Eastern Europe. This farmland-based rich biodiversity is threatened on one side by intensification, on the other side by land abandonment (and following natural succession or afforestation). Therefore, measures within the CAP need to be properly adapted to safeguard the biodiversity value of Central and Eastern European farmland.

In disadvantaged areas it is vital to combine agriculture, tourism, local and small enterprises within integrated RDPs. For this purpose a common local platform and organisational framework for actors from the different sectors is needed. Additionally, appropriate human resources should be built up to acquire financial support from the different EU sources available (EAFRD, structural funds etc.).

In Germany many traditional farmland landscapes are maintained by local Landcare Associations. These initiatives are organized within the German Association for Landcare. Experiences and qualifications available in these initiatives may be a valuable basis to share with partners from Central and Eastern European countries. The German Federal Environment Agency therefore supports a consultation project between the German Association for Landcare and the Pogany-Havas Regional Association in the Carpathian Mountains in Romania. The project aims at assisting Romanian partners in finding appropriate organizational structures and activities to support sustainable integrated rural

development in the Pogany-Havas region following a bottom-up approach and thus activate and integrate both local and central (government) resources for this process.

The region is typical for traditional extensive grassland farming and characterized by a rich biodiversity, which could get lost in the case of either intensification or land abandonment. The region is threatened by depopulation and land abandonment, but important for local identity. A landcare association is being developed and hopes to find a sustainable perspective based on traditional agriculture, soft tourism and other income sources outside of agriculture.

On European level, Landcare Associations are organized within the network of Landcare Europe. For more information: https://www.dvl.org/themen/landcare.

6.2.3 Excess manure and cost efficient manure transport

To close the nutrient cycle in agriculture and to use nutrients efficiently as a fertilizer to optimize crop yields and minimize environmental burden, it is in some cases necessary to transport manure from areas with intensive livestock production to areas with low stocking rates, where agriculture is focused on growing crops. In such areas manure may not be only a valuable fertilizer providing nutrients but also may contribute to equalize humus balance and thus to maintain soil structure and other physical parameters favourable for agriculture.

Poultry manure can be dried down to low water contents making it economically feasible to transport the product over more than 100 km, whereas pig and cattle manure contain up to 90% water, which normally causes considerable costs for transportation. Furthermore, ordinary tank trucks suitable for liquid transports cannot take any freight on their way back, and these empty tours pose another economic obstacle for manure transports.

To provide a solution at least for the latter problem a new type of combi liners has been developed in Germany called the “Opti twin“. These trailers have two separate compartments (one for liquids and another one for solid materials) and thus are able to transport manure or fermentation residues from biogas plants in one direction and e. g. feedstuff like corn or cereals in the other. Thus the transport capacity can be fully capitalized and empty tours avoided. The Opti twin is used by specialized logistic companies in regions where stocking densities are extremely high and local soils cannot take up all the excrements.

6.2.4 Paludicultures

Paludiculture is the agricultural use of wet or restored peat soils. A traditional version is to cultivate reed (Phragmites communis) for thatched roofs. More recent versions are growing reed for bioenergy

or cultivating mosses (sphagnum-species) to substitute turf (dried peat) as substrate in horticulture. Other crops from paludicultures (such as reed) may be used in some traditional house construction (thatched roofs). Due to site conditions, conventional landuse methods are not applicable but have to be modified accordingly.

One of the main objectives of paludiculture is to preserve or restore peat. In drained peatland soils organic matter is decomposed at high rates which causes soil degradation and nutrient release into water bodies. Drained peat soils are also hot-spots of greenhouse gas emissions like methane and nitrous oxide. Thus, paludicultures counteract soil degradation, water pollution and climate change. Moreover, crops from paludicultures are renewable resources and allow a sustainable agricultural use of peat soils.

Research is being done in Germany to improve and promote paludiculture systems (https://www.moorwissen.de/en/index.php).

6.2.5 The "Baltic Farmer of the Year" prize

Since 2010, the World Wide Fund for Nature (WWF) has organized the competition "Baltic Farmer of the Year". Every farm inside the Baltic Sea catchment can take part in this yearly event. It is meant "to inspire farmers and decision makers in the agricultural sector by highlighting concrete examples of all the positive things that farmers are doing around the Baltic Sea." In many cases the farmers have taken measures on their own initiative to reduce nutrient runoff to the Baltic Sea and to achieve sustainable farming. The competition "aims to highlight how important their work is and showcase their good examples across the region". As in this way farmers receive awards from environmentalists it is also an outstanding example on how to reduce tensions between both groups and establish cooperation and personal contacts in a common effort to improve farming and protect the environment.

The competition has been held already in all nine countries around the Baltic Sea. National awards have been presented to one farmer in each of the participating countries (identified by national juries respectively), and out of the national winners an international jury has selected the regional winner who receives a prize of 10,000 EUR. The event has been sponsored by a number of partners. The award is handed over within an annual conference called "A Greener Agriculture for a Bluer Baltic Sea", which is organized in cooperation with the Baltic Marine Environment Protection Commission (Helsinki Commission, HELCOM).

6.2.6 Buffer strips and sedimentation ponds: an example from Latvia

In Latvia, a farmer family working in a conventional dairy and crop farm (700 ha, 300 cows; cereals, sweet corn and grassland) has established wetlands and buffer strips along watercourses and sedimentation ponds within its drainage system to slow down water flow and to allow purification of drainage water by sedimentation and plant uptake. Thus, the nutrient losses to surface water bodies and finally the Baltic Sea could be reduced considerably. Sedimentation ponds are not only a valuable device to improve water quality and fight eutrophication. In regions fighting droughts they may also serve as water reservoirs, improve the landscape water budget and stabilize yields in agriculture.

Meanwhile a research project is under way in cooperation with the Latvian Agriculture University to optimize the system in both agronomical and ecological terms. Besides this, the farmers welcome visitors including farmers, students and researchers at their farm and promote their approaches via a well-designed website. The owners are proud of their achievements and received a great reputation among nature conservationists.

In 2014, the farmers won the WWF-HELCOM "Baltic Farmer of the Year" prize.

6.2.7 The "Integrated Nutrient Pollution Control" project in Romania

In Romania an extended integrated project has been run since 2008 to improve nutrient management and safeguard water quality. The total project has a 60 million EUR budget, with 50 million EUR coming from a World Bank loan. The three components of the project are commune-based investments in NVZs, institutional strengthening and capacity building as well as raising public awareness and multiply understanding of agri-environment issues, especially nutrient management and water quality.

Within the first project component a bunch of technical measures and investments was implemented in NVZs, including construction of communal storage facilities and equipments for handling manure from small holders, connections of rural households to sewage systems as well as a biogas plant processing manure. Furthermore, training sessions were held to communicate and propagate the national Code of GAPs among farmers, and a demonstrative agricultural programme with about one thousand participants was concluded to explain and disseminate CAP cross compliance (SMRs and GAEC).

The project provided financial support for building communal platforms for solid manure and in case of individual households, where necessary, of small individual platforms with a tank for the collection of the liquid fraction. The project also provided equipment for collecting, composting and application

of manure/compost on the farm land in communes, including bins for individual households for the selective collection of recyclable waste.

The need to have an integrated intervention system for the reduction of nutrient pollution led to an analysis of testing opportunities and feasibility of biogas production from manure through anaerobic fermentation and power cogeneration. The result was the building of a pilot plant for biogas production from manure.

In the framework of the project's component of providing support for institutional capacity strengthening and development, the monitoring capacities for eutrophication and nitrate pollution were extended, including investments into laboratory equipment and field analysis instruments as well as capacity building for the obligatory reporting to the EC on the implementation of the ND.

The third component of the project on public awareness and replication strategy carried out a public awareness programme in order to raise the level of understanding of agricultural practices for the protection of the environment and to disseminate good agricultural practices for water and soil protection,

as well as for promoting best practices and financial instruments for the ND. The public awareness campaign included a media campaign, direct communication with farmers, local authorities and institutional stakeholders and permanent dissemination, information and involvement of all target groups in order to obtain quantifiable behavioural changes.

The Romanian Government got the World Bank's support in receiving an additional financing to support continuing the project's investments until 2022 for communities and associations of communities affected by nitrates pollution from agricultural sources. The project will also continue the public information and awareness campaign and will establish a national knowledge transfer network for farmers' permanent information and engagement.

For more information: http://www.inpcp.ro/en/home/.

6.2.8 Advisory service on soil and water management in Upper Austria

The profitable agricultural production in Upper Austria is based on well supplied soil and excellent water quality. It is quite challenging for the agricultural cultivation to protect soil and water and at the same time to be competitive. The Boden.Wasser.Schutz.Beratung (Consultation for Soil and Water Protection, https://www.bwsb.at/) in Upper Austria works on behalf of the Upper Austrian government. Besides providing support for farmers in terms of soil conservation it also contributes protecting the surface and ground waters.

The objectives of the consultation are:

- reduction of substances in the surface water caused by soil erosion;
- reduction of the nitrate pollution in the ground water;
- reduction of nutrient pollution in the surface water;
- reduction of the pesticide contamination in surface and ground water;
- securing a sustainable supply of drinking water;
- sustainable soil protection.

The consultation has a three-stage approach that is proven to work sufficiently:

1) the consulter establishes and supervises a working group of farmers;
2) the consulter cooperates with qualified and trained farmers called Wasserbauern (water farmers), who are the heads of the 54 working groups;
3) the Wasserbauern act as multipliers to the working group members (ca. 2.200) and disseminate the specialized know-how of the consultation.

Key activities of the consultation are:

- participating in the implementation of the Austrian RDP in order to promote an environmentally friendly agriculture;
- implementation of the Upper Austrian pesticide strategy;
- reduction of the phosphate and sediments inputs of waters;
- consulting service in regions with contaminated water resources;
- consultation in terms of soil compaction, recultivation, humification, catch crops, sewage sludge, humus, fertilizers;
- field exercises;
- information dissemination to local farming communities.

6.2.9 Capacity building to upgrade facilities of intensive rearing sector in Serbia

The general objective of the project "Further Implementation of the IED in the Intensive Rearing of Poultry and Pigs" was to support the Serbian Competent Authorities and operators in the adoption of a sustainable approach for the implementation of the IED in the intensive rearing sector, considering the connections with other EU Directives and the specificity of the involved installations. This will enhance the preparation of Serbia to the transposition and implementation of IED and the other related Directives.

The project was implemented by the Cleaner Production Centre of University of Belgrade in partnership with the Ministry of Agriculture and Environmental Protection of the Republic of Serbia. Different activities were organized within the project such as joint workshops for competent authorities and operators, visits to selected production facilities, training events for representatives of Local Self-Governments (LSGs) and environmental inspection, as well as active participation in the preparation of integrated permits. The project was supporting ten selected operators in preparation of integrated permit applications and other relevant documentation and ten LSGs in preparation of draft permits.

Representatives of other operators and LSGs had the opportunity to work with the team of international and local experts through participation in workshops.

6.2.10 Sustainable floodplain management in the Tisza floodplain, Hungary

The Tisza River is the longest tributary of the Danube, its landscape was dramatically changed in the last 150 years. Before the large scale river regulation works in the 19th century, the Tisza was a meandering river with a wide, open floodplain where the natural processes determined the everyday life of the local communities. Traditional floodplain management practices did not impact the integrity of the ecosystem. Then, river regulation works narrowed the river space, drained the floodplains to provide more area for arable lands, but dramatically changed the formerly self-supporting system. The landscape became vulnerable and the need for management is realized.

Floods and droughts have always affected the Tisza River Basin. While in the past the traditional natural landscape was resilient to both phenomena, today, as a consequence of substantial changes in land management, they cause serious difficulties for most of the agricultural activities. Some of the areas are used for intensive, non-native tree plantations, the old pastures and hay meadows are partly abandoned. This facilitated the spread of invasive alien species.

The restoration and rehabilitation of the floodplains in the of Middle-Tisza Basin are currently ongoing, in the last decade nearly 1,000 hectares of former floodplains have been reconnected to the Tisza River with dike relocations in connection with sustainable floodplain management. In the case of the existing floodplains, where it was possible, the meadow or pasture was restored instead of arable land, where grazing can be again an important activity. In order to improve runoff conditions and increase biodiversity, forestry interventions are being made by suppressing invasive species. In connection with water retention, fish spawning areas are being established in the former clay pits and backwaters are being rehabilitated in the floodplains.

A good example for implementing the listed measures is the Bavarian-Austrian-Hungarian SUMAD (Sustainable Use and Management of Diked River Areas) project, which has already been implemented in Bavaria and in the Middle-Tisza region. The basic concept of the project has been used by the overall Hungarian floodplain management for 15 years. Another important best practice in the sustainable rehabilitation of floodplain in the Middle-Tisza region is the LIFE-SUMAR project (LIFE 03 /H/ ENV/000/280) and the related complex, sustainable floodplain development (flood protection,

habitat rehabilitation, water retention) coordinated by the Middle Tisza District Water Directorate of Hungary. About 500 ha of former floodplains were reconnected 10 years ago in the area of Bivaly-tó, near to Rákóczifalva, together with those additional measures. The Water Directorate constantly operates the newly created floodplains as a good example of sustainable floodplain management using a herd of almost 400 grey cattles.

Moreover, the projects of WWF Hungary on three sites supported and encouraged the local communities to identify and implement sustainable floodplain management measures in the Middle-Tisza region for the benefit of people and nature.

In Tiszajenő, Hungarian grey cattle were introduced on the pastures to repel invasive species, in particular False indigo (Amorpha fruticose). The area turned into a valuable grassland and the Corncrake (Crex crex) started breeding again.

In Tiszakürt 8,4 ha hybrid poplar plantations were transformed into grassland where also cattle and water buffaloes were introduced for maintenance work and another 4 ha was replaced by native poplar forest.

In Tiszatarján invasive species were also repelled in cooperation with local communities and with the financial support of investors. The biomass from the invasive false indigo were sold for energy production, and generated new income for the locals and also ensured payback to the investors motivating them for long term cooperation. Then on cleared, non-productive croplands, seminatural wetlands were restored, native energy willow trees were planted, that generates future incomes. As a complementary tool, the remaining areas which fitted for grasslands are grazed by water buffalos.

As one-third of the Tisza floodplain is infected by false indigo, the upscaling potential is high.

6.2.11 Novel approach for erosion control in Upper Austria

Between 2011 and 2018 four projects on nutrient emissions and fine sediment pressures in rivers were carried out in cooperation of the Environment Agency Austria, Vienna University of Technology and the environmental consultant companies “wpa” and “blattfisch”.

By means of a model network, the sources and pathways of phosphorus (P) and fine sediment input into surface waters were localised. The current situation of the Upper Austrian water bodies and the underlying processes could be described. Furthermore, the reduction efficiency of the CAP measures in place were analysed.

Over the last decades there was a significant reduction of phosphorus loads through improvement and construction of wastewater treatment plants. Between 2001 and 2017 sewage treatment reduced P-entries further by approx. 15%. In the same time, P-loads increased partly due to intensified cultivation of erosive crops like maize and soybean. In several rivers the monitoring showed an increasing trend of P loads.

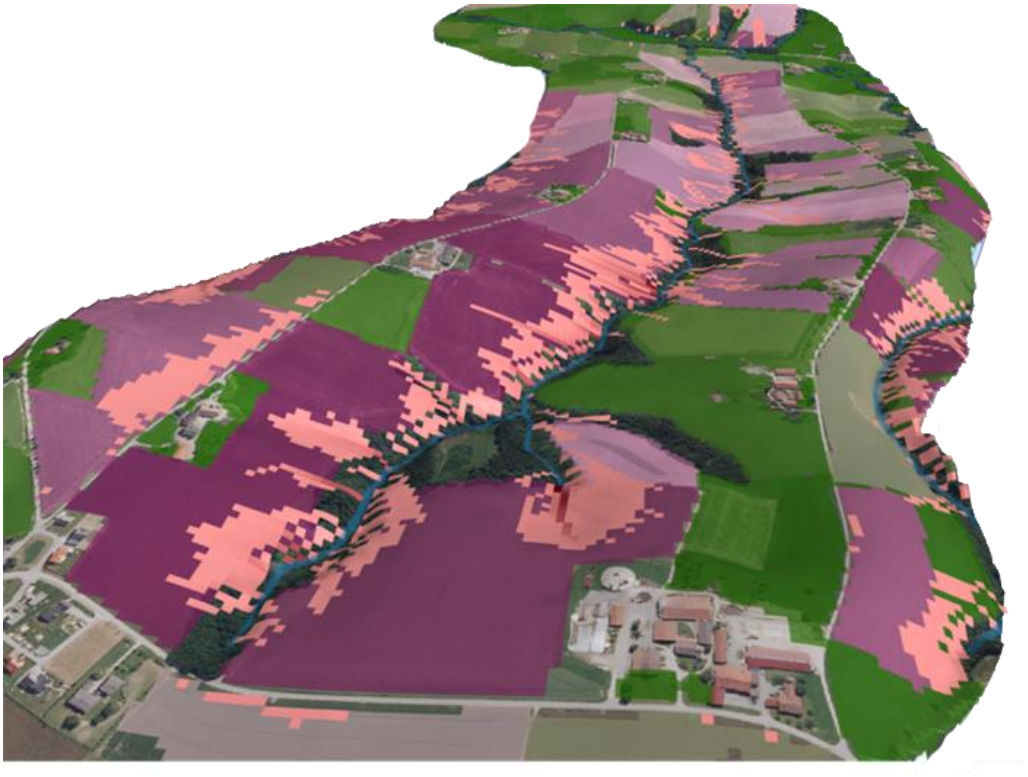
Although the measures of the current Austrian Rural Development Programme “ÖPUL” achieve a high effectiveness to reduce soil erosion locally, on catchment scale the reduction of total phosphorous is usually below 10 percent, even lower for orthophosphate. Particularly in the intensively used areas in the Upper Austrian Alpine foothills, there is a high risk that many water bodies will fail to achieve good ecological status according to the WFD. A key issue in this regard are the high fine sediment loads in many of these waters.

Land use change, more direct entry paths (ditches, drainages, reduced retention in the landscape), morphological changes in the rivers (loss of structures and thus loss of hydraulic variability), changes in hydrology and dynamics and especially the interruption of the river-floodplain-connection impact the aquatic fauna and flora. Heavy rainfall events, extended periods of low flow conditions and further changes in land use through the climate crisis will further deteriorate the situation.

The model PhosFate (Phosphorus Fate) helped to identify high risk areas “hotspots” for erosion and to indicate pathways of phosphorus and fine sediments from the fields to the rivers. On basin scale only 20% of the arable land (the “hotspots”) are responsible for approximately 80 percent of the particulate P-emissions into the rivers.

These “hotspots” are shown as “violet areas” on map layers, where erosion prevention measures are badly needed and have the highest effect. Thus, by targeted erosion prevention measures like optimized location of riparian buffer strips, street buffer strips and by greening of preferred waterways the cost efficiency of CAP measures can be increased considerably. Targeted intervention approaches are much more cost-effective than random ones.

Mapping and model application is accompanied by consultation of farmers to bring in their experience. With the new CAP proposal a fair and attractive incentive system for a sound rural development with a focus on agri-environmental measures is developed. The findings allow new targeted approaches for erosion control when designing the new CAP Strategic Plan and the next National River Basin Management Plan.



6.2.12 Delta Plan for Agricultural Water Management in the Netherlands

The Delta Plan for Agricultural Water Management (DAW) is an initiative of LTO Nederland (the Dutch agricultural stakeholder organization), at the invitation of the central government. The aim is to contribute to challenges in water management in agricultural areas and to achieve economically strong and sustainable agriculture. In order to solve the problems in the field of water, within DAW intensive cooperation exists between the agricultural sector and water managers, such as the regional water authorities, nature organisations, provinces and (drinking) water companies.

The aim of DAW is to facilitate agricultural entrepreneurs and to promote cooperation with the water authorities and water companies, for example by starting regional processes and sharing knowledge and practical experience with other farmers. Target groups are farmers in open cultivation (potatoes, grain, roughage, outdoor vegetables, flower bulbs, trees and fruit cultivation), including land-based dairy farming.

The Administrative Consultative Committee on Open Cultivation and Livestock Farming (BOOT) implements the DAW. It has appointed a core team to further implement the DAW. All this is done on behalf of the Water Steering Committee of the Ministry of Infrastructure & Water management. The national and regional authorities are represented in the Steering Committee on Water. The business community is also represented in BOOT by directors of agricultural stakeholder organization (LTO).

The ambition of the Delta Plan for Agricultural Water Management is:

1) By 2021, 80% of the remaining water quality problems will have been solved in a motivating and stimulating manner and 100% by 2027;
2) By 2021, the agricultural water supply will be sustainable by using as limited water as possible at farm level, water conservation at area level and a smarter distribution and buffering at national level, in line with the Dutch Delta Decision that was taken in 2014;
3) Through area processes, new spatial instruments and innovative techniques, the agricultural production potential at regional level will be increased by 2% per year.

DAW therefore aims for a coherent programmatic approach, focused on the intrinsic motivation of the agricultural entrepreneurs for water and soil-oriented management and on stimulating it, in order to

offer a sustainable solution for the water tasks in our country and for economically stronger agriculture and horticulture. The task is therefore threefold.

To achieve the objectives of the ND and the WFD, the necessary measures will be taken in the sixth action programme (2018-2021), the seventh action programme (2022-2025) and in both the second and third generation of WFD River Basin Management Plans (2015-2021 and 2022-2027). These plans describe the measures at regional level or per water body. The additional impulse will also require an elaboration for individual farmers. DAW is ideally suited for implementation at the local level.

The Delta Programme Freshwater can be used for water quantity measures. An implementation programme is already underway (the Freshwater Delta Plan 2015-2021). There are already large groups of farmers who are implementing measures aimed at extra buffering and more efficient irrigation, among other things.

Based on the ND (6th NAP), a target value of 50 mg/l nitrate in groundwater applies. Too much nitrate is now found in several groundwater abstractions, where groundwater is used to make drinking water. With the current generic policy, the quality of groundwater is improved, but not yet sufficiently everywhere. Extra efforts are needed, which is why the Administrative Agreement on the Approach to Nitrate in Groundwater was concluded. The decision was not to tighten up the rules, but to adopt an approach based on better soil management and farmers' expertise. The government, provinces and water companies have made a total of approximately 12 million EUR available for agricultural supervision and monitoring over the next five years.

More information can be found on https://agrarischwaterbeheer.nl/. Below, some information is presented on a project on circular agriculture called ‘Vruchtbare Kringloop’ (‘Fruitful Recycle’) and a large number of projects focusing on nitrate leaching bundled in ‘Waterwijs Boeren’ (‘Waterwise Farmers’).

Vruchtbare Kringloop (‘Fruitful Recycle’)

While available agricultural land is limited and the environmental requirements are becoming stricter, there are more and more mouths to feed worldwide. The agricultural sector has to produce more on less land. This can only be achieved if the sector takes a smarter, better and more efficient approach that is being worked on in various regions within the project ‘Vruchtbare Kringloop’.

These are regional projects, initiated by LTO Noord (the agricultural stakeholder organization active in the northern part of the Netherlands), focusing on the efficient use of minerals and the reduction of mineral losses (nitrate and phosphate) in the agricultural sector.

The participants are supported by a unique coalition of large chain partners, social partners and the government. In a dynamic combination of bottom-up initiatives and top-down facilitating and directing, a powerful project has been created that achieves appealing results in working on clean groundwater and improving soil fertility.

Agricultural entrepreneurs participating in Vruchtbare Kringloop are working hard on the realisation of regional recycling/circular agriculture and sustainable soil and water management. The project inspires agricultural entrepreneurs and offers them practical tools for cooperation, improving soil fertility and making their businesses more sustainable. The participants are working on the efficiency of their mineral use in order to obtain more return from the soil and are therefore becoming increasingly 'future-proof', not only in terms of operating results. In this way, Vruchtbare Kringloop works towards a sustainable future for agriculture and a good environment.

Waterwijs Boeren (‘Waterwise Farmers’)

According to the ND the nitrate content of groundwater or fresh surface water must not exceed 50 mg of nitrate per liter. This is laid down in the 6th NAP. At the moment, the Netherlands does not yet comply with this directive everywhere. Efforts are being made to comply with the provisions but the most important reason for limiting nitrate leaching is to keep the quality of the drinking water good.

Farmers take their responsibility and take an active part in it. For example, in the Dutch province of Gelderland, a separate administrative agreement has been concluded for this and three areas have been designated where nitrate leaching must be reduced. In those regions ‘kitchen table discussions’ were held with entrepreneurs and tailor-made plans were developed, focusing on what is possible and what measures the farmers want to take. This is done under the title ‘Waterwijs Boeren’.

7. Implementation and follow-up activities

Danube countries are encouraged to establish a specific water-agriculture working group and cooperation platform at national level to support policy making on sustainable agriculture. Partnership should be developed between the environmental departments/administration bodies (water management, nature protection, environmental protection), the agricultural sector and other relevant stakeholders in order to jointly and effectively work on the elaboration of agricultural strategic plans. Such platform would be able to advise policy making how to transform RBMP measures into agricultural measures and how to translate and coordinate result and impact indicators. It is also recommended to conduct a stakeholder analysis and to develop a national implementation plan for aligning water and agricultural policies.

Countries are also encouraged to organise a sort of roadshow for information dissemination on the national agricultural strategic plans, the measures to be implemented and the available funding schemes. This may include consultation events for the public supported by information materials, thematic workshops for relevant stakeholders and field demonstration events for farmers and land managers. The roadshow could pave the road towards common understanding and cooperation between the water and agricultural sector and efficient implementation of the strategic plans. Moreover, it could prepare the ground for the FAS and AKIS activities during the implementation phase of the agri-environmental policies.

At the basin-wide level, the established dialogue and cooperation with the agricultural sector and the joint discussions on common goals and win-win solution will remain high on the agenda after the finalisation of the guidance document.

Building on the experiences gained during the elaboration of other guiding principles (e.g. inland navigation or hydropower), a coordinated follow-up process is recommended to be carried out in an integrative manner with involvement of representatives from administrations, the agricultural sector, river basin organisations, NGOs and other interested parties, allowing to bring in expertise from various backgrounds. (Bi)annual workshops and thematic technical meetings would allow to exchange knowledge on good agricultural practices and case studies and to share the experiences with the implementation of the guidance document. Such events would also provide a common platform for potential amendments and fine-tuning of the guidance. This exchange could also be supported by joint pilot projects on specific issues, based on regional collaboration and/or co-funding of research and development (R&D) projects.

Based on the example of HELCOM, it is also considered to establish a sort of Danube farmer's prize which would reward some of those farmers from the DRB who have been implementing good agricultural practices. This would reinforce that good practices are recognized and appreciated and also would facilitate the demonstration of good examples.

Finally, it is recommended to strive for a close exchange with Priority Area 4 "Water Quality" in the execution of possible follow-up activities since specific actions on water quality and agriculture are also foreseen under the revised action plan of the EU Danube Strategy[70].

[70] https://waterquality.danube-region.eu/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Contact

ICPDR Secretariat

Vienna International Centre / D0412

P.O. Box 500 / 1400 Vienna / Austria

T: +43 (1) 26060-5738 / F: +43 (1) 26060-5895

secretariat@icpdr.org / www.icpdr.org