Water availability, surface water quality and water use in the Eastern Partnership countries

An indicator-based assessment

ISSN 1977-8449

Project funded by the European Union and implemented by the European Environment Agency

European Environment Agency

Water availability, surface water quality and water use in the Eastern Partnership countries

An indicator-based assessment

Project funded by the European Union and implemented by the European Environment Agency

European Environment Agency

Cover design: EEA
Cover photo: Carpathians, Ukraine – © Dmytro Averin
Layout: Rosendahls a/s

Brexit notice
The withdrawal of the United Kingdom from the European Union did not affect the production of this report. Data reported by the United Kingdom are included in all analyses and assessments contained herein, unless otherwise indicated.

Luxembourg: Publications Office of the European Union, 2020

ISBN 978-92-9480-291-0
ISSN 1977-8449
doi:10.2800/635170

European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark

Tel.: +45 33 36 71 00
Internet: eea.europa.eu
Enquiries: eea.europa.eu/enquiries

Contents

Acknowledgements

This report was developed and written by Nihat Zal (EEA), Lidija Globevnik (ETC/ICM), Kari Austnes (ETC/ICM) and Gašper Šubelj (ETC/ICM.

Contributions received from Luka Snoj (ETC/ICM) , Alexander Psomas (ETC/ICM) and George Bariamis (ETC/ICM).

We would also like to acknowledge those organisations and groups that provided input to the report or feedback as part of the consultation process:

National Focal Points in the Eastern Partnership countries:

Armenia: Gayane Shahnazaryan — Ministry of Nature Protection; Nelli Baghdasaryan — Statistical Committee

Azerbaijan: Faig Mutallimov — Ministry of Ecology and Natural Resources; Rena Lazımova — State Statistical Committee

Belarus: Ekaterina Poleshchuk, Belstat — National Statistical Committee; Elena Kaminskaya — Ministry of Natural Resources and Environmental Protection

Georgia: Maia Javakhishvili — Ministry of Environmental Protection and Agriculture; Vasil Tsakadze and Georgi Sanadze — National Statistics Office

Republic of Moldova: Veronica Lopotenco — Ministry of Agriculture, Regional Development and Environment; Silvia Nicolaescu — Environmental Agency; Elena Orlov — National Bureau of Statistics

Ukraine: Valentyna Vasilenko — Ministry of Ecology and Natural Resources; Oleg Prokopenko — State Statistics Service

National assistants in the ENI SEIS II East project:

Armenia — Yurik Poghosyan; **Azerbaijan** — Vafadar Ismayilov; **Georgia** — Tamar Bakuradze; **Republic of Moldova** — Maria Tarigradean; **Ukraine** — Dmytro Averin.

National water experts from the Eastern Partnership countries:

Armenia: Anna Zatikyan and Gayane Hazutyunyan — Ministry of Nature Protection; Naira Mandalyan and Ani Hambardzumyan — Statistical Committee

Azerbaijan: Matanat Avazova, Dilara Gulmamadova, Khayala Gulieva, Durdana Madatova, Asif Verdiyev and Gunay Hasanova — Ministry of Ecology and Natural Resources; Emil Sultanov- Ministry of Emergency Situations; Farid Osmanov and Gara Jafarov — Azerbaijan Amelioration and Water Economy OJSC; Elunur Nasirov and Tural Agharzayev — AZERSU OJSC

Belarus: Ekaterina Poleshchuk and Veronika Zhosan — National Statistical Committee; Elena Bogodiazh, Ekaterina Vasilenok and Polina Palchek — Belhydromet; Aliaksandr Pakhomau — Central Research Institute for Complex Use of Water Resources

Georgia: Nana Kitiashvili, Marina Zuleyva, Gulchina Kuchava, Marine Arabidze and Nino Imnadze — National Environment Agency; Mariam Makarova, Tamar Gamgebeli and Gvantsa Sivsivadze — Ministry of Environmental Protection and Agriculture; Nino Zurabishvili, Irakli Tsikhelashvili and Tamar Tarashvili — National Statistics Office

Republic of Moldova: Ina Ghilan and Rodica Adascalita — State Hydrometeorological Service; Ludmila Lungu — National Bureau of Statistics; Rodica Sîrbu and Ana-Maria Cojocaru — Apele Moldovei;

Ukraine: Shpanchyk Mariia- State Water Agency.

Additional support and guidance were received from Galina Georgieva (EEA), Paul McAleavey (EEA), Ronan Uhel (EEA), Stéphane Isoard (EEA) and Angela Bularga (DG NEAR).

Support received from Adriana Gheorghe (EEA), Peter Kristensen (EEA), Cécile Roddier-Quefelec (EEA) and Caroline Whalley (EEA).

Experts from the EU Water Initiative Plus project consortium:

Paul Haener, Alexander Zinke, Andreas Scheidleder, Christoph Leitner, Matthew Griffits, Alisher Mamadzhanov, Kristina Schaufler, Philippe Seguin, Daniel Trauner.

The report was edited by Joanna Kay Laval (EEA).

List of abbreviations

Abbreviation	Name
BOD	Biological oxygen demand
CEPA	Comprehensive and Enhanced Partnership Agreement
DPSIR	Drivers – Pressures – State – Impact – Response
EaP	Eastern Partnership
EEA	European Environment Agency
Eionet	European Environment Information and Observation Network
ENI	European Neighbourhood Instrument
ENP	European Neighbourhood Policy
EPIRB	European environmental protection of international river bodies
EU	European Union
GDP	Gross domestic product
HLPF	High-level Political Forum
IWRM	Integrated water resources management
N	Nitrogen
NH_4	Ammonium
NO_2	Nitrogen Dioxide
NO_3	Nitrate
OECD	Organisation for Economic Co-operation and Development
O_2	Oxygen
P	Phosphorus
PO_4	Phosphate
PPP	Purchasing power parity
QA/QC	Quality assurance / Quality control

Abbreviation	Name
RB	River basin
RBMP	River Basin Management Plan
RWR	Renewable freshwater resources
SDG	Sustainable Development Goal
SEEA	United Nations System of Environmental-Economic Accounting
SEIS	Shared Environmental Information System
SoE	State of the environment
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
USD	US dollar
WB	World Bank
WEI	Water Exploitation Index
WFD	Water Framework Directive
WHO	World Health Organization
WISE	Water Information System for Europe

Key messages

- Renewable freshwater resources are unevenly distributed throughout the six Eastern Partnership (EaP) countries due to natural conditions. In 2017, Georgia (12 000 m^3/capita) and Belarus (6 000 m^3/capita) were regarded as water-abundant countries, whereas Armenia (3 000 m^3/capita) held sufficient renewable water resources. The Republic of Moldova (1 800 m^3/capita) and Azerbaijan (1 730 m^3/capita) are prone to water scarcity over the period 2000-2017.

- In 2017, Armenia and Azerbaijan overexploited renewable freshwater resources for agriculture and public water supply; the estimated water exploitation index was 61 % and 72 %, respectively. Due to ineffective water demand management, both countries have experienced water scarcity for a long time.

- Water pollution is not a new issue in the region, but will be exacerbated in future by intensified agriculture and industrialisation and urbanisation, particularly if these developments are not supported by improved wastewater treatment. The lack of financial resources or insufficient management of water resources will exacerbate the problem.

- The main problem in rivers related to high concentrations of ammonium (NH_4) and phosphate caused by discharges of untreated or insufficiently treated wastewater and by agriculture. At two thirds of the river sites reported in the EaP countries the current concentration of ammonium is above the recommended levels for cyprinid fish in the European Union (EU) Fish Directive. Phosphate concentrations have increased since 2008. At present, almost half of the EaP river sites have phosphate concentrations which are high enough to cause eutrophication.

- The pollution of surface waters has direct impact on the volume of groundwater abstracted by increasing demand on groundwater resources, particularly in Azerbaijan, Armenia and Georgia. Overall, between 2000-2017, the water abstraction from surface and groundwater increased by 32 % in Armenia and 10 % in Azerbaijan. Water abstraction in Georgia has also increased by 20 % since 2005. In other EaP countries, the water abstraction has relatively decreased due to decline of some economic sectors (e.g. agriculture in Moldova) or water-use efficiency (e.g. in Belarus).

- Aged water-conveyance systems cause high water losses and spillover effects on increasing water abstraction for public water supplies. In 2017, the water-conveyance system in Armenia caused 79 % water loss in the public water supply. Similarly, 63 % of water was lost in the Georgian water-conveyance system, 49 % in Moldova, and 48 % in Azerbaijan, whereas Belarus, with only 18 % of water losses, registers the highest conveyance efficiency among the EaP countries.

- The EaP countries have improved their economy by generating gross domestic products between two to four times higher since 2000. However, only Belarus achieved absolute decoupling between water use and increase in gross domestic product. In 2017, Belarus used 8 m^3 of water to produce one unit of gross domestic product whereas Armenia used 79 m^3, Azerbaijan 58 m^3, Moldova 43 m^3 and Georgia 39 m^3 for the same unit of product.

- Knowledge-based policymaking still remains a key objective for the EaP countries, at least in the water sector, which should be supported by improving monitoring programmes and development of systematic capacity building in using available data and information for the national experts. This may also stimulate the effectiveness of cooperation and collaboration in the context of transboundary large river basins.

- Within the framework of the European Neighourhood Policy (ENP) , all partners have committed to achieve tangible benefits to the livelihood of the citizens across the region by focusing on achieving 20 deliverables for 2020, including in the field of the environment. Furthermore, the Association Agreements between the EU and Georgia, Republic of Moldova and Ukraine, as well as the EU-Armenia Comprehensive and Enhanced Partnership Agreement support, among others, the alignment of national water legislation with the EU and international standards. When achieved, significant progress will be registered in the protection and integrated management of water resources in the region.

- Countries are still facing several important institutional and managerial challenges. Specifically, attention should be paid to the establishment and functioning of river basin councils, the development of stakeholder models and practices and public involvement, the development of a sustainable funding mechanism for implementing the River Basin Management Plan (RBMP) and the production of robust and reliable data. At the regional level, bilateral and multilateral cooperation on transboundary basins should be strengthened both within the region and with EU Member States and other countries.

Executive summary

Action on environment and climate goals has received significant attention within the Eastern Partnership (EaP) initiative. As a specific regional dimension of the European Neighbourhood Policy, the EaP aims to strengthen and deepen the political and economic relations between the EU, its Member States and the six partner countries: Armenia, Azerbaijan, Belarus, Georgia; the Republic of Moldova (herein after referred to as Moldova), and Ukraine. The EaP is also geared towards delivering on global commitments, including the Paris Agreement on Climate Change and the UN (UN SDGs) 2030 Agenda and its Sustainable Development Goals.

Long-lasting efforts have been made within the EaP framework to improve the evidence base for environmental decision-making in line with the European Commission's Communication 'Towards a Shared Environmental Information System (SEIS)'. In 2011, the EU initiated a project on SEIS implementation in EaP countries, which has seen two phases up to 2020. This demand-based project, implemented by the European Environment Agency (EEA), has supported EaP countries in accessing EU and European Environment Information and Observation Network (Eionet) knowledge and experience. Water was one of the priority thematic areas of cooperation.

This report is one of the results of the implementation of Shared Environmental Information System (SEIS) principles in EaP countries. It presents a regional assessment of freshwater availability and water-use efficiency based on seven selected United Nations Economic Commission for Europe (UNECE) water indicators chosen in agreement with the EaP countries. The selection of the indicators was mainly driven by data availability across all EaP countries. Since the selected indicators are only capable of addressing limited issues concerning the protection of water resources and sustainable and integrated water resources management (IWRM) by the EaP countries at the regional level, this report does not address all environmental impacts of pressures and the effectiveness of policy responses (measures) in the water area. Primarily, at the regional level, it quantifies trends and current renewable water resources, water use by economic sector, economic water use efficiency, efficiency of the water-supply industry and the pollution of surface water.

From the hydrological perspective, all large rivers in the EaP countries, for example, Vistula, Neman, Daugava, Danube, Dnieper, Dniester, Prut, Aras and Kura, are either transboundary or share a basin, including with EU Member States. Three indicators have been used for the regional assessment of renewable freshwater resources (RWR) over the years: RWR per capita; dependency ratio; and water stress. Georgia holds the highest RWR per capita on average with 13 500 m^3/capita/year, whereas Moldova has the lowest at 1 800 m^3/capita/year. This indicator shows an increase trend in RWR per capita in all countries except Azerbaijan, where the total RWR decreased by 27 % between 2000-2017, whereas the population increased (in 2000, it was 2 902 m^3/capita/year, up from 1 732 m^3/capita/year in 2017).

The dependency ratio, which measures what part of RWR flows from upstream/neighbouring countries to downstream, is the highest in Azerbaijan and high in Belarus. Azerbaijan's dependency ratio is greater than 70 %. In Belarus, it is around 38 %. There is insufficient information available for estimating the recharge, storage and discharge of groundwater in aquifers that are lying between countries.

Even though the annual RWR per capita in the region indicates there is no water stress, Armenia and Azerbaijan are facing severe water-scarcity conditions due to over-abstraction of freshwater for agriculture and a high rate of water losses in water. In extreme conditions, such as in 2017, Armenia exploited 61 % of available renewable water resources while Azerbaijan exploited 72 %. On average, the water exploitation index is above 40 % in both Armenia and Azerbaijan. The main reasons for excessive water use are inefficient irrigation in Azerbaijan and over-abstraction of water for aquaculture in Armenia.

Surface waters represent the largest portion of water demand in Azerbaijan, the Republic of Moldova and Georgia, at 89 %, 85 % and 75 %, respectively (average 2000-2017). Belarus and Armenia use almost the same share of both groundwater and surface water (65 % groundwater in Belarus and 45 % in Armenia). Between 2000-2017, water abstraction increased by 32 % in Armenia and 12 % in Azerbaijan. In Georgia, water abstraction has increased by 20 % since 2005. In other countries, water abstraction has decreased due to recessions in some economic sectors (e.g. agriculture in Moldova) or water-use efficiency (e.g. in Belarus).

Agriculture and public water supply are the major water-use sectors in nearly all EaP countries. Agriculture accounts for more than 70 % of total water use at the regional level, where irrigation and fish farming are two major subsectors.

The accessibility of safe drinking water in the region is very high. Three quarters of the population are connected to public water-supply systems. In Armenia and Belarus, more than 95 % of the population is connected to the public water supply; in Georgia, the figure is 66 %. In Azerbaijan and Moldova, public systems supply drinking water to larger municipalities, accounting for approximately half the total population, while the rural population rely on self-supply from groundwater resources or other local supply systems. In Moldova, daily water use per person is 86 litres, in Armenia 89.6 l, Belarus 107 l, Azerbaijan 176 l, and Georgia 248 l. Ageing conveyance systems and the great distance they have to cover are causing substantial water losses in public water supplies. In 2017, the losses totalled 70 % in Armenia, 63 % in Georgia, 49 % in Moldova, and 48 % in Azerbaijan. Water losses in Belarus are minimal.

Water-use efficiency measured as water input per unit of gross domestic product (GDP) at purchasing power parity (PPP) is highest in Belarus and lowest in Armenia. In Belarus, 23 m^3 of water was used to produce international dollars (I$) ([1]) 1 000 in 1990 and only 8 m^3 for I$ 1 000 in 2017. Currently, in Armenia, 106 m^3 of water is used for I$ 1 000. In Georgia, Moldova and Azerbaijan, 39 m^3, 45 m^3 and 58 m^3 of water is used for I$ 1 000, respectively. Although the EaP countries registered an increase in GDP between 2000-2017, it would appear that this has been at the cost of the overexploitation of water resources, except in Belarus.

In Armenia and Azerbaijan, around 600 and 450 million m^3 of water is supplied respectively each year by the water-supply industry. In Armenia, this amount represents 20 % of the total water abstracted, of which 80 % is lost in the water-supply system. In Azerbaijan, the water-supply system accounts for 5 % of total water abstraction, of which almost 50 % is lost in the supply system. In Georgia, the water industry supplies around 800 million m^3 of water, 40 % of all water abstracted in the country, of which 66 % is lost in the supply system. In Belarus, the water industry supplies around 550 million m^3 of water, which represents 30 % of all abstracted water, with low losses at only 16 %. In Moldova, 72 % of total water use in the country (0.1 million m^3) is supplied by the water industry for cooling purposes.

Many lakes and rivers in EaP countries are polluted as the result of poor or non-existent wastewater treatment and the leaching of nutrients by agricultural practices. Three quarters of the river-monitoring sites analysed have very high ammonium concentrations, and biological oxygen demand (BOD) is very high at one quarter of these sites. The average BOD has only decreased slightly since 2008 and was at 2.7 mg O_2/l in 2017. The average ammonium concentration for the EaP countries fluctuated between 0.6-0.8 mgN_4-N/l over the period 2008-2017, which is far above the recommended level for healthy fish communities.

The main sources of nutrient pollution are agriculture, wastewater and storm water. Nitrate concentrations in rivers do not present a high eutrophication risk for rivers in EaP countries, since more than 60 % of the river sites analysed have rather low concentrations of nitrate. On the other hand, 40 % of the sites analysed have phosphate concentrations which are high enough to cause eutrophication. Average river phosphate concentrations have also increased slightly since 2008.

Where indicated, there is usually a significant difference between river water quality up and downstream of cities and towns, with higher concentrations downstream of cities. Increasing concentrations were also observed, to a larger extent, for sites downstream of settlements.

Poor surface water quality in many EaP countries is an indication that groundwater resources are at a high risk of being more polluted and more exploited. Since 2000, this trend has already caused a fourfold increase in water abstraction from groundwater in Azerbaijan and threefold in Armenia.

([1]) An international dollar would buy a comparable amount of goods and services in the cited country as a US dollar would buy in the United States. This term is often used in conjunction with PPP data (World Bank, 2017b).

There is still a problem with data availability in many of the countries. For example, we could not determine the state of groundwater quality in most of the countries because data on the measured quality parameters are not freely available or are not collected in uniform national information databases. There is also a poor understanding of the importance of comprehensive assessments of water quality state, pressures and impacts. When data are available for selected water locations, they are not interpreted or integrated into regular water management purposes.

With EU support, Armenia, Azerbaijan and Georgia have developed water information systems as a pilot activity by replicating the overall approach of the Water Information System for Europe (WISE). This will ensure the effective sharing of data and information among water agencies, while improving the capacities of these countries to respond to regional and international reporting commitments. In this context, sustainability and further improvements within the existing information systems are vital.

In future, the sharing of available data and information among national water agencies, as well as with external stakeholders, will be key, along with integrating all data relevant to managing water resources. Enhancing countries' monitoring capacities is equally important. This will provide a robust baseline for developing and implementing water-focused environmental policies, not only at the national level but also at the regional level — an essential process in improving cooperation among transboundary river basins.

1 Context, scope and methodology

Key messages

This report was developed in the context of the EEA cooperation with the Eastern partnership region.

The report primarily aims to present regional information and assessment from the aggregated results of environmental indicators for the water sector with the aim of supporting knowledge-based policymaking at the regional level. Problems arising on the quality and quantity of water resources have already become more acute in almost all EaP countries' transboundary river basins, calling for joint actions among the countries.

The methodology used to develop the indicators is built on key elements from the EEA's work with its Eionet partner network, in full recognition of the different set-ups concerning interactions with partner countries in the EaP region.

By its very nature, the report is indicator based and its content is confined only by the selected indicators agreed with the EaP countries. Its scope does not aim to respond to the elements of a comprehensive integrated assessment.

The EaP sets out a path for the EU to follow to deepen its relations with Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine through bilateral and multilateral cooperation. Since its establishment in 2009, cooperation between the EU and EaP countries has resulted in significant achievements. For example, EU support has enabled modern water policy at basin level concerning more than 30 million people across the six partner countries. Since 2017, four river basins plans have been adopted in line with EU benchmarks. All the countries have received modern equipment to better monitor and reduce their populations' exposure to water pollutants.

Environment and climate action is gaining prominence within the EaP. The recent Communication on the EaP 'Reinforcing Resilience – an Eastern Partnership that delivers for all' lists environmental and climate resilience among its five priorities. The proposed agenda aims to: (1) scale up action in areas that are critical for people's health and well-being; (2) increase economies' resource efficiency; (3) develop new green jobs and economic opportunities linked to the green transition; (4) develop local and renewable sources of energy; and (5) manage natural assets to maximise sustainability. The EaP also aims to support progress on the Sustainable Development Goals (SDGs) and the Paris Agreement on Climate Change (EC,, 2020a).

The Eastern Partnership Ministerial Meetings on Environment and Climate Change provide a policy platform where the EaP countries and the EU jointly review progress on the goals and priorities in various environmental domains.

As a specific Eastern dimension of the European Neighourhood Policy, the EaP combines bilateral and multilateral tracks. The overall framework guiding relations between the EU and its six Eastern Partners is provided by relevant bilateral agreements, such as the Association Agreements, as well as the Association Agendas, the Partnership Priorities, and the EaP 20 Deliverables for 2020 aligned across four key priority areas: (1) stronger economy; (2) stronger governance; (3) stronger connectivity, energy efficiency, environment and climate action; and (4) stronger society, together with targets for the cross-cutting issues of gender, civil society and strategic communication.

The Association Agreements between the EU and Georgia, Moldova and Ukraine, the EU-Armenia Comprehensive and Enhanced Partnership Agreement (European Commission, 2020a) accelerate a gradual improvement in national water legislation, including alignment with the EU's water law, where relevant. Negotiations between the EU and Azerbaijan on a new agreement, and dialogue with Belarus towards Partnership Priorities, have already been initiated (European Commission, 2020b).

Launched in 2009, the EaP is a strategic and ambitious partnership based on common values and rules, mutual interests and commitments, as well as shared ownership and responsibility. It aims to strengthen and deepen the political and economic relations between the EU, its Member States and the partner countries, and supports reform processes in partner countries.

The EU Water Framework Directive (EU WFD) has provided an important benchmark for the reform of water policies in the EaP countries. The main aim of the EU water policy is to ensure that a sufficient quantity of good-quality water is available for both people's needs and the environment (EEA, 2018). The EU WFD set environmental objectives for protecting and sustainably managing water resources (Directive 2000/60/EC) via the implementation of integrated water resources management (IWRM). It is suggested that the same principles are pertinent to those international river basins extending beyond the boundary of the EU. The EU WFD recommends producing a single RBMP for international river basin districts with neighbouring countries.

WISE has been developed as a partnership between the European Commission (Directorate-General for Environment, Joint Research Centre and Eurostat) and the EEA. The EEA hosts the water data centre and thematic WISE webpages. WISE collects, shares and disseminates data and information on water resources and water resources management, including data reported by the EU Member States under the reporting cycle of the EU WFD RBMP ([2]). WISE has also been used by the Eionet member countries ([3]) for reporting and sharing water data under the State of the Environment data flows.

1.1 Scope of the report

In 2016, the EU initiated a project on the implementation of Shared Environmental Information System (SEIS) principles and practices in the European neighbourhood regions. The four-year project, implemented by the EEA, aimed to transfer the knowledge and experiences from the EU and Eionet to the EaP countries, whereby the EEA and the EaP countries jointly developed national and regional work plans for various environmental thematic areas (EEA, 2020).

With such technical and financial support from the EU, the EaP countries — among others — implement activities to strengthen the principles of the SEIS in the area of water and water resources management. Taking into account the three main pillars of the SEIS, i.e. content, cooperation and infrastructure, the EEA and the EaP countries tailored the national and regional work plan so as to support SEIS implementation in the thematic area of water (Figure 1.1). EEA activities implemented with the EaP countries covered the following domains of SEIS pillars.

Content

- Harmonisation of the national water data with Water Information System for Europe (WISE)
- Water accounts for developing the relational water database
- Indicator development line with the EEA indicator method and template for regional comparability.

Infrastructure

- Information systems as pilot activity in Armenia, Azerbaijan and Georgia to strengthen implementation of the SEIS principles.

This report primarily aims to present regional information and assessment from the aggregated results of water indicators to support existing or potential regional ***cooperation*** with regionally harmonised data, information and assessment. Furthermore, the report briefly touches on the gap in regional data on water resources and the need for further work to improve knowledge-based environmental policy and the sustainable management of water resources.

The scope and content of this report have been confined by the selected UNECE water indicators (UNECE, 2007a) which have been agreed with the EaP countries. The selection of indicators has been mainly driven by data availability across all countries and common issues at the regional level, such as RWR, water pollution, water scarcity and resource efficiency (Table 1.1).

(2) https://water.europa.eu/freshwater

(3) The European Environment Information and Observation Network (Eionet) is a partnership network of the European Environment Agency (EEA) and its 38 member and cooperating countries: https://www.eionet.europa.eu/

Box 1.1 The Shared Environmental Information System (SEIS)

On 1 February 2008, the European Commission adopted the Communication Towards a Shared Environmental Information System – SEIS (COM(2008) 46) (EC, 2008). The overall objective was to improve data collection and sharing as well as modernise the data processing by centralising the reporting systems in various European environment domains. It was a collaborative initiative between the European Commission, the EEA and its Eionet member countries (EEA, 2018). Its implementation has also been expanded to the UNECE region (UNECE, 2016h).

SEIS is built on three pillars — content, cooperation and infrastructure — and based on seven principles. The information should be:

— Managed as close as possible to its source;

— Collected once and shared with others for many purposes;

— Readily available to easily fulfil reporting obligations;

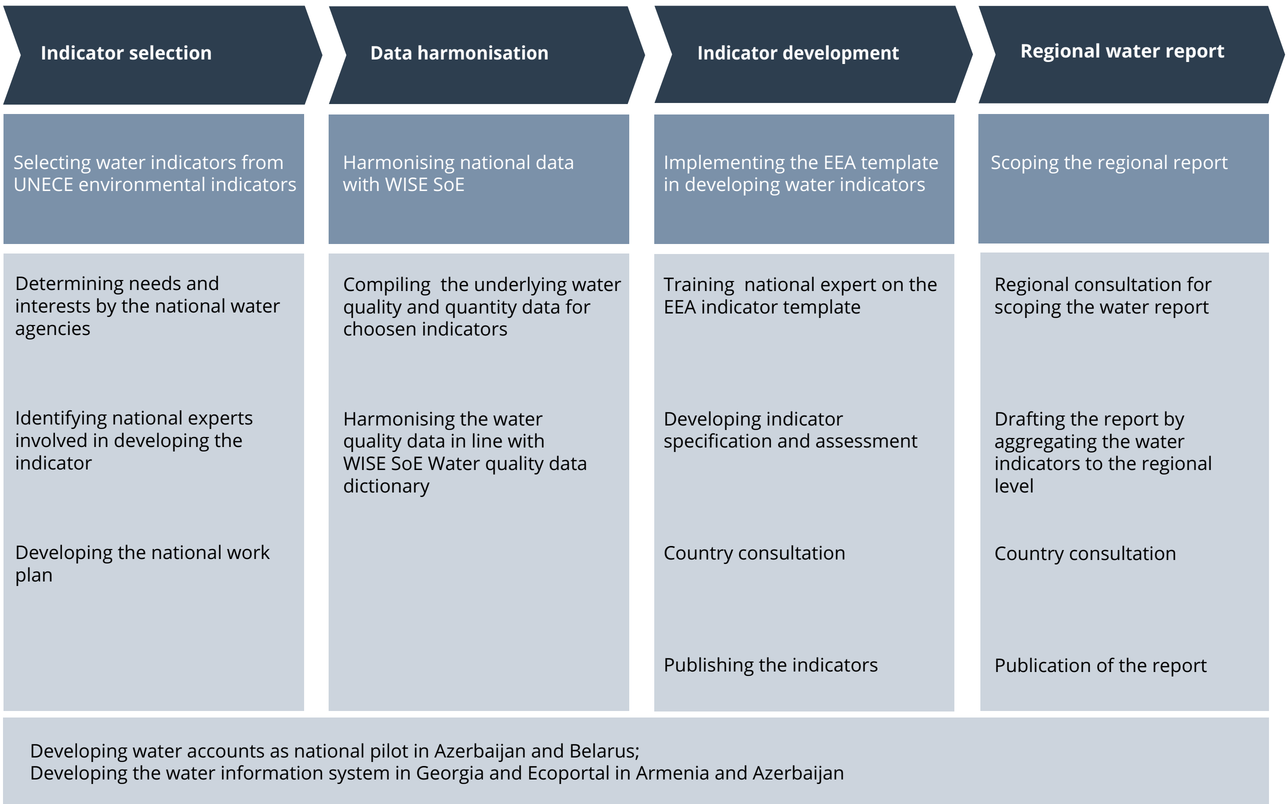
— Easily accessible to all users;

— Accessible to enable comparisons at the appropriate geographical scale and the participation of citizens;

— Fully available to the general public and at national level in the relevant national language(s);

— Supported through common, free, open software standards.

Figure 1.1 Implementation of activities under the water component of the ENI SEIS II East project



Source: EEA

Table 1.1 List of water indicators implemented under the ENI SEIS II East project by national experts in the EaP countries

Water indicators	Armenia	Azerbaijan	Belarus	Georgia	Moldova	Ukraine
C1. Renewable freshwater resources						
C2. Freshwater abstraction						
C3. Total water use						
C4. Household water use per capita						
C5. Water supply industry and population connected to water-supply industry						
C10. BOD and concentration of ammonium in rivers						
C11. Nutrients in freshwater						

Note: Individual indicators can be seen on the ENI SEIS II East project website: https://eni-seis.eionet.europa.eu/east/indicators

The suitability of indicators for individual countries was limited by their respective data provision. As the State Statistics Service of Ukraine does not have a mandate for collecting water quantity data, Ukraine's freshwaters are not covered by water quantity assessments. However, this report addresses water quantity in Ukraine to a limited extent, based on data available online in different national or international domains to ensure a proper regionally horizontal assessment.

1.2 Methodological approach

An indicator is a measure, generally quantitative, that can be used to illustrate and communicate complex phenomena simply, including trends and progress over time (EEA, 2005). The EEA designs, develops and updates a number of water indicators as part of a core set of indicators to inform EU and national institution policymakers ([4]).

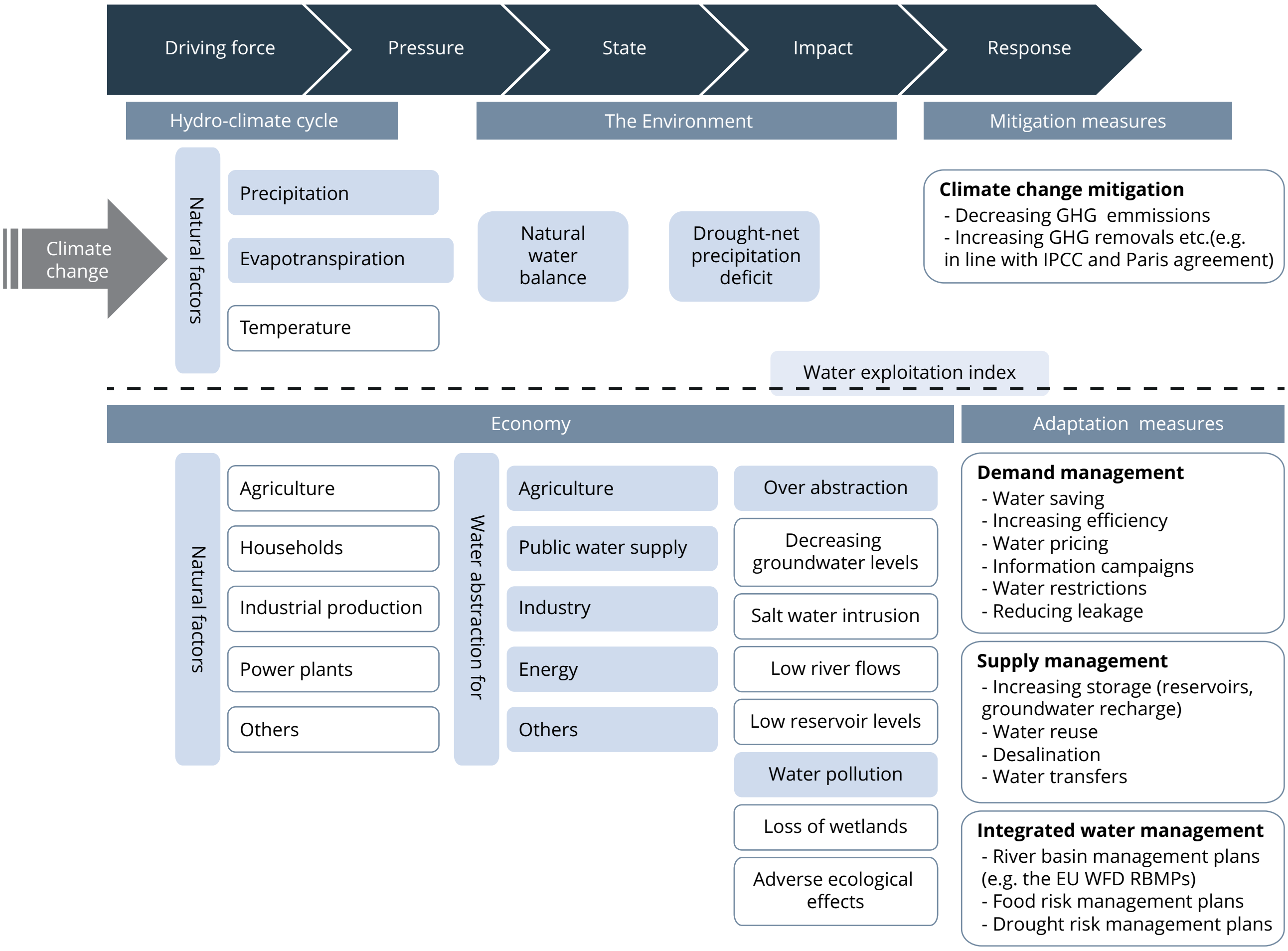
The establishment and development of the EEA core set of indicators follow a certain structure and template to ensure transparency from monitoring to data collection and knowledge creation. As this set of indicators can also be positioned with the so-called DPSIR framework ([5]), the indicators selected within the scope of this report were also designed around the key elements of the EEA DPSIR framework (Figure 1.2). They were developed jointly with national water experts from the EaP countries, and EaP countries and partners of the European Union Water Initiative Plus (EUWI+) consortium ([6]) were consulted on all indicators before they were published ([7]).

However, the selected indicators are capable of addressing limited issues concerning the protection of water resources and sustainable, integrated water resources management (IWRM) in EaP countries at the regional level. EaP countries face various challenges, such as political, administrative, financial, technical and human capacities in protecting and managing the water resources, which are not fully addressed in this report. The added value of this report is primarily to quantify the magnitude of and trends in the pollution of surface water, renewable freshwater resources, and water use by economic sectors. The report presents a regional overview with up-to-date data and information mainly provided by the EaP countries. Nevertheless, addressing all the environmental impacts of pressures and the effectiveness of the policy responses (measures) remain out of the scope of this report because of its inherent structure.

Water quality is more or less a common issue across EaP countries due to high emissions from agriculture and the discharge of untreated wastewater into the environment. Within the scope of this report, BOD5 and ammonium concentration in rivers and nutrients in freshwater are two indicators selected

([4]) See all EEA core set and thematic indicators at: https://www.eea.europa.eu/data-and-maps/indicators/#c0=30&c12-operator=or&b_start=0
([5]) DPSIR stands for 'Drivers – Pressures – State – Impact – Response, which has been used by the EEA as a conceptual framework for data flow and undertaking the assessment.
([6]) EUWI+ is the largest EU-funded project running in the EaP countries to help Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine bring their legislation closer to EU policy in the field of water management, development and implementation of pilot RBMPs, building on the improved policy framework and ensuring the strong participation of local stakeholders: https://euwipluseast.eu/en/
([7]) The full set of indicators can be seen at: https://eni-seis.eionet.europa.eu/east/countries/

Figure 1.2 Thematic coverage of the selected indicators in line with the DPSIR framework



Note: Light-blue boxes indicate those areas covered by the selected indicators in the report.

Source: Slightly modified from (Collins et al., 2009).

to address water-quality issues in both surface water and groundwater. These two indicators replicate EEA core set indicator 019 (EEA, 2019b) and EEA CSI 020 (EEA, 2019a) in the EaP regional context, which enables further comparison with EU Member States. However, with the exception of Georgia, none of the EaP countries provided data on nutrient concentration in groundwater. Therefore, the assessment of groundwater quality in the report is mainly literature-based.

The report has been split into six chapters dedicated to various aspects of water resource management in the region. Chapter 1 contextualises the indicator selection, and explains the report's methodological approach and its potential contribution to regional water policies. Chapter 2 is about regional policy context, while Chapter 3 deals with assessments on RWR and climate change impacts on water resources. Chapter 4 focuses on the pressures of economic sectors and water use efficiencies across EaP countries. Chapter 5 is dedicated to overall water-quality issues, with a special focus on organic and nutrient pollution of waters and their drivers, while Chapter 6 addresses future work and the outlook across the region.

2 Policy context of water resources management in Eastern Partnership countries

Key messages

Bilateral cooperation is already taking place for integrated water resources management in the transboundary river basins, such as the Dniester Treaty between Moldova and Ukraine, and the bilateral agreement between Belarus and Ukraine.

All EaP countries have governmental organisations to manage water resources. However, frequent reorganisation among the respective agencies and ministries and staff turnover create risks as regards developing expert knowledge and the operational capacity of water institutions.

EaP countries are home to around 70 million people and are still in the transition period towards market economies. Population dynamics show mixed trends, declining in some countries, such as Armenia, while sharply increasing in, for example, Azerbaijan. Ukraine has the largest population at 42 million, followed by Azerbaijan with 10 million. Belarus has a population of 9.46 million, Georgia 3.7 million, Moldova 3.5 million and Armenia 3 million.

The EaP countries are located on terrain where freshwater ecosystems are very diverse, with floodplains, rivers and lakes (Map 2.1). Surface and groundwater resources are strategic natural resources for supplying water to 70 million people and key to maintaining the countries' major economic sectors, such as agriculture, energy and manufacturing industries.

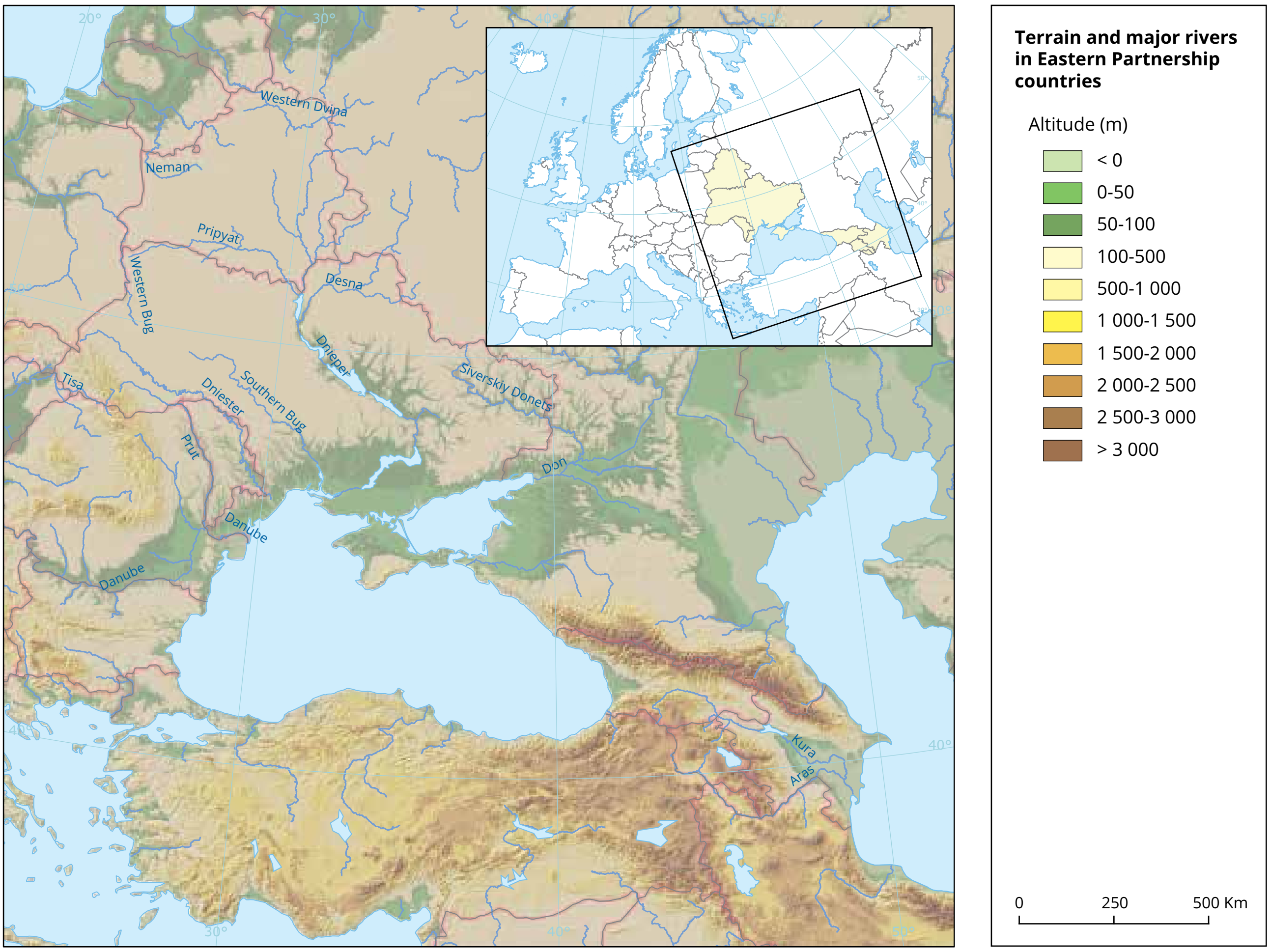
However, in some countries, renewable water resources are either overexploited by economic sectors (e.g. in Armenia and Azerbaijan) or polluted by high-level nitrate and phosphorus (P) emissions (excluding Belarus), mainly from agriculture and the direct discharge of wastewater. One third of the population at the regional level do not have access to a public water supply. In some countries, almost half of the population rely on self-supply. In addition, direct discharge or insufficiently treated wastewater exacerbates the pollution of surface and groundwater resources. These problems, either partly or entirely, are common in all EaP countries and have already been addressed in several publications (EEA, 2011; OECD and UNECE, 2014; UNECE, 2007c; UNENGO, 2015).

In 2014, by signing agreements with the EU and its Member States, Moldova, Georgia and Ukraine started the gradual adjustment of their national legislation to European environmental standards and principles, while some other countries, for example, Belarus, have voluntarily aimed to harmonise their water legislation with the EU water *acquis*.

Many of the existing national water laws are adopting principles similar to the EU water *acquis*, particularly the EU Water Framework Directive and its daughter Directives. For example, Water Law no. 272/2011 in Moldova has partly harmonised its water legislation with the EU water *acquis* (Republic of Moldova, 2011) on the protection of water against nitrate pollution from agricultural sources, bathing waters, environmental quality standards in the field of water policy, and on urban wastewater treatment. In Ukraine, the process of implementing European water policy started with the new legislation, namely, the Water Code of Ukraine (amended on 4 October 2016). The Code sets the basis for implementation of extended water-quality monitoring programmes, for example to support the assessment of the ecological status of surface-water bodies. Georgia adopted new water legislation in 1997, and is currently reforming its national environmental legislation and water protection sector to adapt to the EU water *acquis* (Vystavna et al., 2018). Meanwhile, some countries are renewing their water legislation and water strategy, with EU support, such as Azerbaijan.

Armenia and Azerbaijan also participate in the European Nieghbourhood Policy. Political cooperation between the EU and Armenia is based on the

Map 2.1 Terrain and major rivers in EaP countries



Reference data: ©ESRI

Source: (NASA, 2020; EEA, 2012b).

Comprehensive and Enhanced Partnership Agreement (CEPA) which was signed on 24 November 2017. With this agreement, the EU started to support Armenia in adopting EU environmental standards and updating the Water Code of Armenia as part of the implementation of EUWI+ activities. Political cooperation between the EU and Azerbaijan began in 1999 with signature of the Partnership and Cooperation Agreement (EC, 1999).

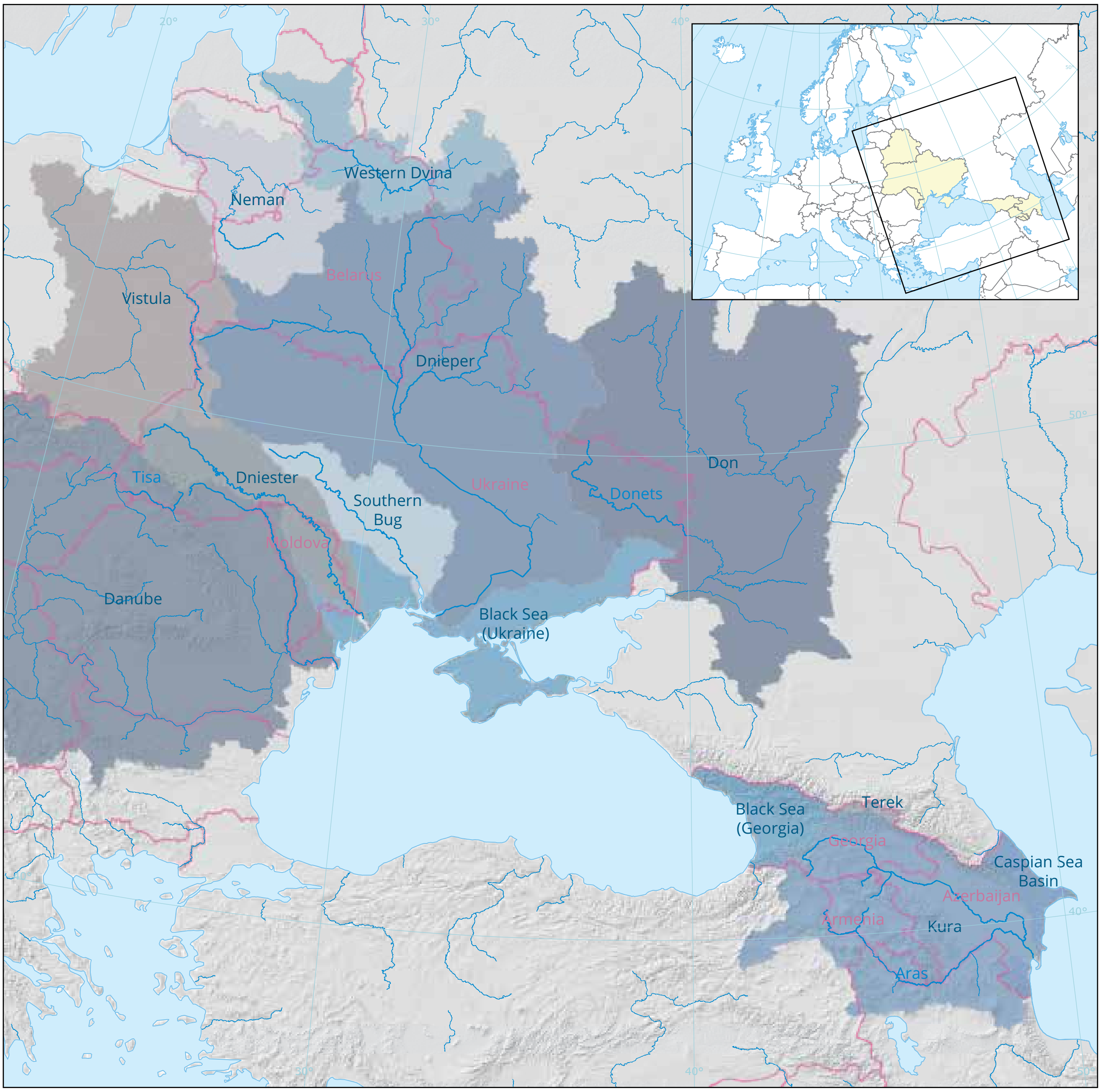
The EU provides financial and technical support for a number of international projects in the region, aiming to strengthen the capacities of the governmental and public administration bodies in monitoring, water information systems, water supply, sanitation, river basin management, the protection of freshwater ecosystems, and public participation. For instance, the EUWI+ and SEIS II East are projects funded through the European Neighbourhood Instrument (ENI), and are active in all six countries. The EUWEI+ focuses on the consolidation of monitoring systems and supports further reforms of water policies and the development of RBMPs in all six countries with the involvement of stakeholders and the wider public. The ENI SEIS II East project supports capacity building for an integrated assessment of the state of environment and data reporting to international bodies.

2.1 Cooperation in transboundary basins and EU water diplomacy

Cooperation in transboundary river basins plays a significant role in ensuring the sustainable use of water resources by EaP countries. Thus, the Dnieper Basin is shared by Belarus and Ukraine; Dniester by Ukraine and Moldova; Aras by Armenia and Azerbaijan;

and Kura is shared between Armenia, Georgia and Azerbaijan (Map 2.2). Furthermore, some of the river basins in EaP countries are shared with EU Member states — for example, Western Dvina/Daugava, Danube and Prut river basins. A comprehensive assessment of the status of transboundary waters and related ecosystems in the pan-European region was conducted in 2011 by UNECE in the framework of the 'Environment for Europe' process and in conjunction with the UNECE Water Convention (UNECE, 2011d). The 'Second Assessment of Transboundary Rivers, Lakes and Groundwaters' covered more than

Map 2.2 River basins in the EaP countries



Reference data: ©ESRI

River basins in Eastern partnership countries

River — Country border

0 250 500 km

Data source: ECRINS database (EEA, 2012b).

140 transboundary rivers, 25 transboundary lakes, about 200 transboundary groundwaters, 25 Ramsar sites and other wetlands of transboundary importance. It presents a broad analysis of transboundary water resources, pressure factors, quantity and quality status, and transboundary impacts, as well as management responses and future trends.

Over the last decade, the problems arising around the quality and quantity of water resources have become more acute in almost all transboundary river basins in the EaP countries, which calls for joint actions by the countries. However, financial constraints, the reluctance among national water agencies to facilitate data and information exchange and, in some cases, the loss of institutional memory due to the frequent reorganisation of the water agencies, staff turnover and repeatedly changing governments with varying political priorities, present limitations for underpinning knowledge-based policymaking in the water domain. All these acute problems require the commitment from and participation of all riparian and upstream countries.

Given that transboundary basins cover around 60 % of the EU's territory (EC, 2019a), Member States have a vast experience of cooperation in such basins. EU water diplomacy calls for enhancing EU diplomatic engagement on water and facilitating the prevention, containment and resolution of conflicts, contributing to the equitable, sustainable and integrated management of water resources, as well as promoting resilience to climate change impacts on water (EC, 2018). In this context, the EU reiterates the need for full compliance with international environmental safety standards while developing projects in EU neighbouring countries which impact on transboundary water resources.

2.2 United Nations Sustainable Development Agenda 2030

All countries have taken action to affirm their commitment to attaining the United Nations Sustainable Development Goals (UN SDGs) and are therefore actively involved in international policies for environmental protection and sustainable development. The main UN platform for joint and harmonised international actions for UN SDGs at the global level is the United Nations High-level Political Forum on Sustainable Development (UNHLPF, 2020). Since 2015, all six countries have actively worked with the HLPF and are creating the necessary national infrastructure for implementation of the UN SDGs, also in the area of water. Two political goals most frequently referred to in the region concern drinking water supply and sustainable water use.

Within the EU Water Diplomacy initiative, the EU promote accession to and implementation of international agreements on water cooperation: in particular, UNECE Convention on the Protection and Use of Transboundary Watercourses and International

Box 2.1 The Water Convention

The 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) not only promotes cooperation on transboundary surface waters and groundwater but also strengthens their protection and sustainable management. It provides internationally recognised norms for measuring the effectiveness and efficiency of sustainable development. The status of ratification of the Water Convention by the EaP countries is given in Table 2.1:

Table 2.1 Status of ratification of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes

Participant	Signature	Ratification, Accession(a), Acceptance(A), Approval(AA)
Azerbaijan		3 Aug 2000 a
Belarus		29 May 2003 a
Republic of Moldova		4 Jan 1994 a
Ukraine		8 Oct 1999 a

Source: (UN, 2020).

Armenia and Georgia have not yet acceded to the Water Convention. Despite some legacy bilateral agreements existing among the Caucasus countries in the Soviet era before 1991, it is not clear how relevant they are now in practice (Yildiz, 2017). The UNECE Water Convention has recently become a global instrument, whereby countries outside the UNECE region can accede to the Convention.

Lakes (Helsinki Water Convention 1992), the United Nations Convention on the Law of Non-Navigational Uses of International Watercourses (UN, 1997), and other relevant international agreements (EC, 2018).

EaP countries also implement joint activities with bilateral and multiparty agreements (UNECE, 2007c; FAO, 2009; Yıldız, 2017). Some have already developed joint monitoring systems, exchange information, and implement activities on water pollution prevention and control, and water flow regulation in international river basins. For instance, Ukraine and Moldova signed a bilateral treaty on the Dniester Basin in 2012 to provide a framework for cooperation in various areas of water resources management (UNECE, 2012). Based on this treaty, the Dniester Commission was established to prioritise harmonisation of both countries' national legislation with the EU environmental *acquis* (Dniester-Commission, 2020). There is also a bilateral agreement between Belarus and Ukraine on the joint use and protection of transboundary waters, which entered into force on 13 June 2002.

Armenia and Georgia, and Azerbaijan and Georgia also engage in bilateral dialogue towards achieving an agreement for managing water resources in the international basins of the River Kura (FAO, 2009; Yıldız, 2017; Yu et al., 2014).

Recently, Azerbaijan and Georgia have been working on developing a bilateral agreement on transboundary water cooperation (UNECE, 2015) with a special focus on flood prevention and wastewater management.

In addition, both countries have met several times to identify priorities for further transboundary cooperation, such as capacity building, databases updates and developing information-sharing systems (Strosser et al., 2017).

2.3 Institutional organisation for integrated water resources management

The protection and sustainable and integrated management of water resources are the backbone of the EU water *acquis* (EU, 2000). In this context, water governance at all levels is essential for long-term stability. It requires appropriate institutions, reliable data, capacity building, awareness raising and funding. It should foster sustainable, durable, climate-resilient water management as well as consideration of the interlinkages between water, energy, food security and ecosystems (EC, 2018).

There are governmental authorities responsible for water management and environmental protection in all EaP countries. Overall, ministries of environment are the main governmental bodies responsible for developing water management policy and legislation. Within these ministries are dedicated institutions for monitoring, analysing and disseminating data and information on water quality and quantity. In most countries, these are hydrometeorological and geological services. Some countries have also established special information centres engaged in

Box 2.2 Dniester Treaty

A bilateral treaty on 'Cooperation in the Field of Protection and Sustainable Development of the Dniester River Basin', by the Ministry of Environment of Moldova and the Ministry of Ecology and Natural Resources of Ukraine, was signed in the Italian Parliament on 29 November 2012 in the framework of the High-level Segment of the sixth session of the Meeting of the Parties to United Nations Economic Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention).

Under the Treaty, the Dniester Commission was established with the main goal of implementing measures to achieve the rational and environmentally sound use and protection of water and other natural resources and ecosystems of the river basin. The Commission is led by two co-chairs and comprises deputy co-chairs, representatives of the competent central executive authorities, regional authorities, academic institutions and organisations and non-governmental organisations from Moldova and Ukraine. In its work, it is guided by the rules of procedure, approved on 17 September 2018, which govern activities. Meetings of the Commission, its working groups and experts are held at least once a year, alternately in the territory of both states.

The Treaty identifies principles and provides a framework for cooperation on water pollution prevention and control, water flow regulation, conservation of biodiversity, and protection of the Black Sea environment. It also addresses the monitoring of data exchange, public participation and cooperation in emergency situations.

More information on the Treaty and other activities of the Dniester Commission are available at: https://dniester-commission.com/en/publications/

environmental protection and/or natural resources management that can be sponsored by international programmes. Their overall function is to disseminate information to the public at large. They are typically involved in projects as the operators of information systems or web portals suitable for publishing indicators.

In all EaP countries, there are additional agencies that manage water supply and use, some of which are oriented towards implementing monitoring programmes of hydrometeorological and geological services. In some countries, they are organised as joint-stock companies. The ministries of environment are supported by other ministries, for example: Ministry of Emergency Situations; Ministry of Health; Ministry of Regional Development; Ministry of Housing and Utility Services; and Ministry of Agriculture.

Nevertheless, frequent reorganisation within the respective national agencies and ministries and staff turnover create risks for the sustainability of expert knowledge and operational capacity of the water institutions.

3 Renewable water resources under the changing climate

Key messages

Overall, annual renewable freshwater resources per capita is above 1 700 m^3 in EaP countries (no data available for Ukraine) indicating no actual water stress. However, due to irrigation practices and high water losses in the conveyance systems, Armenia and Azerbaijan face severe water-scarcity conditions.

In absolute terms, the available data indicate that renewable freshwater resources in Azerbaijan fell by 27 % between 2000-2017, whereas renewable freshwater increased in Armenia, Belarus, Georgia and Moldova. Further analyses are needed to justify this mixed trend across EaP countries.

Available studies suggest prolonged droughts in summer seasons are associated with increasing water stress conditions in EaP countries in the near future.

Changing natural hydrological conditions associated with greater socio-economic demand for water may exacerbate competition and tensions between upstream and downstream water users in the region. Strengthening monitoring programmes, regionally harmonised data and effective exchange of data and information at the regional level may facilitate informed policy dialogue among EaP countries.

Water is a cross-cutting area in the context of climate change impacts. There is growing evidence that climatic changes in recent decades have already affected the global hydrological cycle, for example, through changes in seasonal river flows (EEA, 2017). In addition, human and economic activities exacerbate the impacts of climate change, and climate change poses an additional threat to the flow regime of water ecosystems (EEA, 2012a). According to projections, annual average land temperature across Europe will rise in the range of 1.0 °C to 4.5 °C by the end of this century (2071-2100 compared to 1971-2000) (EEA, 2019). Projections indicate that water availability will continue to decline, particularly in southern Europe, under the scenario of 1.5-2 oC global warming according to pre-industrial levels (Bisselink et al., 2020).

According to recent assessments, the soil-moisture conditions in the Dinester Basin might change because of rising temperatures, especially in the winter months. This trend would be associated with increasing temporal variations of drought and heavy precipitation at the seasonal scale (Krakovskaya et al., 2012).

Available studies indicate rising precipitation and humidity in the highlands of the Caucasus, whereas the frequency and magnitude of drought and warmer summers in the lowlands, such as southern Armenia, central Azerbaijan and eastern Georgia, are increasing (Rucevska, 2017; Elizbarashvili et al., 2017; Toropov et al., 2019). This trend will be exacerbated by the drastic melting of glaciers in the Caucasus due to rising temperatures, thereby causing a reduction in the area of glaciation of up to 0.69 % per year (Toropov et al., 2019).

The EU's recent policy initiative, the European Green Deal, addresses climate change and water stress in the context of moving to a circular economy and becoming climate neutral (EC, 2019b). It should be underlined that the EU Water Diplomacy initiative promotes sustainable and IWRM as a response to climate change adaptation and resilience of the environment (EC, 2018).

Renewable water resources are generated and replenished by precipitation and the inflow of surface and groundwater from neighbouring countries throughout the hydrological year. Net precipitation (internal flow as the difference between precipitation and actual evapotranspiration) replenishes surface run-off to rivers, lakes and recharge groundwater aquifers. Surface waters and groundwater flowing from neighbouring countries (external inflow or inflow from upstream countries) is an important part of renewable water resources (UNECE, 2020a).

Due to natural hydro-climate and other physio-geographical conditions, RWR are not evenly distributed among the EaP countries. In some countries, water is considered to be abundant, while others face severe water shortages throughout the year. Similarly, there are also regional variations in RWR within each individual country. Three relevant indicators are used in this analysis to address RWR in EaP countries: water availability per capita; water stress level; and dependency ratio.

3.1 Water availability per capita

The Falkenmark indicator (Falkenmark et al., 1989; Brown and Matlock, 2011)ie countries for which there are fluctuations between a dry season and a season when rain occurs. The paper discusses the general vulnerability of the semi-arid zone in terms of four different types of water scarcity, the effects of which are being superimposed on each other: two are natural (type A, arid climate, type B, intermittent drought years sets 1 700 m³/per capita/year of water availability as the threshold for water stress. Those countries with above 1 700 m³/per capita/year of RWR are regarded as not being under water stress. In that context, in 2017, none of the EaP countries, excluding Ukraine where no data is available for assessment, were considered as water stress countries (Figure 3.1).

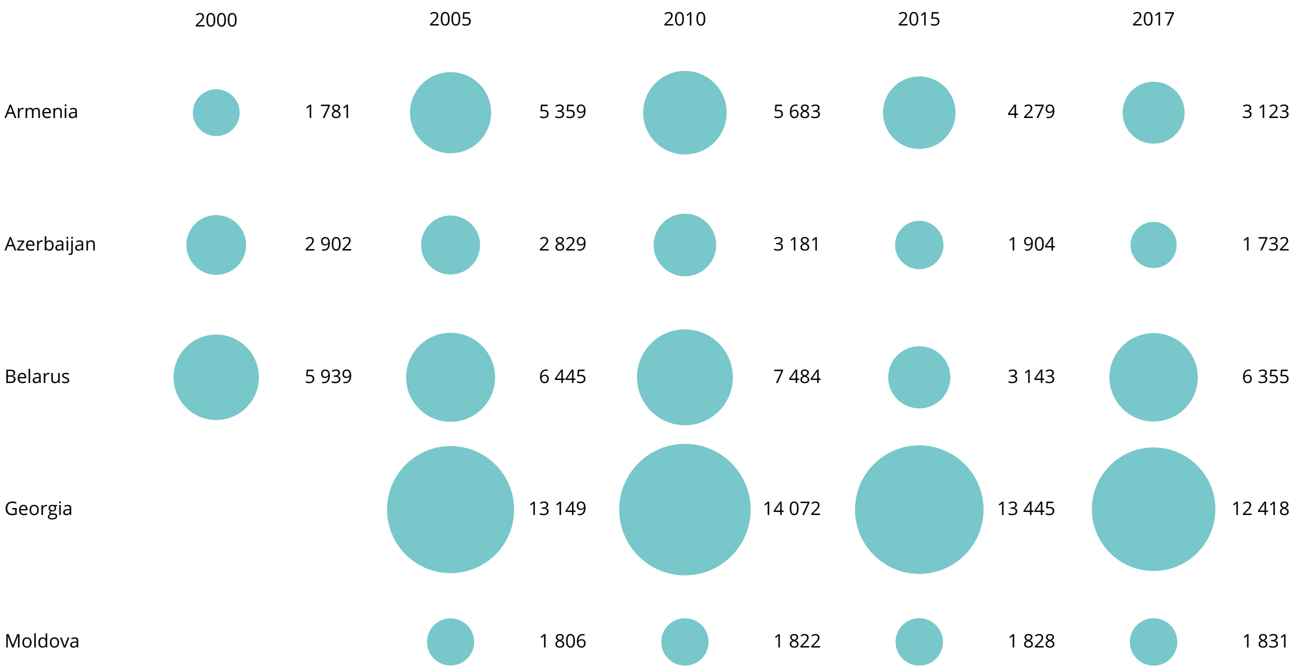
On average, Georgia holds the highest RWR per capita with 13 500 m³/capita/year, whereas Moldova has the lowest at 1 800 m³/capita – only slightly above the Falkenmark indicator threshold of water stress. However, this assessment needs to be interpreted with caution due to uncertainty over the data on Moldova's RWR.

Each country presents different internal and external dynamics of RWR over the years. As the indicator is affected by changes in total population and climate conditions both inside and outside the countries' territories, the trend of this indicator provides a very mixed overview across the countries. With the exception of Azerbaijan, there is a declining or stable trend in total population in all countries.

The Armenian population declined by 8 % between 2000-2018 which, coupled with higher precipitation, increased RWR per capita from 1 000 m³/capita/year in the early 2000s to 2 211 m³/capita/year in 2018.

Azerbaijan presents a very dynamic population trend, with a remarkable increase of 22 % between 2000-2017. Over the same period, internal flow and inflow of water

Figure 3.1 Annual renewable freshwater availability per capita (m³/capita/year) in 2017



Note: Data provided under the ENI SEIS II East project. Since there were no data from Ukraine, the country could not be included in the chart.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: State Statistical Committee of the Republic of Azerbaijan; Belarus: Belstat (National Statistical Committee of the Republic of Belarus), Water Cadastre Information System of the Republic of Belarus; Georgia: National Statistics Office of Georgia; Moldova: Statistical Databank of the National Bureau of Statistics of the Republic of Moldova.

from other countries fell sharply. As a result, RWR per capita dramatically decreased by 40 % in the country between 2000-2017.

The population dynamics in Georgia have remained stable over the last decade (2008-2017). Whilst Georgia has the highest RWR per capita in the region, it seems that climate conditions are impacting this, showing a 6 % fall per capita between 2008-2017.

Belarus also shows a strong correlation between population decrease and RWR increase per capita: between 2000-2017, the population decreased by 7 % and RWR per capita increased by 8 %.

Since 2000, there has been no significant change either in the total population of Moldova or in RWR per capita. Total population in the country has fallen by 1.4 % while RWR per capita increased around 1.3 % between 2000-2017.

Taking into account both natural and man-made factors influencing RWR in the EaP countries, a declining trend in RWR might be expected in the near future, which would exacerbate shortages in both seasonal and annual water supplies.

3.2 Water stress conditions in EaP countries

Comparing water availability against demand is another strong indicator used to identify the level of water stress caused by man-made factors such as agriculture, industry, households, energy, etc. Overall, water stress occurs when demand for water exceeds a certain level of water availability: above 20 % indicates moderate water stress whereas 40 % and more indicates severe water scarcity conditions and unsustainable water resources management (Raskin et al., 1997). Changes in natural conditions, such as decreasing precipitation or increasing evapotranspiration may negatively influence the availability of RWR. Similarly, man-made factors, such as changing land cover/land use or increasing water demand, might also increase the water stress level. The Water Exploitation Index (WEI) is applied as a strong measure of the level of water stress. The WEI, or withdrawal ratio, is defined as the annual total abstraction of freshwater divided by the annual freshwater resources.

Application of the WEI indicates that Armenia and Azerbaijan have been experiencing severe water-scarcity conditions (Map 3.1).

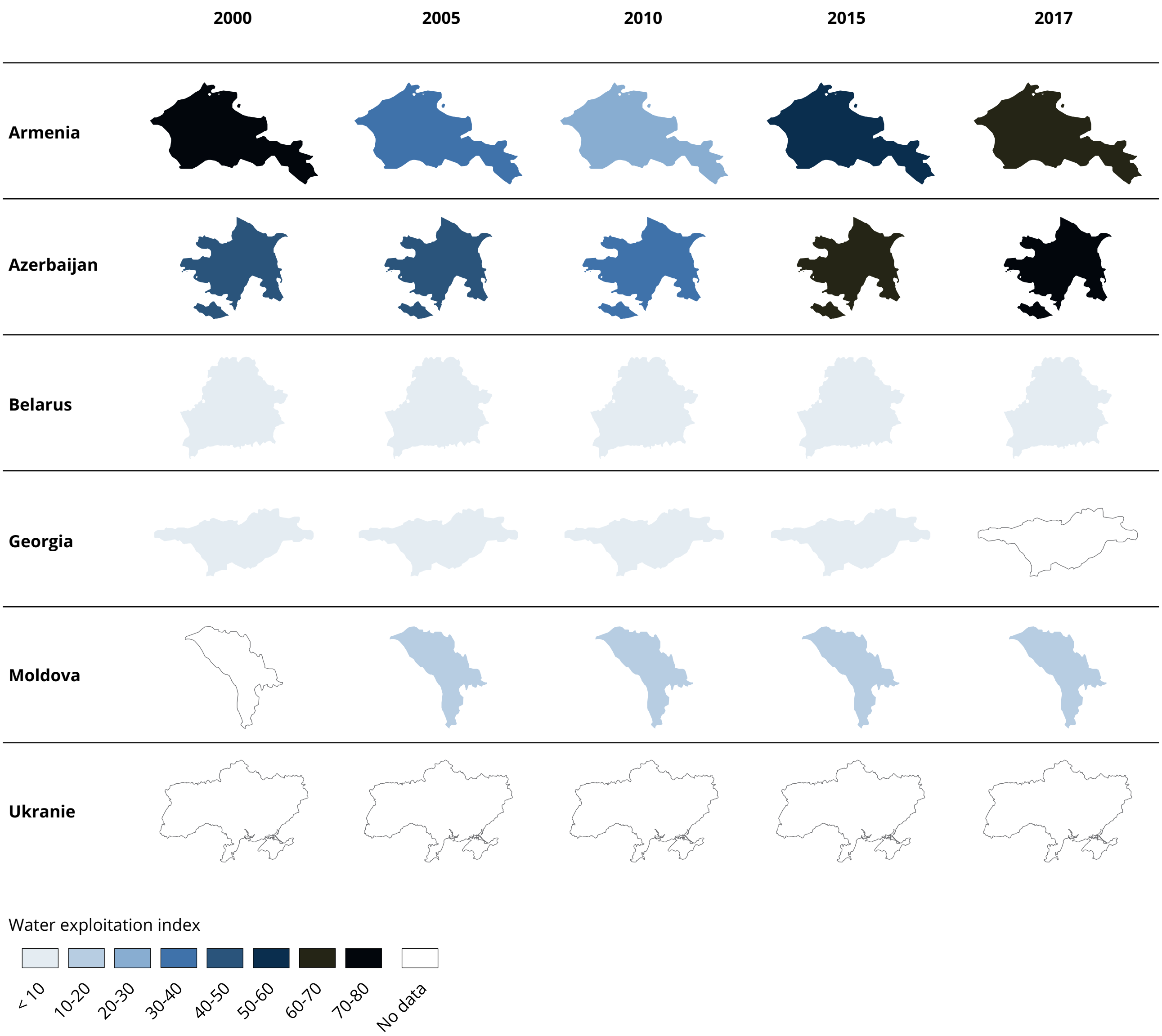
The estimated WEI for Armenia and Azerbaijan indicate 'unsustainable' levels of water stress. In fact, although Armenia has sufficient renewable water resources per capita, the over-abstraction of freshwater for agriculture, for example, fish farming from groundwater resources and the high rate of water losses in transport, have raised the water stress level. Between 2000-2017, the annual renewable freshwater resource in the country was around 6 670 million m^3, corresponding to 2 189 m^3/capita/year. However, due to poor water management practices (e.g. high water losses and leakages), it has been facing severe water stress conditions for a long time. The average annual WEI has constantly been above 40 %, when in 2017 it was 61.4 %. That means that almost two thirds of all RWR in Armenia were abstracted to meet the country's water demands. Despite the total population of Armenia declining around 8 % between 2000-2017, water demand increased by 4.5 % over the same period. Ageing and inefficiency in the water distribution system has put tremendous pressure on the country's water resources. For example, in 2000, 79 % of the total water supplied by the water-supply industry was lost through leakages. In recent years, Armenia has invested in improving the public water-supply network and restructuring its drinking-water-supply sector, particularly to rural areas (World Bank, 2017a), and water losses are slowly being reduced.

Armenia meets about 65 % of the total water demand from surface-water resources. In particular, Lake Sevan plays an important role in meeting the country's water demand, which creates pressures on both the ecological and hydrological conditions of the lake. In parallel, water abstraction from groundwater resources has also more than doubled since 2000. Groundwater is mainly used for drinking purposes and agriculture, particularly for fish farming (UNECE, 2000c).

Azerbaijan is another country in the region facing severe water stress conditions, and where the annual average water exploitation index is above 40 %. (e.g.72.3 % in 2017) ([8]). As a result of climate conditions, only a quarter of the total precipitation contributes to internal flow in the country's water resources. Annual average RWR are declining. In 2000, they were 23 000 million m^3, falling to only around 17 000 million m^3 in 2017. In Azerbaijan, the agriculture sector creates the highest water demand. Irrigation accounts for 90 % of total water abstraction every year, watering around 4.8 million ha of agricultural land, mainly lying in the lowlands of the Kura and Aras basins. In general, agricultural land occupies 55 % of the total country area with no significant change in extent over

([8]) More up-to-date data and information on Azerbaijan's water resources can be found at: http://meteo.az/su

Map 3.1 Development of water stress level (2000-2017)



Note: Data provided under the ENI SEIS II East project. Since there were no data from Ukraine, the country could not be included in the chart.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: State Statistical Committee of the Republic of Azerbaijan; Belarus: Belstat (National Statistical Committee of the Republic of Belarus), Water Cadastre Information System of the Republic of Belarus, World Bank Databank; Georgia: Water Division of the Department of Environment and Climate Change and the Integrated Management Division of the Department of Environmental Assessment - Ministry of Environmental Protection and Agriculture; Moldova: Statistical Databank of the National Bureau of Statistics of the Republic of Moldova, Agency Apele Moldovei.

time. The agricultural sector employs 38 % of the country's population (UNECE, 2011c). Water abstraction increased by 12 % between 2000-2017, while RWR decreased by 27 %.

Azerbaijan has very high rates of water use for irrigation. In 2017, water intensity in crop production was around 14 000 m^3/ha (The State Statistical Committee of the Republic of Azerbaijan, 2019). Under similar climate conditions, water intensity in crop production in southern European countries is between 5 000 to 7 000 m^3/ha. The available literature suggests almost 40-50 % of water is lost in irrigation conveyance systems (UNECE, 2011a).

The Kura and Aras are large rivers flowing into Azerbaijan which play a significant role in the country's overall water balance. In addition, Azerbaijan has 140 reservoirs, of which only three have volumes larger than 1 000 million m^3. The Mingachevir reservoir on the River Kura is the largest, with a capacity of 15 700 million m³. Water from this reservoir is also used for power generation and irrigation.

Water-scarcity conditions are increasing in both Armenia and Azerbaijan, requiring the rapid implementation of climate change adaptation measures, as well as greater efficiency in water use across economic sectors.

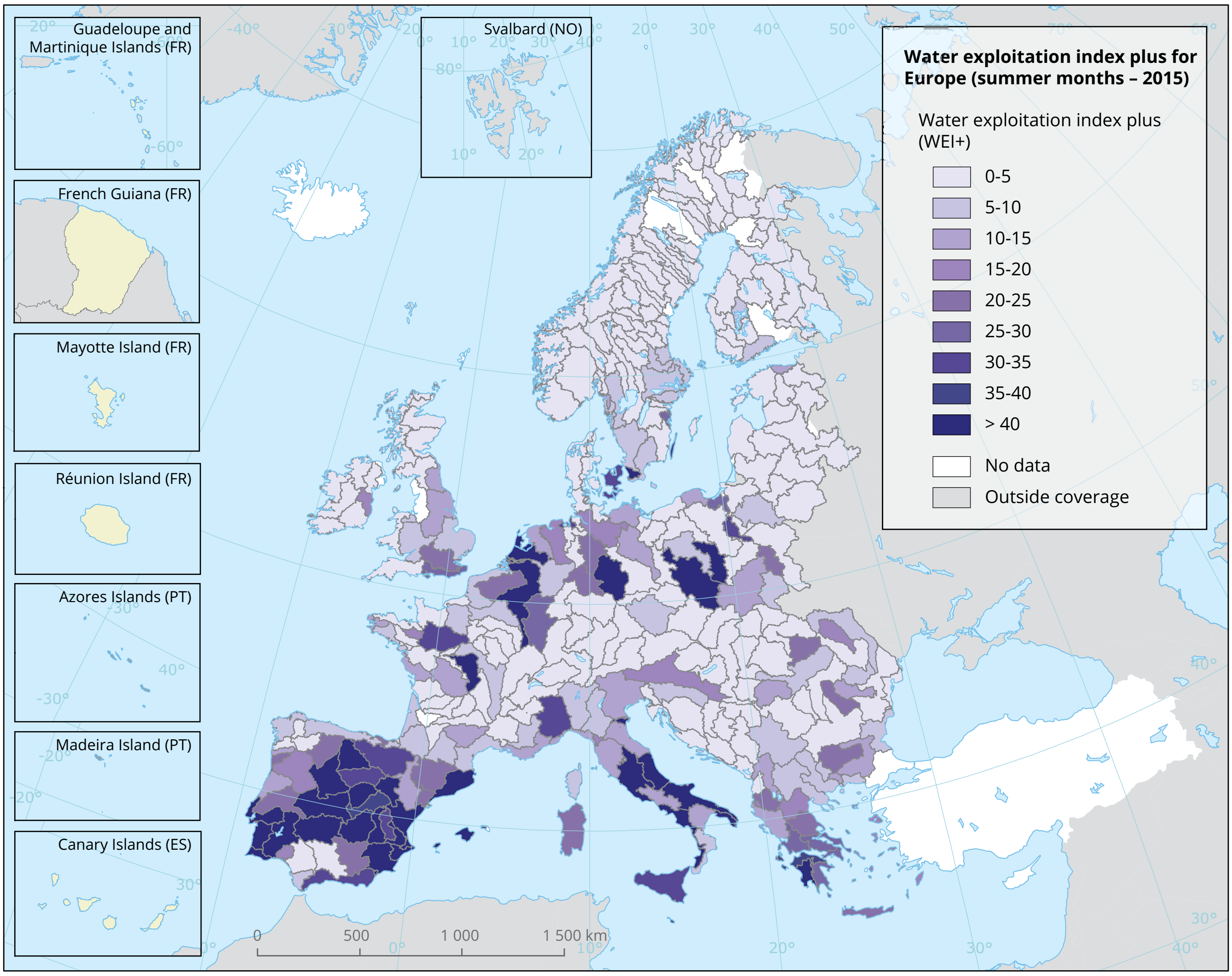
Moldova is experiencing higher water stress conditions – the annual average water exploitation index is around 13 % – compared to its neighbouring countries, Belarus and Ukraine. However, the country is still a relatively long way from being under severe water stress conditions.

Water scarcity is not an issue at the national level for Georgia and Belarus, with local diversions at the river-basin level, for instance in Georgia's Alazani Basin. Both countries are regarded as water abundant at the national level.

Since 2015, the EEA has been developing the seasonal (WEI+ at the sub-basin level for the whole of Europe (EEA, 2019d). The overall aim of developing the georeferenced water exploitation index is to better capture the level of pressures from the water-use sectors exerted on RWR (Map 3.2).

Therefore, developing an annual WEI at the country level usually hides the actual pressure of water abstraction and water use. Developing the RBMP

Map 3.2 Water exploitation index plus for Europe (summer months – 2015)



Reference data: ©ESRI

Source: (EEA, 2019d).

in accordance with the EU WFD practices and principles will also quickly enable the EaP countries to develop the seasonal WEI at the basin level, as it is implemented by the EEA across the EU.

3.3 Importance of inflow from neighbouring countries

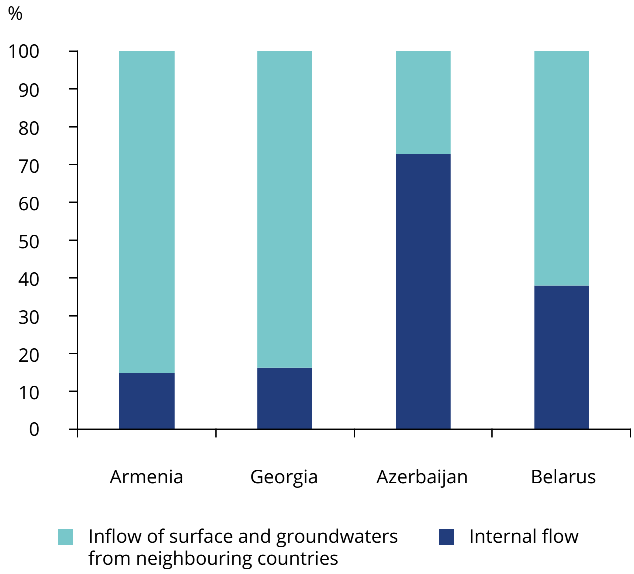
Almost all large rivers — for example, the Dnieper, Dniester, Prut, Aras and Kura — flow through more than one EaP country. There are also international river basins where EU Member States and some EaP countries share hydrological basins or they are riparian ([9]). For instance, the Danube (Romania, Hungary, Slovakia, Moldova and Ukraine), Vistula (Poland, Ukraine and Belarus), Neman (Lithuania and Belarus) and Daugava (Latvia and Belarus) are some of the river basins hydrologically linking the countries (EEA, 2012b).

The EU Water Framework Directive underlines the importance of coordination with those non-member states where the river basins extend beyond the boundaries of the EU with reference to the UN Water Convention (EU, 2000).

Water inflow from neighbouring countries is an indispensable part of generating the RWR in the downstream countries. Therefore, coordination and cooperation among the respective countries are vital to sustain freshwater ecosystems and meet socio-economic water demand in line with international norms, such as the UNECE Water Convention, which is a long-term UN endeavour. In many cases, a large proportion of RWR are generated in the upstream or riparian catchments of the international basins. The measure of the proportion of RWR flowing from upstream/neighbouring countries to downstream countries is called the dependency ratio.

Because all large rivers flow through the countries, water inflowing from neighbouring countries also has political impacts among the EaP countries. Aras and Kura start from Turkey and flow through Armenia, Iran and Azerbaijan and Georgia and Azerbaijan to the Caspian Sea. Overall, Azerbaijan is most heavily dependent on the inflow of surface water and groundwater from neighbouring countries, followed by Belarus (Figure 3.2). On average, Azerbaijan's dependency ratio for upstream water is greater than 70 % of its total RWR.

Figure 3.2 Share of inflow from neighbouring countries and internal flow in the generation of renewable freshwater resources (2017)



Note: Data provided under the ENI SEIS II East project. Due to insufficient data from Moldova and no data from Ukraine, neither of these countries could be included in the chart. Inflow from neighbouring countries for Georgia has been estimated as a substitute for the internal flow from total renewable freshwater resources for 2017, as no data are available for the respective year.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: Ministry of Ecology and Natural Resources of the Republic of Azerbaijan; Belarus: Belstat (National Statistical Committee of the Republic of Belarus), National environmental monitoring system of the Republic of Belarus, Water Cadastre Information System of the Republic of Belarus; Georgia: Administration Division at the National Environmental Agency - Ministry of Environment Protection and Agriculture.

Similarly, around 38 % of total renewable water resources is generated by water inflow from neighbouring countries in Belarus.

Data and information on inflow from upstream and outflow to the downstream countries are crucially important for dialogue among the countries. However, in many cases, these data are not available. Neither the contribution of the groundwater into inflow or outflow are known. In particular, quantity and quality groundwater resources present a number of 'unknowns' in the EaP countries.

([9]) The terms international river basin and riparian countries used in this report do not refer to any legal definition, but rather take the spatial relations of hydrological elements into account derived from the database of the European catchments and rivers network system (Ecrins).

Box 3.1 Azerbaijan-Georgia bilateral cooperation for the Kura River Basin

Lake Shaori Racha © Tamar Bakuradze

Azerbaijan Ministry of Ecology and Natural Resources and Georgia's Ministry of Environment and Natural Resources Protection are cooperating in the sustainable management of water resources in the Kura river. In 2017, the four-year project 'Kura II Project: Implementing IWRM Across the Kura River Basin' started. It is a United Nations Development Programme (UNDP)-GEF funded project with an allocated budget of USD 5.3 million. National partners in Azerbaijan and Georgia have contributed over USD 190 million in co-financing (GEF, 2017).

The project is strengthening water institutions, building capacity for water managers across sectors, promoting actions to reduce water stress in critical areas, supporting stakeholder education, building awareness and empowerment, and employing science for governance. The project coordination unit is based in Baku with a national project office in Georgia. The project is implemented through the UNDP Istanbul Regional Hub. Collaboration has been established with the EUWI+ project which provides complementary support in transboundary cooperation between the two countries.

The 2030 Agenda for Sustainable Development, adopted by all United Nations member states in 2015, set a number of qualitative and quantitative targets for measuring the efficiency and effectiveness of cooperation between countries that share river basins. In this context, UN SDG 6.5 sets a target to implement IWRM at all levels, including through transboundary cooperation, where appropriate, by 2030. The target for transboundary cooperation is measured by indicator 6.5.2: the proportion of transboundary basin area with an operational arrangement for water cooperation. According to the UN indicator database, Moldova performs the best, followed by Ukraine, while other countries in the region vary greatly (UN, 2018).

Overall, the EU Water Initiative and the EU Water Diplomacy initiative promote accession to international agreements, such as UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes and policy dialogue at the national and regional level (EC, 2018).

Eventually, changing natural hydrological conditions associated with increasing socio-economic demand for water may exacerbate competition and tensions between upstream and downstream water users in the region. This may be overcome by implementing the principles of IWRM based on improved monitoring programmes, harmonised regional data, and the free exchange of data and information at the regional level. Further measures for increasing efficiency in water use, and coherent development pathways in all economic sectors, which respect the limitations of the hydrological conditions, need to be implemented (see also (Strosser et al., 2017)).

3.3.1 Harmonised data availability in regional cooperation

As outlined above, data availability and accuracy are the main concerns when assessing water flow between the countries in both international and riparian basins. Procedures for delineating river basins, identifying surface and groundwater bodies and deploying appropriate monitoring programmes are still far from adequate in all countries in the region.

There is insufficient information to estimate water storage in groundwater aquifers, as well as their recharge and discharge, in Armenia, Azerbaijan, Belarus, Georgia and Moldova. Because of the reluctance among national water agencies to exchange and share data, in many cases, estimating the RWR is also challenging — for example, in Georgia and Moldova. Data and information on groundwater quantity and quality must be further improved in the coming years across all EaP countries. Reinforcing national water information systems can facilitate local and transboundary data exchanges. Therefore, EU financial and technical support towards developing the water information system in several EaP countries, such as Armenia, Azerbaijan and Georgia, is crucial.

Box 3.2 EUWI+ project (EU WI plus, 2020)

This project is the EU's biggest commitment to the water sector in the EaP countries. It is helping Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine to bring their legislation closer to EU policy in the field of water management, with the main focus on the management of transboundary river basins. It supports the development and implementation of pilot RBMPs, building on the improved policy framework and ensuring strong participation from local stakeholders.

The project's main objective is to improve the management of water resources, in particular transboundary rivers, developing tools to improve the quality of water in the long term, and its availability for all. More specifically, the project aims to support partner countries in bringing their national policies and strategies into line with the WFD and other multilateral environmental agreements.

4 Water abstraction and water use

Key messages

Between 2000-2017, the annual total water abstraction in Belarus, Moldova and Ukraine declined substantially but increased in Armenia (32 %), Georgia (22 %) and Azerbaijan (10 %).

Overall, surface waters meet the largest proportion of water demand in the EaP countries, while groundwater resources are the main source of water in Belarus. Since 2000, water abstraction from groundwater resources has increased by a quarter in Georgia, doubled in Armenia and almost quadrupled in Azerbaijan. Water abstraction from groundwater has decreased by 25 % in Belarus and by 24 % in Moldova.

Agriculture and public water supply are the major water-use sectors in almost all EaP countries, placing significant water demand on renewable freshwater resources. Agriculture accounts for more than 70 % of total water use at the regional level in the EaP. Irrigation and aquaculture (fish farming) are two major subsectors of agricultural activities demanding large volumes of water abstraction and water use.

Public water supply is the second largest water-use sector in the EaP countries. Ageing conveyance systems and the great distance they have to cover have caused substantial water losses in the public water supply. In 2017, water loss reached 79 % in Armenia, 63 % in Georgia, 49 % in Moldova and 48 % in Azerbaijan.

Armenia and Belarus have progressed significantly in connecting the population to the public water supply, reaching over 95 %, whereas around 66 % of the Georgian population were connected to the public water supply system in 2017. Almost half of the population in Azerbaijan and Moldova rely on self-supply.

Further progress is needed to ensure access for all to sanitation services and hygiene in Armenia, Azerbaijan, Georgia and Moldova, with a particular focus on the rural population.

Although the EaP countries registered an increase in GDP between 2000-2017, it seems that this was at the cost of the overexploitation of water resources, with the exception of Belarus.

Water is an essential natural resource for human beings and economic development. Agriculture, public water supply and industry are the major sectors requiring water in the EaP countries. Low efficiency of water use, particularly in agriculture and public water supply, is exposing high water-abstraction demands and increasing pressures on water resources in Armenia, Azerbaijan, Georgia and Moldova. This chapter deals with the pressures currently exerted by the economic sectors on water resources, and trends in water abstraction and water use across the countries (see Box 4.1 for clarification of water abstraction and use).

4.1 Water abstraction by source

Overall, water abstraction in Belarus, Moldova and Ukraine has substantially decreased for various sector-based drivers. Despite continuous severe water-scarcity conditions, water abstraction in Armenia and Azerbaijan have shown a steady increase, whereas a substantial increase has been observed in Georgia, since 2005 (Figure 4.1).

In general, surface waters meet the largest proportion of water demand in the EaP countries, while groundwater resources are the main source of water

Box 4.1 Terms for water abstraction and water use

In many cases, the terms water abstraction and water use are used interchangeably. However, using both these terms in the same context is often confusing for local lay readers. As the EaP countries provided data on both these variables in accordance with the description in the UNECE environmental indicators (UNECE, 2020a), both variables are defined as follows: water abstraction is the total freshwater abstracted annually from surface and groundwater, whereas water use is the net freshwater supply after subtraction of water losses in transport. In this context, the difference between water abstraction and water use is also an indication on the conveyance efficiency.

The EEA uses water abstraction as an indication of economic pressures on water resources, for example, surface and groundwater. Therefore, water abstraction is mainly assessed in the water resources context, while water use is mainly taken into account as sectoral efficiency in water use (EEA, 2019d).

Similar confusion may also occur between the water-supply industry (public water supply) and water use by households. In practice, water is supplied either by public water supply or self-supply. Water use by households refers to the volume of water used to meet the water needs of households and the related utilities; water may be supplied either by public water supply or self-supply.

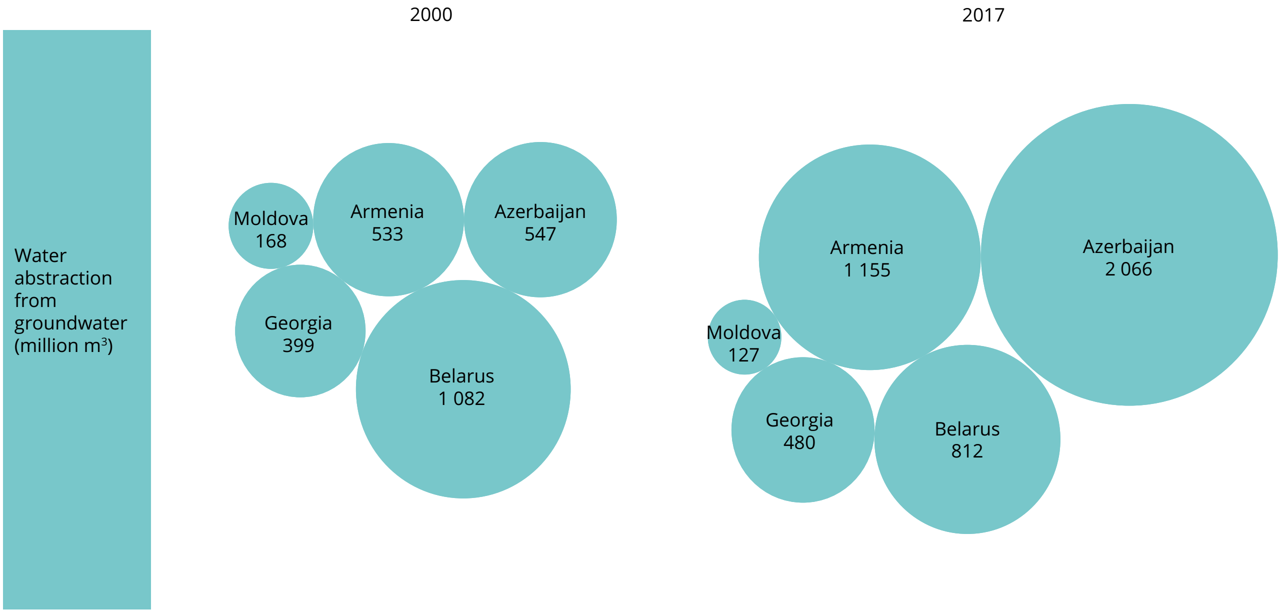
Figure 4.1 Annual total freshwater abstraction (2000-2017)

Note: Data made available to the EEA under the ENI SEIS II East project.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: Az STAT (State Statistical Committee of the Republic of Azerbaijan); Belarus: Belstat (National Statistical Committee of the Republic of Belarus), Water Cadastre Information System of the Republic of Belarus; Georgia: Water Division of the Department of Environment and Climate Change and the Integrated Management Division of the Department of Environmental Assessment - Ministry of Environmental Protection and Agriculture; Moldova: Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei; Ukraine: Data has been obtained from the website of the State Statistics Service of Ukraine: (http://ukrstat.gov.ua/operativ/operativ2006/ns_rik/ns_e/opvvr_rik_e2005.htm) abstraction in Belarus. However, there is increasing pressure on groundwater resources, particularly in Armenia and Azerbaijan (Figure 4.2).

In Armenia, on average (1993-2017), around 65 % of the total annual water demand was met by surface water resources, coming mainly from Lake Sevan. High water demand on Lake Sevan continues to put pressure on its hydrological and ecological condition. Meanwhile, Armenia noted a remarkable rise in gross agricultural productivity (61 % increase between 2008-2018), at the cost of using a huge amount of phosphate fertilisers (almost 75 times more in 2015 compared to 2008) which caused increasing phosphate concentrations

Figure 4.2 Water abstraction from groundwater resources in 2000 and 2017



Note: Data made available to the EEA under the ENI SEIS II East project. Data for Georgia 2016.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: Az STAT (State Statistical Committee of the Republic of Azerbaijan); Belarus: Belstat (National Statistical Committee of the Republic of Belarus), Water Cadastre Information System of the Republic of Belarus; Georgia: Water Division of the Department of Environment and Climate Change and the Integrated Management Division of the Department of Environmental Assessment - Ministry of Environmental Protection and Agriculture; Moldova: Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei.

Box 4.2 Groundwater resources in Armenia's Ararat Valley

Sevan Lake, Armenia © Ani Hambardzumyan

In the Ararat Valley, the River Aras/Araks (Armenia's border with Turkey) supplies high-quality artesian groundwater. Due to its rich groundwater resources, the valley is the largest agriculture zone in Armenia and is of strategic importance to the country's economy. Since 2000, a large number of fish farms have been established here. In 2013, groundwater use by fish farms alone exceeded the sustainable level (World Bank, 2017a). As a result, artesian groundwater resources have sharply declined. Increased groundwater withdrawals adversely affected spring flow, reduced well discharges, resulted in falling water levels, and reduced the number of artesian wells flowing in the southern part of Armenia's Ararat Basin (Valder et al., 2018). This has caused conflicts with other artesian groundwater users, irrigation, domestic, industrial, and cooling waters. For example, due to reduced discharge from the Aknalich springs (located upstream on the left bank of the River Sevjur), Armenia's nuclear power plant, Metsamor, can take only half of its water requirements (Mendez England and Associates, 2016).

in rivers (see Chapter 5). Since then, pumping water from groundwater resources has been seen as a viable option, with a 41 % increase in water abstraction for agriculture and drinking purposes. Similarly, poor treatment of urban discharge exacerbates the deterioration of surface water quality and intensifies the pressure on groundwater resources, particularly in downstream areas of urban settlements. In parallel with increasing trends in water abstraction from groundwater, water irrigation in Armenia also increased by 21 % between 2011-2018 (Statistical Committee of the Republic of Armenia, 2020a).

On average, Azerbaijan abstracts 11 000 million m^3 of water annually to meet the demands of various economic activities, 89 % of which is met by surface waters. The Kura and Aras, the largest rivers flowing into Azerbaijan, play a significant role in the country's overall water balance. In addition, Azerbaijan has 140 reservoirs, only three of which have a volume larger than 1 000 million m^3. The Mingechevir reservoir on the River Kura is the largest, with a capacity of 15 700 million m^3, from which water is used for power generation and irrigation. The River Samur plays an important role in providing drinking water supplies and irrigation in north-eastern Azerbaijan and the Absheron Peninsula, via the Samur-Absheron channel.

Azerbaijan faces water scarcity throughout the year, not only in quantitative terms, but also in terms of water quality. To meet the growing water demands from agriculture and for drinking, it began to abstract more groundwater. It abstracted around four times more water from groundwater resources in 2017, compared to 2000, which created environmental problems, including aquifer depletion and contamination and triggering landslides (Israfilov et al., 2014). Pressures on groundwater will increase if current trends in water abstraction continue in Azerbaijan.

Due to an economic recession and the introduction of water metering in the second half of the 2000s, total water abstraction in Belarus has decreased significantly in recent years (UNECE, 2016c). The annual average total freshwater abstraction is around 1 650 million m^3, of which more than half is taken from groundwater resources and used mainly for drinking purposes. Long-term intensive groundwater abstraction has already caused large-scale water-level reductions and reduced the flows of small rivers around the city of Minsk. As a policy response to the environmental consequences of intensive groundwater abstraction, the Government of Belarus developed a strategy for environmental protection. It plans to reduce groundwater abstraction to 700-750 hm^3 per year by 2025. The country's current level of annual groundwater abstraction is around 800 million m^3.

On average, Georgia meets (2000-2015) about 74 % of its annual water demand from surface waters, particularly from rivers. Groundwater is mainly used for drinking water. River basins into the Black Sea generate 75 % of the total inland surface water (42 500 million m^3/year), while the remaining 25 % of the total inland surface water is generated in the Caspian Sea basin (14 400 million m^3/year). Between 1981-1991, an average of 35 000 million m^3 of water flowed out of Georgian territory into the sea each year (representing 75 % of the total outflow), and 10 000 million m^3 (25 %) flowed into neighbouring countries. The current state of water supply and demand in Georgia is unknown because of the lack of adequate data. As Georgia is a water-abundant country, withdrawing surface-water resources seems more economically viable than pumping groundwater ([10]). However, high rates of water loss in the conveyance system (see Chapter 4.2.2) is exacerbating the environmental impacts of inefficient water use. Abstraction from surface water for agriculture has more than doubled in Georgia since 2003 (UNECE, 2016d). The leaching of nutrients from agricultural areas causes higher concentrations of nitrates, phosphates and ammonia in the waters (see Chapter 5).

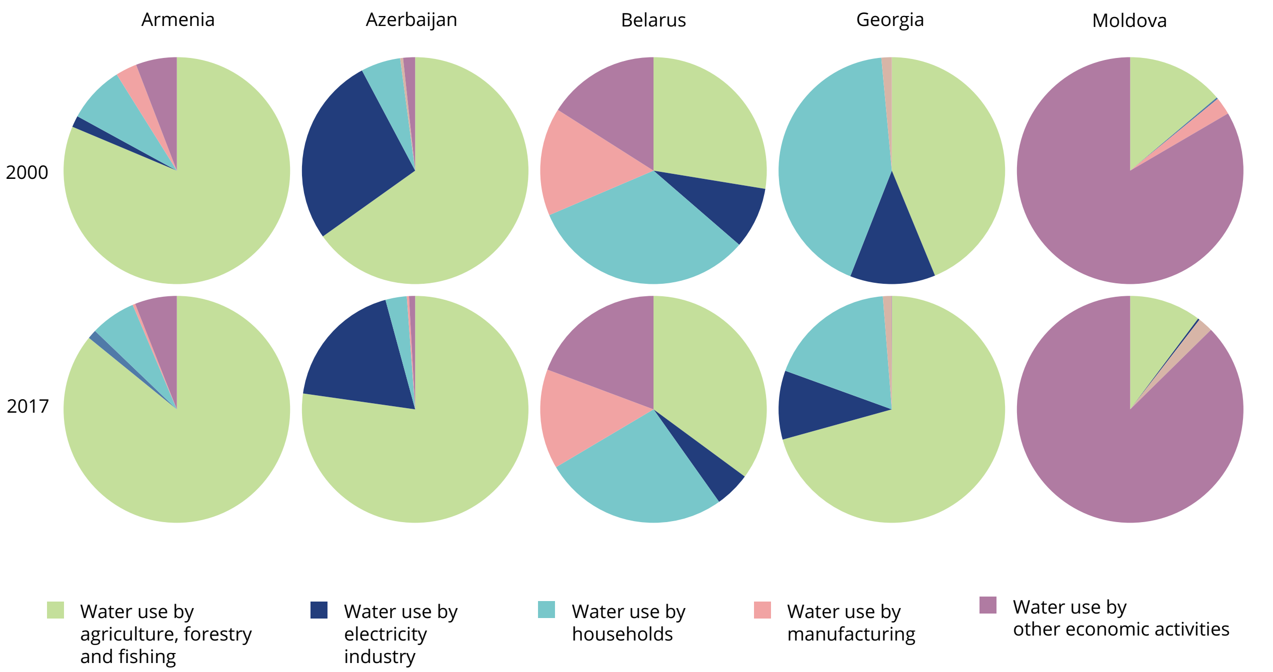
Moldova meets 85 % of its annual water demand from surface waters, especially from the River Dniester and Prut. The Dniester Basin is also a very important source of groundwater abstraction, providing around 84 % of total water abstraction from groundwater. However, as abstraction by individuals is not monitored in the country, this is unlikely to be the actual level overall.

4.2 Sectoral water use and resource efficiency

All economic sectors need water for their activities; agriculture, industry and most forms of energy production are not viable if water is not available (EEA, 2012c). Overall, agriculture and the water-supply industry are the major sectors in EaP countries putting

([10]) However, unregulated groundwater abstraction — for example, in eastern Georgia — is an issue, especially because aquifers are artesian which means the water does not need to be pumped (personal remark from Christoph Leitner, EUWI+).

Figure 4.3 Water use by economic sectors (2017)



Note: Data for Belarus 2006 and Georgia 2016. Data made available to the EEA under the ENI SEIS II East project.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia; Azerbaijan: Az STAT (State Statistical Committee of the Republic of Azerbaijan); Belarus: Belstat (National Statistical Committee of the Republic of Belarus), Water Cadastre Information System of the Republic of Belarus; Georgia: Water Division of the Department of Environment and Climate Change and the Integrated Management Division of the Department of Environmental Assessment - Ministry of Environmental Protection and Agriculture; Moldova: Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei.

significant water demand on RWR (Figure 4.3). Agriculture accounts for more than 70 % of total water use at the regional level in the EaP. Irrigation and aquaculture (fish farming) are two major sub-sectors of agricultural activities demanding large volumes of water abstraction and water use. This is particularly true in Armenia and Belarus which are land-locked countries where fish farming is very important in the food supply chain. Thus, water use for aquaculture accounts for a substantial share within the agriculture sector. For instance, in Belarus, irrigation only represents 2 % of total water use for agriculture, whereas the remaining volume is mainly used for fish farming. Similarly, in Armenia, on average, 25 % of water used for agriculture is allocated for aquaculture every year. Economic transition and market conditions at the regional level also shift water demand pressures among different sectors. For instance, due to Moldova's agricultural reforming process, water use for agriculture has declined substantially. Electricity is also a very important water user, particularly in Azerbaijan and Georgia.

As in the other EaP countries, agriculture is dominant in Armenia. Gross agricultural productivity has increased significantly over the last decade (61 %), employing around 8 % of the total population. In 2017, agriculture was the largest sector with the highest water use (86 %), followed by households (6 %) (Statistical Committee of the Republic of Armenia, 2020b).

Around 70 % of Armenia comprises agricultural land, of which 22 % is allocated for crop production and almost 50 % of this is irrigated. There was no significant change in the total irrigated area between 2006-2018 (Statistical Committee of the Republic of Armenia, 2018). However, water use for irrigation increased by 52 % between 2000-2017, which might be associated with increasing water loss in conveyance. About half of the water used for agriculture comes from the water-supply industry.

In addition, Armenia uses a large volume of water for aquaculture (fish farms) which accounts for 25 % of total water use by agriculture. Fish farms are mainly located in the Ararat Valley, which is under high water-stress conditions. In order to meet the valley's high water demands, water is transferred from other basins, such as Lake Sevan. Since the 1930s, the water level of Lake Sevan has fallen by more than 19 metres, and there has been a 26 % increase in water use. Since 1981, water has been transferred to Lake Sevan from the River Arpa to raise the lake's water level again. However, water abstraction from the lake for irrigation and energy generation is still increasing and the water level of Lake Sevan has yet to recover to its natural state. Overall, the total population of Armenia fell from 3 226 000 in 2000 to 2 986 000 in 2017, whereas total freshwater abstraction increased by 32 % over the same period (Statistical Committee of the Republic of Armenia, 2020a).

In Azerbaijan, agricultural irrigation is the most significant demand on water resources, accounting for 72 % of total water use every year. Water use for agriculture increased by 34 % between 2000-2017. Water-conveyance efficiency fell dramatically during that period. Water return from agriculture also exposes sanitation problems, particularly in small towns (Asian Development Bank, 2005). Between 2009-2014, the use of fertilisers in agriculture caused increasing ammonium concentrations in rivers, with the highest figures in Ganja-Gazakh (see Chapter 5). The Asian Development Bank (2005) estimated there are 66 000 km of canals transporting water from surface water resources to agricultural fields in the Kura and Aras basins, less than 4 % of which had been lined by 2005.

In Georgia, around 70 % of total water resources are used by agriculture. Irrigation is common in crop production and accounted for 34 % of total water use in 2016. Following the collapse of the Soviet Union in 1991, the abandonment of many agricultural and industrial areas resulted in a substantial decrease in water abstraction between 1990-1995 (UNECE, 2016e). In particular, the collapse of industry after the Soviet era, as well as the transition from state-owned to privately owned farms, resulted in a substantial reduction in water abstraction in manufacturing industries and agriculture. Since 2000, total water use in Georgia has more than doubled (1 834 million m^3 in 2016) largely due to agriculture. Water abstraction and the demand for water use are projected to increase in Georgia in the years to come, while agriculture is expected to remain as the main sectoral pressure on renewable water resources (UNECE, 2016e).

In Belarus, the sectors using significant amounts of the country's water resources are agriculture, particularly fish farming, and the public water supply. Together, the annual average water abstraction for these sectors accounts for 60 % of the country's total water use. Aquaculture (fish farming) accounts for almost 98 % of total agricultural water use. The water-supply industry is the main provider of water for the population, with coverage of households served by a centralised water-supply system reaching 94.7 %.

In Moldova, available data are insufficient to assess the actual level of pressure from individual economic sectors. In 2017, the heating and cooling water was the main water user (66 %), followed by the water-supply industry (20 %) and agriculture (11 %). These shares have stayed mainly steady since 2000. It should be noted that water abstraction for cooling is returned environment with slight loss due to evaporation during the cooling process. In the coming years, it is expected that water abstraction for agriculture will increase because of policy reforms in the sector, which is the main income generator in the country's economy (UNECE, 2014a).

4.2.1 Water-use efficiency in the economy

Water is not only a vital resource for the environment and freshwater ecosystems, but it also plays a significant role in national economies. For instance, without water input, it would not be possible to sustain agricultural activities in parts of countries where irrigation is inevitable for tackling water deficits. Similarly, water is also used for electricity generation (both in hydropower and cooling). In addition, water supply is crucial to aquaculture, which is one of the economic sectors using large quantities in Belarus and Armenia.

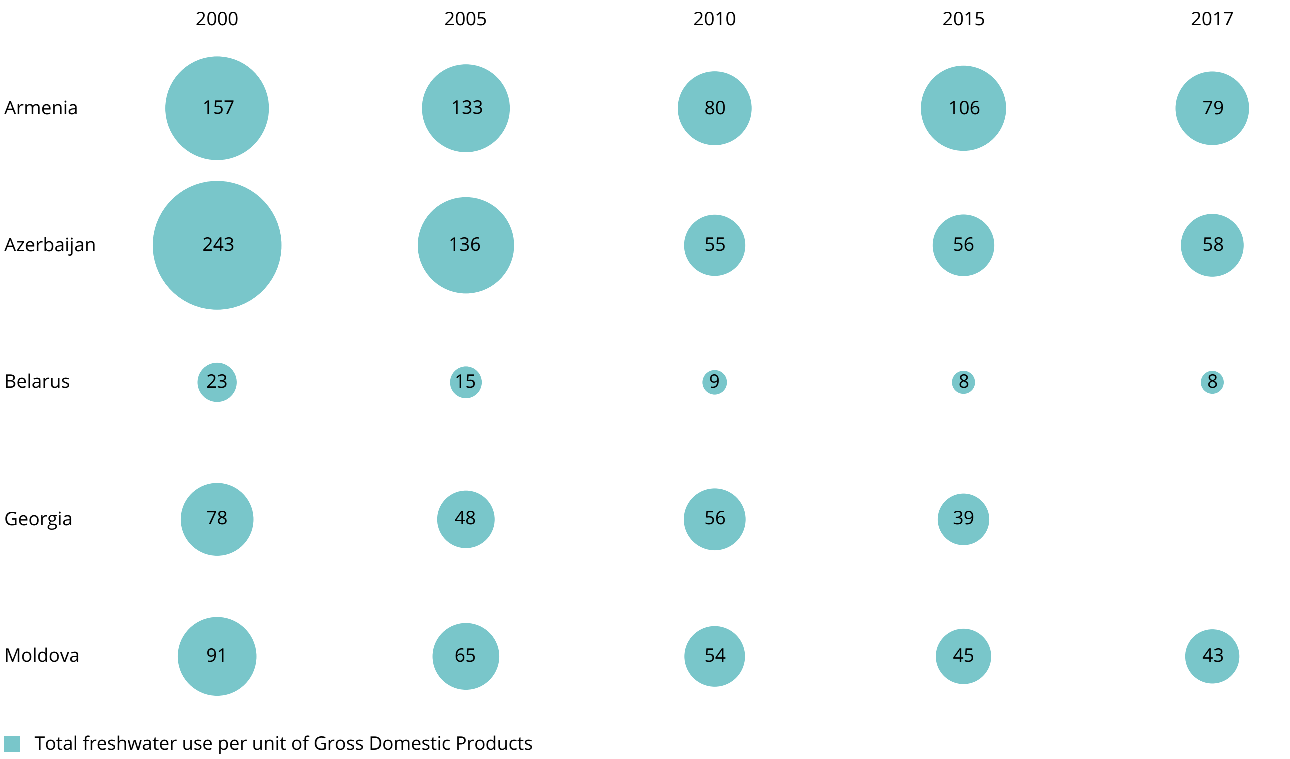
The efficiency of water use in an economy is measured by comparing water input (m^3 or million m^3) with per unit of GDP.

A country comparison of economic water-use efficiency (Figure 4.4) shows that the best-performing country in using less water per unit GDP is Belarus. Among the EaP countries, in 2017, water-use efficiency was the lowest in Armenia. However, between 2000-2017, GDP in Armenia almost tripled (USD 8.97 billion in 2000 compared to USD 25.75 billion in 2017). In parallel, the total water use by economic sectors in Armenia increased by 44.5 % over the same period (Figure 4.7).

All EaP countries registered a GDP at PPP at constant price increase between 2000-2017, but it seems that it has been at the cost of the overexploitation of water resources (Figure 4.5).

([11]) A metric that compares different countries' currencies through a 'basket of goods' approach and thus compares economic productivity and standards of living among countries.

Figure 4.4 **Total water use per unit gross domestic product (GDP) at purchasing power parity (PPP) (m³/1 000 international dollars; 2000-2017)**



Note: Georgia 2015; Moldova 2016. Data made available to the EEA under the ENI EAST SEIS II project.

Data source: World Bank for GDP; Water use: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: Az STAT (Statistical Committee of the Republic of Azerbaijan); Belarus: Belstat (National Statistical Committee of the Republic of Belarus); Georgia: Water Division of the Department of Environment and Climate Change and the Integrated Management Division of the Department of Environmental Assessment-Ministry of Environmental Protection and Agriculture; Moldova: Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei.

As a result of rapid economic improvements in Azerbaijan, GDP increased by more than a factor of four (4.4) between 2000-2017. GDP at purchasing power parity (PPP) ([11]) increased from USD 32.7 to USD 139.2 billion. Over the same period, water use in Azerbaijan decreased from 243 m³/USD 1,000 GDP to 58 m³/USD 1,000 GDP, indicating a relative decoupling of income generation and water use. It should be noted that the total annual freshwater use increased by 1.5 % over the same period. Despite the relative efficiency gained, water losses in transport and an increasing demand for water in agriculture remain major ongoing challenges for water resources management.

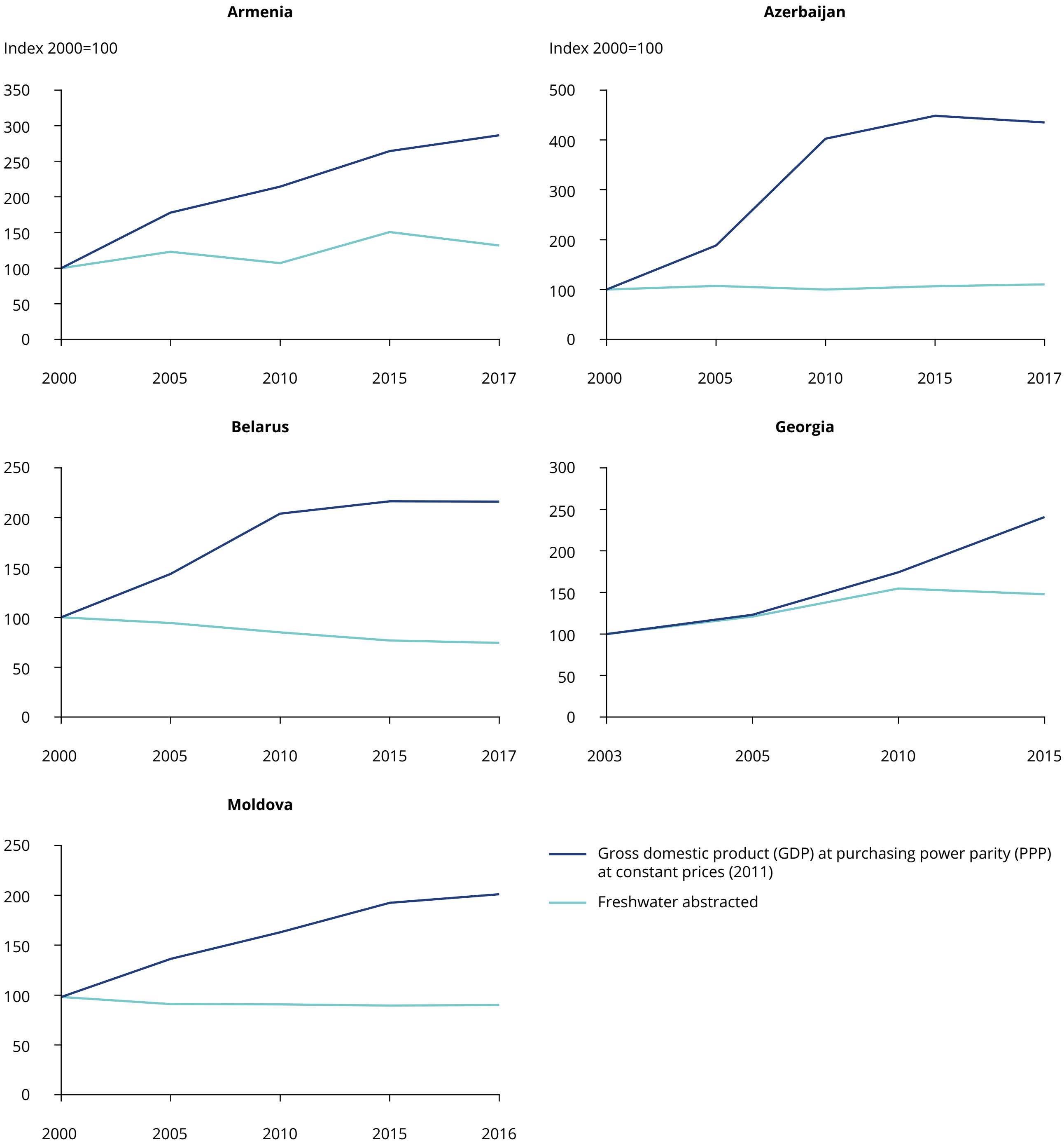
In Georgia, the GDP been increased by 44 % between 1990-2016, but at the cost of increasing water use over the same period. A relative decoupling achieved by reducing water use from 145 m³/1000 I$ in 1990 to 38 m³/1000 I$ in 2015 whereas total water abstraction has increased by 22 %.

Belarus significantly improved its water-use efficiency in the 2000s. As a result, water use per unit of GDP at PPP fell from 33 m³/1 000 USD in 1990 to 8 m³/1 000 USD in 2017. Over the same period, GDP at PPP roughly doubled, from USD 85 billion in 1990 to USD 163 billion in 2017.

Similarly, in Moldova, the country's GDP more than doubled between 2000-2017, from USD 8.4 billion in 2000 to USD 18.4 billion in 2017 (World Bank, 2020), while total freshwater use per unit of GDP decreased by about 60 % (not including information on the left bank of the River Nistru/Dniester). The efficiency of total water use per unit of GDP was achieved by decreasing water use while maintaining the upward trend in GDP. In 2000, around 104 m³ of water was used in the country's economy to produce USD 1 000 by the economy, which fell to 43 m³ of water used in 2017 to produce the same unit of GDP. However, it should be noted that 43 m³ of water per GDP unit is still very high compared to other countries, and further water-use-efficiency improvements are needed in future.

Recently, the EU has endorsed a new policy initiative — the European Green Deal — in response to climate and

Figure 4.5 **Development of total freshwater use per unit of gross domestic product (GDP) at purchasing power parity (PPP) in the EaP countries (2000-2017)**



Note: Data on GDP at PPP at constant price (2011) by the World Bank, as of 28 June 2018.

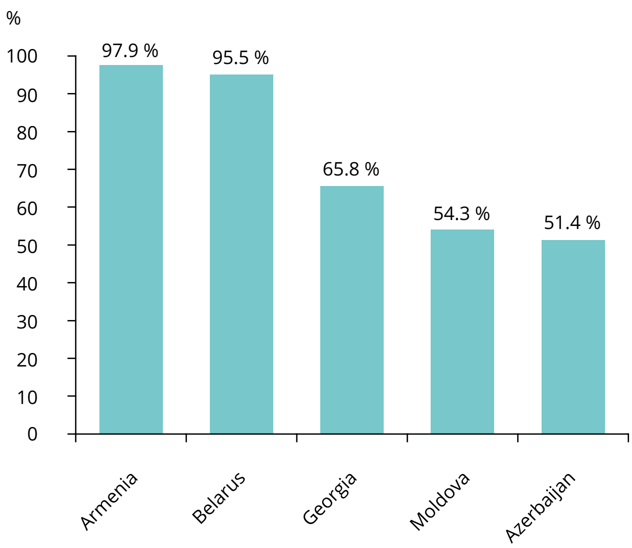
Data source: World Bank for GDP. Water use: ArmStatBank (Statistical Committee of the Republic of Armenia; Az STAT (Statistical Committee of the Republic of Azerbaijan); Water Division of the Department of Environment and Climate Change and the Integrated Management Division of the Department of Environmental Assessment-Ministry of Environmental Protection and Agriculture; Belstat (National Statistical Committee of the Republic of Belarus); Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei.

environmental challenges. The aim is to transform the EU's socio-economy to become more resource-efficient and competitive, with an ambitious target of no net emissions of greenhouse gases by 2050 (EC, 2019b). The environmental ambition of the European Green Deal requires international collaboration and cooperation beyond the EU's territory. Energy and agriculture are potentially areas where resource-efficiency measures must be implemented in the EaP countries. Taking into account the overall objective of the EU WFD to protect water resources and promote IWRM, combined with the European Green Deal targets, cooperation and collaboration between the EU and EaP are expected to be enriched and diversified in various areas of environment and socio-economy in the coming years.

4.3 Access of the population to public water supply

The United Nations (UN, 2010) and the EU recognise access to safe drinking water and sanitation as elements of the rights of humans to an adequate standard of living (EC, 2018). The purpose of sanitation — a term covering collection, transport, treatment, disposal and reuse of wastewater — is to provide

Figure 4.6 Population connected to the water-supply industry (2017)



Note: Data made available to the EEA under the ENI SEIS II East project.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: Az STST (State Statistical Committee of the Republic of Azerbaijan); Belarus: Belstat (National Statistical Committee of the Republic of Belarus); Georgia: National Statistics Office of Georgia; Moldova: Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei.

safe and clean water for citizens and to protect public health. In urban and many rural areas, the public water supply is one of the most effective ways to ensure the provision of safe drinking water.

UN SDG 6 sets targets to ensure equitable access to drinking water and sanitation for all. The EU reaffirms its strong commitment to the implementation of the UN 2030 Agenda and highlights progress in Goal 6 (EC, 2018). UN SDG 6 advocates that wáter-use efficiency is increased across all sectors and that the number of people suffering from water scarcity is reduced. Similarly, countries set national targets in line with the Protocol on Water and Health to the Water Convention (UNECE, 2020b). Azerbaijan, Belarus, Moldova and Ukraine are Parties to the Protocol, while Armenia and Georgia have signed but not ratified it yet (United Nations, 2020). The EU supports the implementation of the Protocol by EaP countries through the EUWI+ programme.

UN SDG indicators 6.1.1 (Proportion of population using safely managed drinking water services) and 6.2.1 (Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water) measure access to safe and affordable drinking water, and adequate and equitable sanitation and hygiene for all. Within the scope of this report, two different indicators — proportion of population connected to water supply, and household water use per capita — have been used as indirectly relevant indicators in response to the respective UN SDG indicators, and supplemented by a brief assessment based on the available WASH database (WHO/UNICEF, 2019).

4.3.1 Population connected to a water supply

The water-supply industry provides the public with water primarily for drinking and domestic use, but also for various purposes including agriculture and industry. The percentage of a national population connected to water-supply services is a measure for quantifying access to improved water-supply services. This indicator is important for defining the level of development of water economy services and the degree of water accessibility to cover all household needs within the population. In this context, countries present highly variable levels of progress over time (Figure 4.6).

In 2018, around 64 % of Armenia's population lived in urban areas (Statistical Committee of the Republic of Armenia, 2020a). In recent years, Armenia has invested in improving the public water-supply network, particularly to rural areas. Thanks to these investments, 97.9 % of the population was connected to the water-supply system in 2018, despite Armenia not setting a national target. However, according to a UNECE environmental performance assessment in 2000 (UNECE, 2000d), around 80 % of the Armenian public water-supply system was over 10 years old and 55 % was over 20 years old. Since then, maintenance of the water-supply system has been neglected. The number of interruptions in supply is now increasing regularly, and the system loses 79 % of water in transport before it reaches the public. Nevertheless, drinking water supply has progressed substantially in Armenia in recent years.

In 2017, about 86 % of Armenia's total population had access to safely managed drinking water and 13 % had a basic drinking water service. 15 % of the rural population (i.e. 6 % of the total population) were faced with sanitation problems and 10 % of the rural population had no access to basic hygiene services (WHO/UNICEF, 2019).

Almost half of the population in Azerbaijan was not connected to the water-supply system in 2017. Since the 2000s, the Azerbaijan government has implemented water-supply projects (UNECE, 2011a). By means of such investments, the total number of people connected to the water supply has increased significantly from 3.6 million inhabitants in 2005 to 5 million inhabitants in 2017. Azerbaijan set targets under the Protocol on Water and Health to ensure access to improved water supplies on a 24-hour uninterrupted service. The targets for 2020 require that 95 % of city residents and 65 % of those in rural areas would have uninterrupted water supplies; for 2030, the targets are for 100 % of city residents and 80 % of those in rural areas. However, two major issues remain as future challenges for water management in Azerbaijan: increasing the percentage of the total population connected to the public water supply; and decreasing the leakages from the conveyance system. Work on these issues needs to continue, which requires financial and technical investments in the public water-supply network. About 18 % of the rural population (corresponding to 7 % of the total population) still does not have access to basic drinking water or sanitation services. In 2017, around 16 % of the total population did not have access to basic hygiene services (WHO/UNICEF, 2019). Further progress is required in these domains to achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, as set out in UN SDG target 6.2.

Belarus aims to supply water to all settlements with more than 100 000 inhabitants. In 2017, around 95 % of Belarusian citizens were connected to the water-supply system, which corresponds to a 17 % increase compared to 2000. Sub-programme 5, 'Pure Water' of the state's 'Comfort accommodations and an enabling environment for 2016-2020' programme, sets the target to supply drinking water to all public consumers by the end of 2020 (Council of Ministers of the Republic of Belarus, 2016). Belarus is very close to achieving this target and the trend in improving the water-supply system is encouraging. Meanwhile, in recent years, Belarus has been investing in renewing and expanding the water supply network. The total length of the public water-supply network increased from 31 156 km in 2010 to 38 204 km in 2017. Over the same period, the total length of the water network renewed was about 1 295 km, corresponding to 3.4 % of the existing supply network. As a result of these investments, water losses in the water supply system have decreased. In 2017, around 97 % of the total population had access to safely managed or basic drinking water services as well as sanitation services, whereas no data were available on hygiene (WHO/UNICEF, 2019).

In Georgia, about 66 % of the total population was connected to the public water supply in 2018. Between 2015-2018, the percentage of the country's population connected to the water-supply industry increased

Box 4.3 Drinking water supply in Georgia

Kolkheti National Park, Georgia © Tamar Bakuradze

In Georgia, the water-supply industry provides 800 to 900 million m^3 of water each year, of which three quarters may be lost. In 2017, the loss represented 66 % of all water supplied, declining from 73 % in 2015. In recent years, the water-sector infrastructure has deteriorated because of a lack of maintenance and weak investments in modernising the water facilities (UNECE, 2016e). Nevertheless, there are signs of improvements. Net water consumption per capita decreased from 94 m^3/year in 2015 to 91 m^3/year in 2018. Furthermore, in 2015, 60 % of the population was connected to the public water supply rising to almost 66 % in 2018.

by 10.4 %. Although Georgia has yet to set national targets for water supply, the country's focus is primarily on urban areas, and it aims to deliver a high-quality, 24-hour supply of drinking water to the population and to improve the water-supply and sanitation system in urban areas. Around 80 % of the urban population had access to safely managed drinking water in 2017 (WHO/UNICEF, 2019). However, the rate of implementation of specific plans for rural water supply sustainability is low (WHO, 2015).

In 2017, almost 96 % of the rural population and 100 % of urban population had access to safely managed drinking-water services in Georgia, whereas no data were available for hygiene (WHO/UNICEF, 2019).

Moldova aims to provide access to improved drinking-water systems to 99 % of its urban population and 85 % of its rural population by 2025. It is also aiming to provide access to improved sanitation for the entire population, and to connect 85 % of the urban and 25 % of the rural population to sewerage systems by 2025. In 2016, 1.6 million inhabitants (54.3 % of the country's total population) were connected to the public water-supply system, while the rest of the population met their water demand by self-supply. The water-supply industry provided 84.8 million m^3 of water, which is equal to 10 % of Moldova's total annual freshwater abstraction. As a result of the high pollution of surface-water resources, the country is heavily dependent on groundwater resources, particularly for drinking purposes, which can result in the overexploitation of these resources (UNECE, 2014a). Because of the poor condition of the country's water-supply system, almost half of the water supplied is lost during transport.

Critical aspects related to Moldova's water-supply infrastructure include: (1) the unsatisfactory technical condition of the drinking-water system and wastewater-treatment systems; (2) the low percentage of the population with access to improved sanitation services; and (3) insufficient investment in the expansion and improvement of the water-supply network and sanitation. The poor condition of the water-supply network and insufficient financial and technical resources are making it difficult to implement the desired conditions in the country's water-supply system. The monopoly on water services, overstaffing (Salvetti, 2015a), and the lack of financial resources are challenges which still face the water sector.

In 2017, about 17 % of the rural population (i.e. 7 % of the total population) did not have access to safely managed drinking water or basic drinking-water services, whereas 31 % of the rural population had only limited or even less hygiene (WHO/UNICEF, 2019). Much remains to be improved in the drinking water, sanitation and hygiene services in Moldova to reach UN SGD target 6.2 which requires, by 2030, access to adequate and equitable sanitation and hygiene for all and an end to open defecation (UN, 2015).

In Ukraine, access to safely managed drinking water is relatively higher in rural areas than in urban areas. In 2017, 99 % of the rural population had access to safely managed drinking water, whereas 7 % of the rural population had either limited access or unimproved sanitation services. In 2017, 8 % of the urban population still had limited access to a basic and safely managed drinking water service. No data were available on hygiene (WHO/UNICEF, 2019).

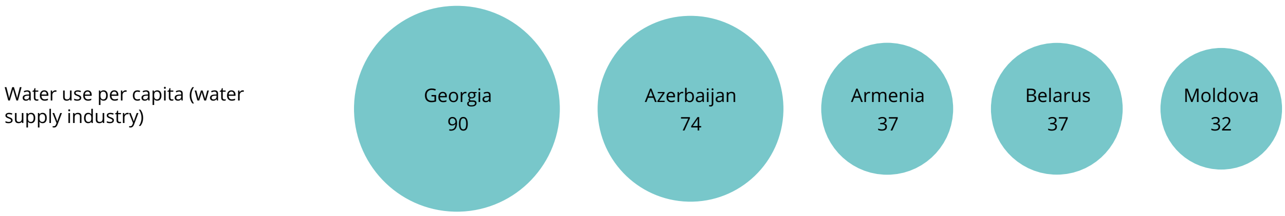
4.3.2 Water use per capita

Water supplied to households is mainly used for drinking, cooking and hygiene, including basic needs for personal and domestic cleanliness, and amenity uses such as car washing and lawn watering (Howard and Bartram, 2003). The global target set by UN SDG No. 6.1 asks countries to 'achieve universal and equitable access to safe and affordable drinking water for all', and 6.2 to 'achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations', by 2030.

Water use by households is driven mainly by the population, the efficiency of the conveyance systems, and the proportion of population connected to water-supply services. Water use per capita is an indication of the performance of the water-utility systems, as well as the cultural behaviour linked to individuals' water consumption. However, measuring the impact of cultural behaviour on water consumption is challenging and requires a peer-to-peer comparison within the same layer of sociological groups.

EaP countries present considerably different progress. Overall, there is a decreasing trend in population in all countries except Azerbaijan. The percentage of population connected to the water-supply system and total water use by households has been increasing in all countries since 2010. Nevertheless, each country presents different trends in total water use for households, either due to improvements in the conveyance systems or continuing growth in the total population (Figures 4.7 and 4.8).

Figure 4.7 Water use per capita by households supplied by a public water supply (m³/capita/year in 2017)



Note: Data for Georgia: 2018. Data made available to the EEA under the ENI SEIS II East project.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: Az STST (State Statistical Committee of the Republic of Azerbaijan); Belarus: Belstat (National Statistical Committee of the Republic of Belarus); Georgia: National Statistics Office of Georgia; Moldova: Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei.

Among EaP countries, Georgia exhibits the highest water use per capita due to high water loss in the conveyance system (Figure 4.9). On average, each Georgian citizen used 90.6 m³ of water from RWR during 2018. This corresponds to approximately 248 litres of freshwater per capita per day. Georgia has improved its water supply network in recent years. About 40.5 % of the total population was not connected to the water supply in 2015, but this figure declined by 6.3 % in 2018 as a result of improvements to the network. Although Georgia is largely a non-water-stressed country, about 34.2 % of its population was not connected to the public water supply in 2018 and had to manage their water demand by self-supply. In addition, the country's water-supply network is in poor condition, causing a loss of 66.4 % of its total water supply.

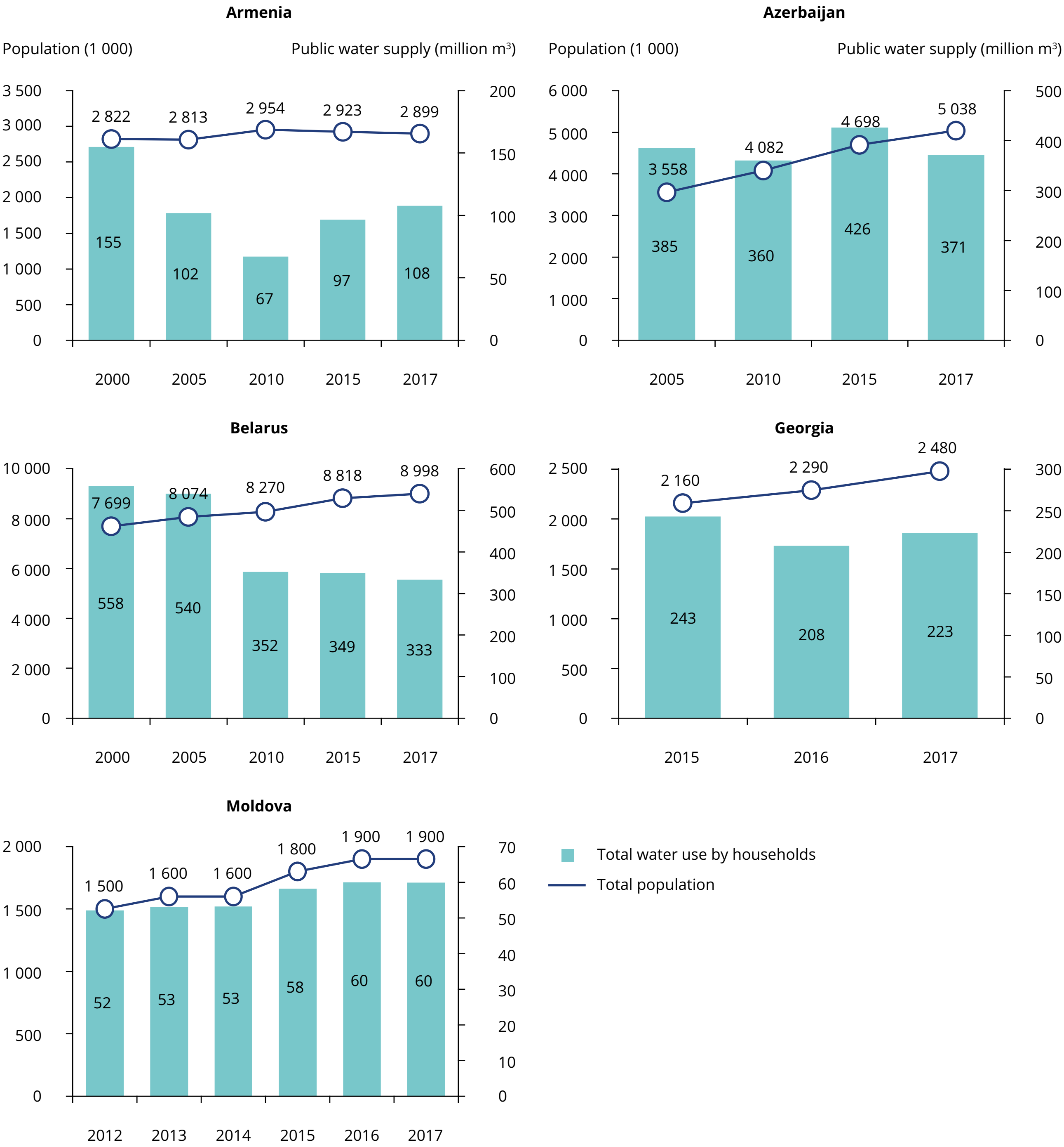
In Armenia, annual household water use has fluctuated significantly in recent years, dropping between 2000-2009, then increasing between 2009-2017, due to the expansion of the public water-supply network to rural areas. As a result of this expansion, the total water volume supplied to households by the water-supply industry increased from 61.4 million m³ in 2009 to 107.6 million m³ in 2017. Over the same period, the country's population fell by 7 %. Water losses during transport remain high, with an average rate of 79 % of the total water supply, putting significant pressure mainly on groundwater resources. In 2017, on average, an Armenian citizen used 36 m³ of water from RWR, which corresponds to approximately 98.6 litres of freshwater per capita per day.

In Azerbaijan, total freshwater use by households has increased since 2005 (Figure 4.8). In parallel, the country's total population grew by 22 % between 2005-2017, whilst the percentage of the population connected to the public water supply only increased by 9.3 % over the same period. In 2017, household water use was estimated at an average of 201.6 litres per person per day. It should be noted that, between 2015-2017, total freshwater use fell by 13 % due to investments in the water-conveyance infrastructure. Nevertheless, as water is mainly supplied to households from surface-water resources, any deterioration in water quality may pose high public health risks. As a result of the growing numbers of the population connected to the water-supply system, water use from the public water-supply system rose by 15 % between 2012-2017. However, since half of the population is still not connected to water-supply services, further efforts are needed to achieve the UN target which states 'by 2030, universal and equitable access to safe and affordable drinking water for all' (UN SDG 6.1).

In Belarus, 333 million m³ water was supplied to households by the water-supply industry, corresponding to 26 % of the total water supply at the country level in 2017. According to Belstat estimates, annual household water use in Belarus declined substantially from 518 million m³ in 2001 to 333 million m³ in 2017. Despite there being no significant change in the population during this period, the substantial fall in demand for household water use can only be due to better water efficiency. As stated in the UNECE third environmental performance review of Belarus in 2016 (UNECE, 2016a), because of increased water metering, water demand from households is expected to decline in coming years. The average Belarusian citizen used 37 m³ of water from RWR in 2017 compared to 72 m³ in 2001, which corresponds to approximately 107 litres of freshwater per capita per day.

In Moldova, in 2017, daily water use per person was estimated to be around 86 litres. Since 2012, there has been a considerable increase in the proportion of

Figure 4.8 Development of total water supplied to households by water-supply industry and number of population connected to public water supply (2000-2017)



Note: Data for Georgia: 2018. Data made available to the EEA under the ENI SEIS II East project.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: Az STST (State Statistical Committee of the Republic of Azerbaijan); Belarus: Belstat (National Statistical Committee of the Republic of Belarus); Georgia: National Statistics Office of Georgia; Moldova: Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei.

the population connected to the water-supply system. In 2017, 53.5 % of the total Moldovan population was connected to the system (compared to 42 % in 2012), the majority of whom live in urban areas. Currently, almost 93 % of the country's urban population and only 27 % of the rural population have access to improved water-supply systems (UNECE, 2014a). Groundwater is the main source of drinking water in rural areas, which puts significant pressure on groundwater aquifers.

4.3.3 Efficiency of the water-supply industry

Supplying sufficient and clean water to the public for different purposes, including for drinking, is the major service of the water collection, treatment and supply sector (water-supply industry). Water supply is the second largest sector in the region, accounting for a significant proportion of overall volume of water used. Water losses during transport are caused mainly by leakages, evaporation, burst mains and meter errors and are measured as the ratio of gross water supply. Apart from population pressures, such as rising water demand due to population growth, the major factors responsible for increasing water losses are ageing conveyance systems and the distance between the water source and the water supply point (UNECE, 2014b, 2000a, 2011b, 2016f, 2016c). More than 70 % of the water abstracted for the water supply industry in Armenia and 60 % in Georgia is lost, while this ratio is around 50 % in Azerbaijan and Moldova (Figure 4.9).

In Armenia, 589 million m^3 of water was supplied by the water-supply industry in 2018, of which 468 million m^3 was lost in the water-supply network, representing 79 % of the total water supply. According to a UNECE environmental performance assessment carried out during the 2000s, around 80 % of the pipes in the network were over 10 years old and 55 % were over 20 years old. Their maintenance had been neglected, thereby increasing the number of interruptions in water supply (UNECE, 2000d).

As Armenia is experiencing high water-stress conditions, cutting water losses by a target of 50 % in the public water supply to urban areas and agriculture/aquaculture may significantly reduce the country's water-stress levels. With financial support from the European Investment Bank, the Armenian government is implementing the Yerevan Water Supply Improvement Project (EBRD, 2016). However, water losses in the network are still incredibly high and continuing to rise. For instance, around 66 % of the country's total water supply was lost in 2000, with losses increasing to 79 % in 2018. High — and steadily increasing — rates of water losses in the transport system would appear unsustainable in the long term.

In Azerbaijan, 609.1 million m^3 of water was supplied by the water-supply industry, of which 290.5 million m^3 was lost in the water-supply network, representing 47.6 % of the total water supply in 2017. Following the introduction of water metering and improvements in the distribution network (UNECE, 2011a), water use by households in the country declined substantially (by 42 %) between 2000-2017, even though the overall population increased.

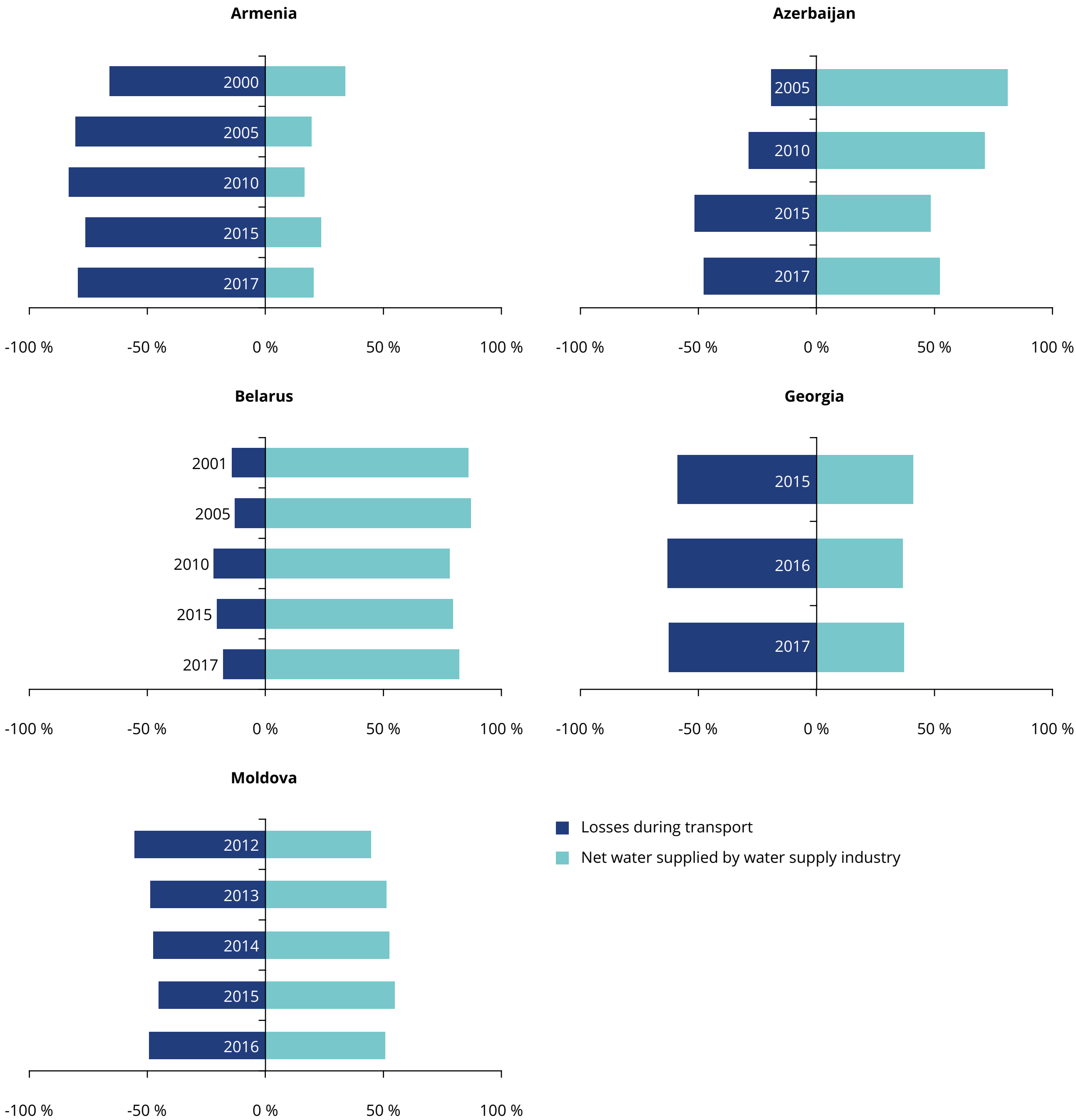
To accommodate growing needs for a water-supply industry in large cities in Azerbaijan, the government is implementing some large projects. For instance, at 250 km long, the Oğuz-Gabala-Baku water pipeline is one the largest projects for water transfers between two basins in the world. It can transfer water at a rate of 5 m^3/s (Sertyeşilişik, 2017). The share of water used for drinking purposes has declined thanks to improvements in the water-supply network (UNECE, 2011a). Nevertheless, there is still much room for improvement in water efficiency in Azerbaijan, particularly in reducing water losses during transport by the water-supply industry.

In Belarus, the industry supplied 553 million m^3 of water, representing 40 % of the country's total annual water abstraction in 2017. On average, around 16 % of the public water supply is lost in the country's conveyance system. Belarus has been investing in renewing and expanding its water-supply network in recent years. The total length of the public water-supply network was extended from 31 156 km in 2010 to 38 204 km in 2017. In addition, over the same period, around 1 295 km of the total water network was renewed, representing 3.4 % of the existing supply network. As a result of these investments, water losses began to decline from 2011.

In Georgia, around 800 million m^3 of water was supplied by the water-supply industry in 2018, of which 531 million m^3 was lost in the water-supply network, accounting for 66 % of the total water supply. In recent years, the country's water-sector infrastructure has deteriorated because of a lack of adequate repair and maintenance and a shortage of funds to invest in modernising the water facilities (UNECE, 2016f). High water losses in the conveyance network are putting significant pressure on renewable water resources.

In Moldova (including the territory on the left bank of the River Nistru/Dniester), the heating and energy cooling is the sector with highest demand for water.

Figure 4.9 Water losses in the water-supply industry (2000-2017)



Note: Moldova 2016; Georgia 2018. Data made available to the EEA under the ENI EAST SEIS II project.

Data source: Armenia: ArmStatBank (Statistical Committee of the Republic of Armenia); Azerbaijan: Az STAT (Statistical Committee of the Republic of Azerbaijan); Belarus: Belstat (National Statistical Committee of the Republic of Belarus), Ministry of Housing and Utilities of the Republic of Belarus; Georgia: GEOSTAT - National Statistics Office of Georgia; Moldova: Statistica Moldovei (Statistical Databank of the National Bureau of Statistics of the Republic of Moldova) and Agency Apele Moldovei.

In 2017, water use by this sector was 55 600 m^3, representing 72 % of the country's total water use. The next biggest users of water are the water-supply industry (15 %) and agriculture (10 %). The remaining water is used by the construction and service sectors.

There are significant differences in public water supply coverage between urban and rural areas in Moldova. Whereas piped water supplies 87 % of buildings in cities, it drops to 25 % of rural settlement buildings. The water-supply system is technically outdated and in poor condition. Water pumps are often inefficient and there are many fractures in the pipe system, causing high water losses (Salvetti, 2015b; UNECE, 2014a). These issues mean that the public water-supply system in Moldova loses almost half of the water it abstracts each year. In addition, drinking-water quality is often poor because of the condition of the water distribution network, resulting, *inter alia*, in water contamination.

The level of investment in the Moldovan water sector is insufficient to match the country's needs. For example, between 2009-2013, only 0.02 % of nominal national GDP was invested in the water sector. This figure is extremely low compared to the 1.2 % recommended by the Organisation for Economic Co-operation and Development (OECD) for low-income countries (Trémolet, 2011; Salvetti, 2015b). There is also no long-term water-supply planning strategy or governmental requirements regarding the economic and technical assessment of investment projects.

5 Water quality

Key messages

The main source of organic pollution in EaP countries is the direct discharge of untreated or insufficiently treated wastewater into the rivers. The average BOD5 in the region has only declined slightly since 2000, remaining at 2.7 mg O_2/l. The average concentration of ammonium for EaP countries fluctuates between 0.6-0.8 mg NH^4-N/l.

In the region, one quarter of the river sites are found in the two highest classes for BOD5 and three quarters for ammonium concentration. The highest average levels are found on sites in the Southern Bug catchment in Ukraine, the Dniester catchment in Moldova, the Black Sea basin in Ukraine and upstream in the River Aras catchment in Armenia.

The main sources of nutrients are agriculture, wastewater and storm water. In general, the nitrate concentration in rivers does not present a high risk of eutrophication in rivers in EaP countries. The average nitrate concentration in these countries fell by 10 % between 2008-2017. Currently, the average concentration is 0.9 mg NO_3-N/l. More than 60 % of all river sites fall into the lowest classes for nitrate. In 2017, the phosphate concentration (0.1-8 mg P/l) was 50 % higher than in 2008. More than 40 % of the sites have a phosphate concentration higher than 0.1 mgP/l, which is considered high enough to cause eutrophication.

River water downstream of cities and towns is significantly more polluted than it is upstream. Overall, while upstream of cities, organic pollution and pollution from nutrients has declined since 2000, concentrations of ammonium and phosphate downstream have increased in many rivers.

Good water quality is essential to maintain aquatic ecosystems and for the direct use of water, for instance for drinking. There are many threats to surface waters, including emissions of environmental pollutants from, for example, industry or agriculture, or hydromorphological alterations. While environmental pollutants can directly affect the toxicity of organisms, hydromorphological changes can affect habitats and migration, for instance, and also have consequences for ecosystem functions, such as self-purification. In this report, the focus is on the pollutants covered by UNECE C10 and C11 indicators (UNECE, 2020a) i.e. organic waste and nutrients, by replicating the similar approach of the EEA's core set of indicators CSI 019 and CSI 020 (EEA, 2019b, 2019a). This chapter gives an overview of the findings for the indicators which have been developed for each EaP country.

Organic and nutrient pollution constitute serious threats to water quality, both from an ecological perspective and as regards human uses such as drinking water, bathing water and recreation.

Wastewater — both municipal and industrial — as well as diffuse run-off from agriculture, are the main sources of organic waste and nutrient pollution. All of these pressures affect water quality across the region.

Despite some remarkable progress made in connecting the population to public water supply systems in all six countries, the treatment of wastewater remains insufficient. For instance, in Armenia, there is hardly any biological treatment of wastewater to break down organic waste. In Baku, the capital of Azerbaijan, only half of the collected water is treated. In Georgia, only a few of the municipal wastewater-treatment plants built in the 1980s are in operation. Organic pollution generated in cities is transmitted directly to the rivers. In Moldova, most treatment plants operate with primary treatment only, which means that organic waste is not processed. In addition, poorly treated industrial wastewater affects the performance of municipal treatment plants, and much untreated industrial wastewater is discharged directly into rivers. In Ukraine, the urban treatment plants have insufficient capacity, lack any tertiary treatment and technically are in poor condition, while there is a general lack of sewage networks in rural areas. However, new investments are ongoing to improve wastewater treatment in the region.

Due to suitable topographic and soil conditions, large areas of the region are used for agriculture and this sector employs millions of rural inhabitants. However, high — and increasing — applications of manure and inorganic fertiliser, as well as inadequate agronomic practices, make agriculture a major driver of the releases of nutrients, ammonium and organic matter into the water system.

Thus, deteriorating water quality is not a new problem in the region. It will be exacerbated in the future with the intensification of agriculture and greater industrialisation and urbanisation, particularly if these developments are not supported by improved wastewater treatment. A lack of financial resources or the insufficient management of water resources, institutionally or technically, will add to the problem.

Under the EU Water Framework Directive, the ecological and chemical status of water bodies is assessed according to a range of components. This status is used as the basis for implementing measures targeted at individual water bodies, with an overall objective of achieving good ecological and chemical (environmental pollutant) status. For the classification of ecological status, the main focus is on the biological components and how the biological conditions deviate from reference conditions. Chemical parameters, such as nutrient concentrations, are used only as supporting quality elements. As such, the indicator approach is simpler. However, the purpose is also different: rather than giving a full basis for implementing measures for individual water bodies, they provide a general overview of regional patterns and development over time for certain aspects of water quality. This gives policymakers and environmental managers an indication of the situation and whether it is improving or deteriorating. Without specific data on emissions coupled to the water-quality data, it is difficult to state the exact causes of the observed changes or differences. However, the general patterns indicate the adequacy of national or regional legislation and regulations and the need for further measures to be taken.

Here, organic matter and ammonium in rivers and nutrients in freshwater are used to evaluate some aspects of the water-quality situation in the region. For the components in question, there are no general thresholds for assessing whether or not the concentrations are acceptable from an ecological perspective. Under the EU WFD, the classification of supporting quality elements is based on national systems with specific class boundaries set for different water-body types, characterised by factors such as geology, climate or altitude. Such classification systems are not available for the EaP countries. Although they often have national targets or maximum permissible concentrations for pollutants, these are frequently quite high and may be targeted at purposes other than protecting the ecosystem, such as the use of water for drinking. These are referred to in the next section.

As a general reference, the targets for ammonium concentration and biochemical oxygen (O_2) demand (BOD) in the EU Fish Directive (2006) are also used ([12]). However, the main approach is to evaluate relative changes over time and regional differences. The common time period studied is 2008-2017, but the text also refers to developments up to 2008, where data were available. The current state of water in rivers is defined as the average for the last three years with available data, i.e. 2015-2017.

5.1 Organic matter and ammonium in rivers

The discharge of large quantities of organic matter containing microbes and decaying organic waste, either from agriculture or as wastewater from households or industrial effluents, may result in poorer chemical and biological quality in river water, reduced biodiversity in aquatic communities, and microbiological contamination that can affect the quality of drinking and bathing water. Organic pollution leads to higher rates of metabolic processes that demand oxygen. This can result in the development of water zones without oxygen (anaerobic conditions) which has profound direct impacts on the ecosystem. The transformation of nitrogen (N) to reduce forms under anaerobic conditions, in turn, leads to greater concentrations of ammonium, which is toxic to aquatic life above certain concentrations, depending on water temperature, salinity and acidity. The organic matter level in water is expressed as the biological oxygen demand (BOD), which is defined as the amount of dissolved oxygen required for the aerobic decomposition of the organic matter present in water. It is measured as the amount of oxygen consumed during five days of incubation at 20 degrees Celsius (BOD5, hereafter named BOD for short). BOD is expressed in mg of O_2/litre, while ammonium concentration is expressed in mg of NH_4-N/litre.

([12]) Water for cyprinid fish targets: 0.16 mg NH_4-N/l and 6 mg O_2/l; water for salmonid fish: 0.03 mg NH_4-N/l, 3 mg O_2/l.

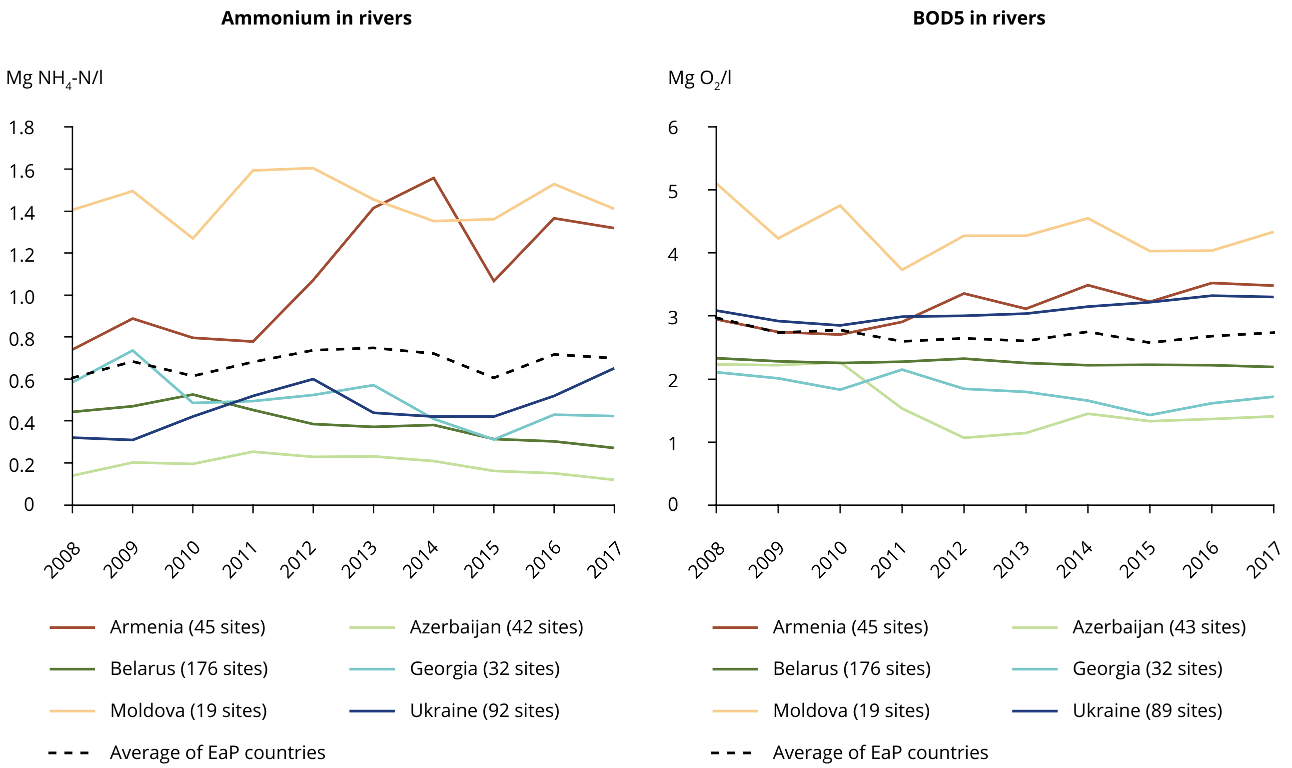
5.1.1 Changes over time

The main source of organic pollution in Armenia is untreated or insufficiently treated wastewater which, due to the lack of treatment plants, is emitted into the rivers. There are only six water-treatment plants in Armenia, using only mechanical treatment whereby organic waste is not processed. From 2008-2017, the ammonium concentrations and BOD in rivers increased by 72 % and 18 %, respectively (Figure 5.1). An increase was mainly observed at sites below settlements. Emissions in the less-populated areas have not changed a lot in this period. The River Hrazdan is one of the longest and most-polluted rivers in Armenia. The effect of the influences of untreated wastewater is significant, especially at one highly polluted monitoring site located downstream, which is the nearest and most-impacted site after Yerevan City, the capital of Armenia and home to around 1 million inhabitants. The pollution level at this site has a major impact on the country average, resulting in both higher absolute levels of pollution and a larger increase over time. This is particularly evident for ammonium.

In Azerbaijan, between 2001-2017, there was a slight increase in ammonium concentration and a slight decrease in BOD (by 32 % and 25 %, respectively, when comparing the average of the last three years to that of the first three years). However, BOD has increased from its minimum level in 2012, while ammonium has decreased in recent years. For both pollutants, there was a period when levels were higher than they are currently. For BOD, this occurred mainly before 2008, although mainly after 2008 for ammonium. The time-series patterns seen at the national level are broadly similar at the regional level.

Transboundary transport, industrial and agricultural production, old sewer systems, and a lack of solid-waste management in some rural areas led to an increase in organic pollution in Azerbaijan up to 2010. The Shamkir and Mingachevir reservoirs along the River Kura were affected by the discharge of

Figure 5.1 Average annual ammonium concentration and BOD for river sites in the EaP countries over the period 2008-2017



Note: Only complete time series after inter/extrapolation are included.

Data source: Armenia: Environmental Monitoring and Information Center SNCO, Ministry of Nature Protection; Azerbaijan: National Environmental Monitoring Department of the Ministry of Ecology and Natural Resources; Belarus: National Environmental Monitoring System by the Ministry of Natural Resources and Environmental Protection; Georgia: National Environmental Agency of the Ministry of Environmental Protection and Agriculture; Environment Quality Monitoring Division of the State Hydrometeorological Service of the Ministry of Agriculture, Regional Development and Environment; Moldova: Ministry of Agriculture, Regional Development and Environment; Ukraine: Ministry of Ecology and Natural Resources.

wastewater from many settlements in the Kura river basin. However, over the last seven to eight years, the installation of new modern wastewater treatment plants in the country has reduced organic pollution.

In Belarus, the average BOD has declined since 1992, particularly in the period 1997-1998. For the whole period 1986-2017, the BOD decreased by 19 % (comparing the average of the last three years to that of the first three years). The largest decrease was observed in the Western Bug river basin, followed by the Dniepr (main river) and Pripyat river basins, while there has hardly been any change overall in Western Dvina, the river basin with the lowest BOD levels.

Although concentration levels of ammonium have been more variable in Belarus, there has been a steady decline since 1998. This is also seen in the different river basins. However, all river basins except Western Dvina experienced a sharp increase in 1997-1998, rising from levels similar to the current level in the preceding decade. This is in contrast to the marked decrease in BOD in the same period and may partly indicate different sources of pollution. However, the falling levels in both parameters — ammonium in particular over the last two decades — indicates an overall reduction in pressure exerted by organic pollution. This is in line with an observed reduction in volumes of wastewater from 2005 to 2014 (UNECE, 2016a).

In Georgia, BOD decreased somewhat between 2004-2018 (by 11 % when comparing the average of the last three years to that of the first three years). The main decline was in the Black Sea river basin (21 %). The average for the Kura river basin increased towards 2006 but has fallen since then. Ammonium concentration showed a more pronounced decrease (50 %). The largest decrease was observed for rivers in the Kura river basin (62 %). The results for the years 2011-2013 should be treated with some caution, due to lower numbers of samples per year, which may explain some of the variability observed for ammonium concentration during this period.

The decreases in ammonium concentrations and BOD in Georgia can be attributed to measures such as better urban and industrial wastewater treatment. Further improvement is expected for the Black Sea river basin where the large cities have not previously had wastewater-treatment plants. Water-treatment plants are currently under construction in Zugdidi and Poti and the construction of a treatment plant in Kutaisi is planned.

In Moldova, the average ammonium concentrations and BOD in rivers show similar patterns over the period 1992-2017, with declining levels until 1997-1998 then fluctuating higher levels, and finally returning to similar levels as at the start of the period. Ammonium concentrations were highest between 2001-2004, while BOD was highest between 2003-2008. However, increases in pollution can be attributed to sites in the Dniester river basin. For sites in the Danube-Prut river basin and the two sites on the Danube and its tributary (Cogîlnic) ammonium concentrations generally declined over time and BOD levels were stable or fell slightly.

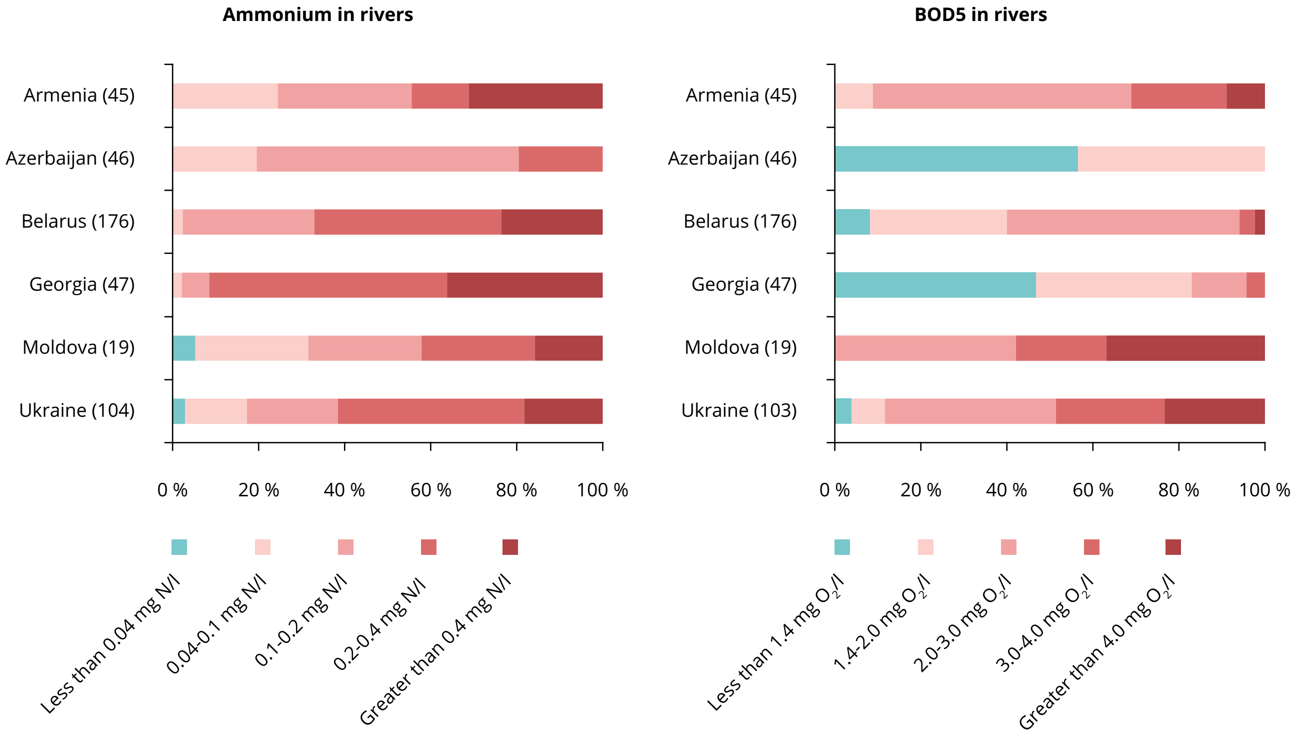
In Moldova, river water downstream of cities and towns was significantly more polluted than that upstream. Upstream of cities, ammonium concentrations have decreased steadily since 1992, although less so in recent years, while concentrations downstream have increased. This trend can be attributed to non-treated effluent from the cities. The up-downstream difference is less for BOD whereby the downstream level has decreased in recent years, approaching that of the upstream level. Poorly treated or untreated wastewater is a general issue in Moldova. Most treatment plants have only mechanical treatment and many do not function very well. There is also an issue with insufficiently pretreated industrial wastewater being discharged into municipal treatment plants, thereby reducing their performance (UNECE, 2014a).

In Ukraine, over the period 2000-2017, the average BOD in rivers was lowest in 2010, after which it increased. However, the current level is similar to that of 2003-2004. Although ammonium concentrations have fluctuated significantly, overall the concentrations increased between 2000-2017. Insufficient or lack of wastewater treatment are important causes of river pollution in Ukraine (UNECE, 2007b).

5.1.2 Current status

In Armenia, 44 % and 31 % of the river sites fall into the two highest concentration classes for ammonium and BOD levels, respectively, based on data for 2015-2017 (Figure 5.2). The highest average BOD was found in the Hrazdan river basin, followed by Akhuryan (Map 5.1). Hrazdan is the most-populated river basin, while the second most-populated city (Gyumri) is located in the Akhuryan river basin. The wastewaters from both cities discharge directly into the rivers, due to a lack of wastewater-treatment plants. The best water-quality conditions are found in the Sevan river basin, where the rivers are mainly subjected to diffuse sources of water pollution which do not have a significant impact. However, even here, two sites had average ammonium concentrations above the recommended levels for cyprinid fish in the EU Fish Directive (2006/44/EC). To reduce the pollution of surface waters (especially in

Figure 5.2 **Distribution of river monitoring sites to ammonium concentrations and BOD classes in EaP countries, based on the average of annual mean values for 2015-2017**



Note: The number of monitoring sites per country is given in parenthesis.

Data source: Armenia: Environmental Monitoring and Information Center SNCO, Ministry of Nature Protection; Azerbaijan: National Environmental Monitoring Department of the Ministry of Ecology and Natural Resources; Belarus: National Environmental Monitoring System by the Ministry of Natural Resources and Environmental Protection; Georgia: National Environmental Agency of the Ministry of Environmental Protection and Agriculture; Environment Quality Monitoring Division of the State Hydrometeorological Service of the Ministry of Agriculture, Regional Development and Environment; Moldova: Ministry of Agriculture, Regional Development and Environment; Ukraine: Ministry of Ecology and Natural Resources.

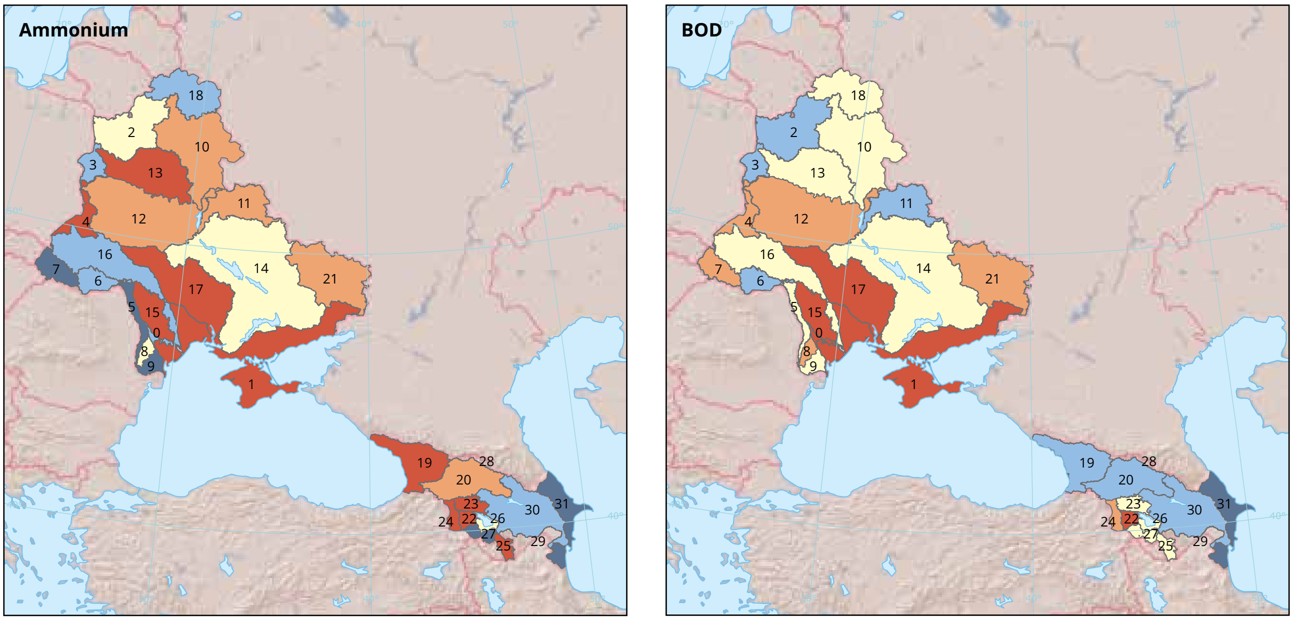
the Sevan river basin) new legislation requires local treatment of wastewater from recreation areas before it is discharged into rivers or lakes.

All but one of Armenia's river basins, the Ararat, had river sites where the current ammonium concentration exceeded the recommended concentration for cyprinid fish. In total, 49 % of the sites exceeded recommended ammonium concentrations. Although most of the elevated concentrations were found downstream of settlements, some were located above settlements, possibly because the headwaters are not protected by the legislation. The Armenian authorities are filling the gap in the legislation to protect headwater areas, starting with the Akhuryan river basin. The recommended BOD level for salmonid fish was exceeded at 31 % of monitoring locations. Two sites also exceeded the BOD threshold for cyprinid fish. The good/moderate thresholds in the national legislation are generally higher than the recommended levels in the EU Fish Directive.

In Azerbaijan, none of the river sites were assigned to the three upper BOD classes. Moreover, no sites exceeded the national maximum allowable concentration for ammonium concentration (0.4 mg NH_4-N/l), which corresponds to the highest ammonium class. Nevertheless, 20 % of the sites had current ammonium concentration corresponding to the second highest ammonium class. The recommended ammonium concentration level for salmonid fish was always exceeded, and the cyprinid threshold was exceeded at 35 % of the sites. River sites in the Kura river basin had somewhat higher ammonium concentrations and BOD than river sites draining into the Caspian Sea.

In Belarus, only 6 % of river sites had current BOD above the lowest national maximum permissible concentration (3 mg O_2/l). The average BOD level was relatively similar among the different river basins. The situation was worse for ammonium concentration, with 67 % of the rivers in the two upper concentration classes. The highest average ammonium concentration was found in the Pripyat and Dnieper (main river) river basins. In Belarus, 25 % of the rivers had average ammonium concentration for 2015-2017 above

Map 5.1 Average river ammonium concentration and BOD for 2015-2017 by river basin



Reference data: ©ESRI

Average river ammonium concentration and BOD for 2015-2017 by river basin

Ammonium concentration (mg N/l): ≤ 0.15; 0.15-0.2; 0.2-0.3; 0.3-0.4; > 0.4

BOD (mg/l): ≤ 1.4; 1.4-2.0; 2.0-3.0; 3.0-4.0; > 4.0

0 250 500 km

Note: The numbers represent river basins

Note: River basins: 0 - Black Sea (MD), 1 - Black Sea (UA), 2 - Neman (BY), 3 - Western Bug (BY), 4 - Vistula (UA), 5 - Prut (MD), 6 - Prut (UA), 7 - Tisa (UA), 8 - Danube (MD), 9 - Danube (UA), 10 - Dnieper (BY), 11 - Desna (UA), 12 - Dnieper - upstream Kiev (UA), 13 - Pripyat (BY), 14 - Dnieper - downstream Kiev (UA), 15 - Dniester (MD), 16 - Dniester (UA), 17 - Southern Bug (UA), 18 - Western Dvina and Gulf of Finland (BY), 19 - Black Sea (GE), 20 - Kura (GE), 21 - Donets (UA), 22 - Hrazdan (AM), 23 - Northern (AM), 24 - Akhuryan (AM), 25 - Southern (AM), 26 - Sevan (AM), 27 - Ararat (AM), 28 - Terek (GE), 29 - Aras (AZ), 30 - Kura (AZ), 31 - Caspian Sea (AZ). No data are available for uncoloured river basins.

Data source: Armenia: Environmental Monitoring and Information Center SNCO, Ministry of Nature Protection; Azerbaijan: National Environmental Monitoring Department of the Ministry of Ecology and Natural Resources; Belarus: National Environmental Monitoring System by the Ministry of Natural Resources and Environmental Protection; Georgia: National Environmental Agency of the Ministry of Environmental Protection and Agriculture; Environment Quality Monitoring Division of the State Hydrometeorological Service of the Ministry of Agriculture, Regional Development and Environment; Moldova: Ministry of Agriculture, Regional Development and Environment; Ukraine: Ministry of Ecology and Natural Resources.

the national maximum permissible concentration (0.39 mg NH_4-N/l), but this level is quite high compared to the recommended levels in the EU Fish Directive; 82 % of the rivers were above the recommended ammonium level for cyprinid fish.

In Georgia, the current BOD was below the national maximum permissible concentration of 6 mg O_2/l for all sites. Moreover, only two sites in the Kura river basin had BOD above the stricter criteria set in the EU Fish Directive for salmonid fish (3 mg O_2/l). However, 91 % of the sites belonged to the two upper ammonium concentration classes, and 36 % of the sites had average concentrations above the national maximum permissible concentration (0.39 mg NH_4-N/l). Only two river sites in Georgia had current ammonium concentrations below the EU Fish Directive level recommended for cyprinid fish, and none were below the threshold for salmonid fish. Ammonia is generally considered to be a main pollutant, with untreated domestic wastewater and agriculture as the main sources (UNECE, 2016e). While average BOD was slightly higher in the Kura than the Black Sea river basin, the opposite was true for the average ammonium concentration. The high ammonium concentrations in the Black Sea river basin probably reflect the poor level of wastewater treatment in this region. However, the increased investment in wastewater treatment (UNECE, 2016e) and the declining ammonium levels (section 5.1.1) indicate a positive development.

In Moldova, 42 % and 58 % of the river sites belonged to the two highest classes for ammonium concentration and BOD, respectively. The highest average levels were found for sites in the Dniester river basins. Average levels of ammonium concentration were far higher here than in the other river basins, and 67 % of the sites in this basin were above the EU Fish Directive recommendation for cyprinid fish. Across all river basins, 47 % of the river sites were above the recommended level.

In Ukraine, 49 % of the river sites had BOD above 3 mg O_2/l. The average levels were the highest by far for sites in the Black Sea river basin, but an additional five river basins had average levels above 3 mg O_2/l. Furthermore, 69 % of the sites had current ammonium concentrations above the EU Fish Directive recommendations for cyprinid fish. The highest average concentrations were found in the Southern Bug, Black Sea and Vistula river basins.

5.2 Nutrients in freshwater

Significant inputs of nitrogen and phosphorus into freshwater bodies from urban areas, industry, and agricultural areas can lead to eutrophication, characterised by excessive algal growth, which may result in oxygen depletion. Eutrophication can cause ecological impacts, such as the loss of plant and animal species (reduction in ecological status) and have negative impacts on the use of water for human consumption and other purposes. In this next section, the concentration of phosphate and total phosphorus is expressed in mg of P/l, while the concentration of nitrate in rivers is expressed in mg of NO_3-N/l. Nitrate in groundwater is also included in the UNECE C11 indicator and is an essential aspect of nutrients in freshwater, in particular in terms of the use of groundwater for drinking water. However, as few countries provided data on this, groundwater is only covered to a limited extent. The availability of lake data was also poor in many of the countries.

5.2.1 Changes over time

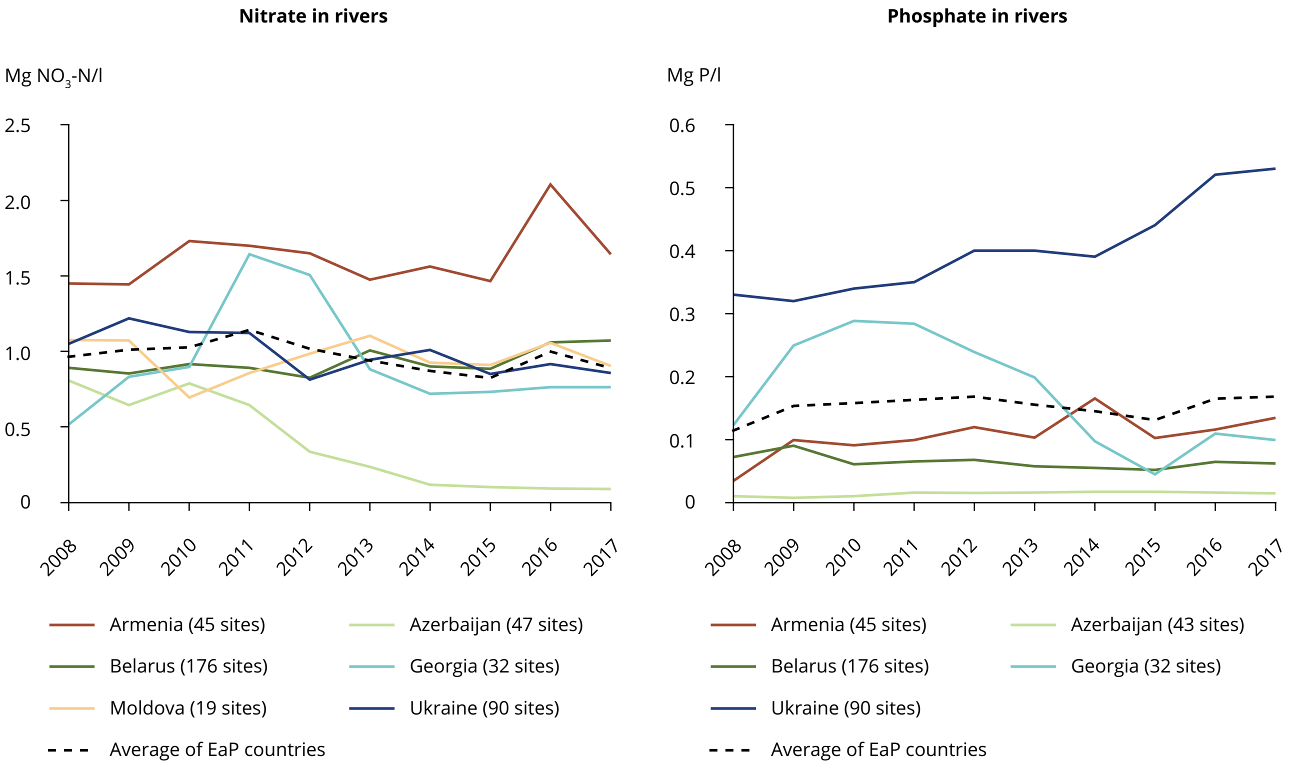
The main sources of nutrients in Armenia are agriculture, wastewater and storm water. There are only six water-treatment plants in Armenia, with mechanical and no organic matter treatment. Nitrate pollution is mainly associated with agricultural run-off. For instance, in Lake Sevan, agriculture has been shown to be a much larger contributor to nitrogen pollution than households (UNECE, 2000d).

In Armenia, river nitrate concentrations increased by an average of 18 % between 2008-2017 (Figure 5.3). However, the increase was associated with sites downstream of settlements. Above settlements, there was a slight fall in nitrate concentrations. In contrast, the increase in river phosphate concentrations was about the same upstream and downstream of settlements. Overall, phosphate concentrations increased by 33 % between 2009-2017. The increase is much higher when comparing 2017 to 2008, but as concentrations were particularly low in 2008 the comparison with 2009 better reflects the general increase. Rising nutrient concentrations are the result of increased emissions from wastewater and agriculture. The River Hrazdan is one of the longest and most-polluted rivers in Armenia and has very high phosphate concentrations, particularly at the nearest site downstream of Yerevan City. Removing this site from the overall average significantly reduces the national phosphate concentration. No such effect is seen for nitrate, indicating that wastewater is the major contributor at this site.

In Lake Sevan, the average nitrate and phosphorus concentrations increased markedly between 2008-2012. This might be a consequence of a rise in the level of the lake in an attempt to restore its natural state (see Chapter 4.1) — when water covered buildings, roads and forests on the lake shore the nutrient pollution increased. Average total phosphorus concentrations in the lake also rose between 2013-2017. Diffuse run-off from agricultural land and untreated domestic wastewater continues to provide significant sources of phosphorus pollution. Although these pollution sources do not have a big impact on the rivers in the region they affect Lake Sevan due to direct discharges into the lake. Moreover, phosphorus stored in the sediment can keep lake concentrations high and prevent improvements to the water quality through management measures.

In Azerbaijan, river data are available from 2001. A strong decline in average river nitrate concentration occurred from 2005, in particular from 2011 onwards, reaching very low average levels from 2014 onwards. The time-series pattern was fairly similar between the different regions. For river phosphate concentration, the time series showed different patterns between regions. The concentrations in Ganja-Gazakh, and particularly in Shirvan, increased markedly between 2009-2011. A slower but steady increase also occurred in the Guba-Khachmaz region. These patterns are reflected in the overall time series for the whole country, where the average phosphate concentration doubled between 2001-2011.

Figure 5.3 **Average annual nitrate and phosphate concentration for river sites in EaP countries over the period 2008-2017**



Note: Only complete time series after inter/extrapolation are included.

Data source: Armenia: Environmental Monitoring and Information Center SNCO, Ministry of Nature Protection; Azerbaijan: National Environmental Monitoring Department of the Ministry of Ecology and Natural Resources; Belarus: National Environmental Monitoring System by the Ministry of Natural Resources and Environmental Protection; Georgia: National Environmental Agency of the Ministry of Environmental Protection and Agriculture; Environment Quality Monitoring Division of the State Hydrometeorological Service of the Ministry of Agriculture, Regional Development and Environment; Moldova: Ministry of Agriculture, Regional Development and Environment; Ukraine: Ministry of Ecology and Natural Resources.

Data from eight lakes and reservoirs in Azerbaijan show an abrupt increase and subsequent decrease for both phosphate and nitrate concentrations, starting in 2009 and 2007, respectively. Despite the decrease, current levels are far higher than at the beginning of the time series in 2001. An overall decrease in nitrate concentrations in rivers was not observed for lakes and reservoirs.

The time series data from Belarus start in 1986. Since then, there has been an increase in average nitrate concentrations. This has been observed both for the country as a whole and in the different regions. Over the last decade, there has only been a slow increase in nitrate concentrations. The maximum concentrations for river phosphate occurred between 1988-1990, and concentrations were also high between 2003-2004. Over the past decade, there has been an increase in phosphate concentrations in the Western Dvina and Neman river basins, and a decrease in the Western Bug and Dnieper (main river) river basins, although the overall trend is for a slight decline. Agriculture is the main source of diffuse pollution in Belarus, where the use of mineral nitrogen and phosphorus fertilisers has increased. The other major nutrient source is wastewater emissions, which fell between 2005 and 2014 (UNECE, ed., 2016a). The somewhat different trends for nitrate and phosphate may be explained by the different trends in these two sources — nitrate is more strongly associated with agricultural run-off than wastewater, while the opposite is true for phosphate.

Average total phosphorus concentration in lakes in Belarus was highest between 1988-1995 and 2003-2007. The highest concentrations were observed in the Pripyat river basin. Over the past decade, the average total phosphorus concentration has decreased in all river basins.

In Georgia, there was a marked increase in both phosphate and nitrate concentration between 2004-2017. These increases were associated with sites in the Kura river basin where, on average, phosphate concentrations were more than three times higher at the end of the time series, whilst nitrate concentrations doubled. Data from 2011-2013 should be treated with some caution because of the lower numbers of samples taken each year. This can explain the higher concentrations observed during these years. The concentrations for sites in the Black Sea river basin have been fairly stable, with a slight decrease observed for nitrate.

Lake data were available for Lake Paliastomi, located close to the coast in the west of Georgia. Here, phosphate concentrations decreased sharply from 2005 and have been relatively stable since 2008. Nitrate concentrations have been highly variable, with the lowest values observed between 2012 and 2014.

In Moldova, there has been an overall decrease in average river nitrate concentrations since 1992. However, the levels have been variable, with a marked peak in 1998. Since 2008, nitrate levels have been relatively stable, a trend which is seen across the three major river basins. River phosphate data were not available for Moldova, but total phosphorus data show that the average concentration fell in the 1990s, rose towards 2008 and then decreased again very slowly. This pattern is seen in all river basins, but most strongly in the Dniester basin.

Data were available for three lakes/reservoirs in Moldova. These showed a general decrease in nitrate concentrations, with the exception of a peak in 1998, similar to nitrate in rivers. The general decrease can be related to a decline in agricultural activities. Total phosphorus concentration showed a steady decrease in the two reservoirs (Dubăsari Centrala Hidroelectrică and Costești Centrala Hidroelectrică) between 1992-2017. However, Lake Ghidighici in the Chișinău area showed a marked increase between 2005-2012, with a subsequent decrease back to its original levels. The increase might be related to a larger input of untreated urban wastewater and higher fertilisation rates from agricultural activities.

In Ukraine, the average river nitrate concentration in 2000 was at about the same level as it is at present, although there was a marked peak in 2009 followed by a subsequent decrease. River phosphate concentrations were lower around 2009 but have increased since and are currently more than 0.1 mg P/l higher than in 2000. The increase in the concentration of phosphate may indicate a lack of wastewater treatment and an increase in the use of phosphate-based detergents. There is some variation in concentration patterns between the different rivers. In the Prut and Dniester river basins, both nitrate and phosphate concentrations have been falling.

5.2.2 Current status

In Armenia, the current river nitrate concentration was in the range between 3.6-5.6 mg NO_3/l at three sites and above 6 mg NO_3/l at one site (Figure 5.4). These sites were found in the Hrazdan and Northern river basins which, along with the Akhuryan river basin, had the highest average nitrate concentrations (Map 5.2). About 36 % of the sites belonged to the lowest nitrate concentration class. For river phosphate, 40 % of the sites belonged to the three upper concentration classes. The average concentration was far higher in the Hrazdan and Akhuryan river basins. As seen for organic pollution, these river basins stand out with particularly high nutrient concentrations. They are the two most-populated river basins with the two largest cities in the country, Yerevan and Gyumri. Wastewater from both cities discharge directly into the rivers due to lack of wastewater treatment. Across all river basins, nutrient concentrations were generally higher downstream than upstream of settlements, due to emissions of wastewater.

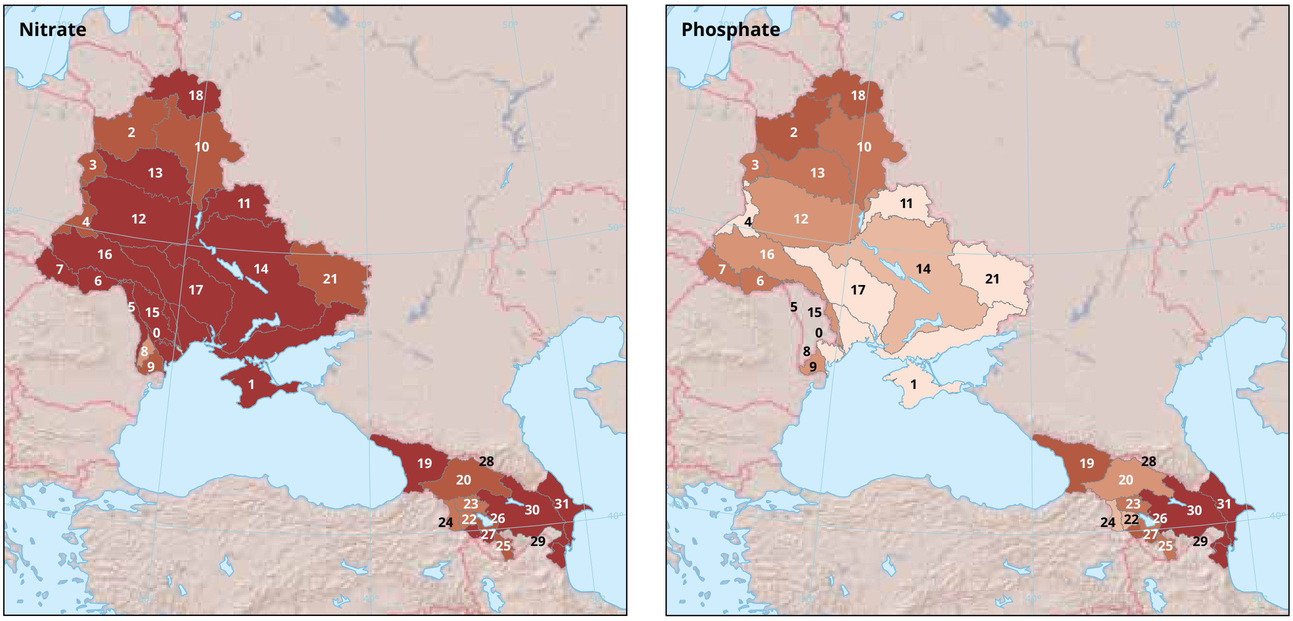
The four Lake Sevan sites all had low nitrate concentrations. In addition, the current total phosphorus concentration was relatively low (below 0.05 mg P/l), although if the increasing trend continues it may reach levels that can cause eutrophication.

In Azerbaijan, current phosphate and nitrate concentrations were generally low at river sites, and way below the national maximum permitted concentrations (1.1 mg P/l and 10 mg NO_3-N/l, respectively). The nitrate concentration was always below 0.2 mg NO_3-N/l. At 28 % of the sites (all in the Kura river basin) phosphate concentrations were in the range of 0.02-0.05 mg P/l. These sites should receive particular attention in terms of management measures to reduce nutrient pollution.

Low nitrate concentrations were also found in lakes and reservoirs, although concentrations were slightly higher than in the rivers. Lake Shabran had nitrate concentrations above 0.8 mg NO_3-N/l, and only the Ceyranbatan reservoir recorded below 0.2 mg NO_3-N/l. For phosphate, the difference between the sites was bigger, and three sites had current concentrations above 0.1 mg P/l, which can be sufficient to cause eutrophication.

In Belarus, all the rivers were in the three lowest nitrate concentration classes. The highest average concentrations were found in the Dnieper (main river) and Neman river basins. Similarly for phosphate, the vast majority of rivers were in the three lowest classes. The rivers with concentrations above 0.1 mg P/l were found in the Dnieper (main river), Pripyat,

Map 5.2 **Average river nitrate and phosphate concentration for 2015-2017 by river basin**



Reference data: ©ESRI

Average river nitrate and phosphate concentration for 2015-2017 by river basin

Nitrate concentration (mg N/l)

≤ 0.8, 0.8-2.0, 2.0-3.6, 3.6-5.6, 5.6-11.3, > 11.3

Phosphate concentration (mg P/l)

≤ 0.02, 0.02-0.05, 0.05-0.1, 0.1-0.2, 0.2-0.4, > 0.4

0 250 500 km

Note: The numbers represent river basins

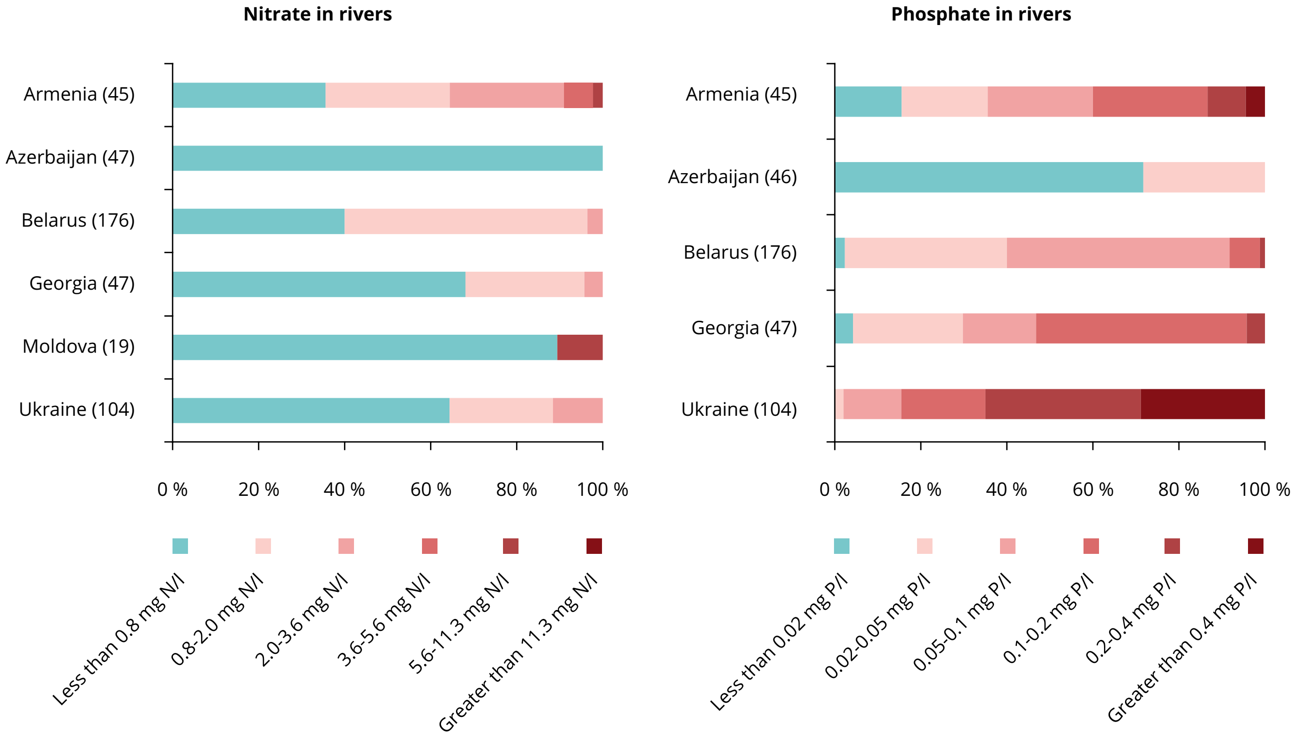
Note: River catchments: 0 - Black Sea (MD), 1 - Black Sea (UA), 2 - Neman (BY), 3 - Western Bug (BY), 4 - Vistula (UA), 5 - Prut (MD), 6 - Prut (UA), 7 - Tisa (UA), 8 - Danube (MD), 9 - Danube (UA), 10 - Dnieper (BY), 11 - Desna (UA), 12 - Dnieper - upstream Kiev (UA), 13 - Pripyat (BY), 14 - Dnieper - downstream Kiev (UA), 15 - Dniester (MD), 16 - Dniester (UA), 17 - Southern Bug (UA), 18 - Western Dvina and Gulf of Finland (BY), 19 - Black Sea (GE), 20 - Kura (GE), 21 - Donets (UA), 22 - Hrazdan (AM), 23 - Northern (AM), 24 - Akhuryan (AM), 25 - Southern (AM), 26 - Sevan (AM), 27 - Ararat (AM), 28 - Terek (GE), 29 - Aras (AZ), 30 - Kura (AZ), 31 - Caspian Sea (AZ). No data are available for uncoloured river basins.

Data source: Armenia: Environmental Monitoring and Information Center SNCO, Ministry of Nature Protection; Azerbaijan: National Environmental Monitoring Department of the Ministry of Ecology and Natural Resources; Belarus: National Environmental Monitoring System by the Ministry of Natural Resources and Environmental Protection; Georgia: National Environmental Agency of the Ministry of Environmental Protection and Agriculture; Environment Quality Monitoring Division of the State Hydrometeorological Service of the Ministry of Agriculture, Regional Development and Environment; Moldova: Ministry of Agriculture, Regional Development and Environment; Ukraine: Ministry of Ecology and Natural Resources.

Neman and Western Bug river basins. The highest average phosphate concentration was in the Western Bug. Overall, the current phosphate concentration exceeded the national maximum permissible concentration (0.066 mg P/l) at 38 % of the rivers. Current total phosphorus concentrations above 0.1 mg P/l were only observed for seven lakes. High phosphorus concentrations can, in some cases, be related to direct discharges of wastewater into lakes. Nitrate pollution of groundwater is known to be an issue in particular for shallow wells, which is an important drinking water source in rural areas (UNECE, 2016a). Areas close to fertiliser storage sites are particularly vulnerable.

In Georgia, most of the river sites were in the lowest nitrate concentration class (68 %), and there were no sites in the three highest classes. For phosphate, nearly half of the sites (49 %) had current concentrations between 0.1-0.2 mg P/l, and there were also two sites in the second highest class. The average phosphate concentration was highest in the Kura river basin, where 64 % of the sites were above 0.1 mg P/l. This is considered high enough to cause eutrophication. Nitrate concentrations were highest in the Kura river basin, but overall nitrate concentrations were relatively low. The current phosphate and nitrate concentrations never exceeded the national maximum permissible concentrations (10.2 mg NO_3-N/l for cyprinid waters,

Figure 5.4 **Distribution of river-monitoring sites to nitrate and phosphate concentration classes in EaP countries, based on the average of annual mean concentrations for 2015-2017**



Note: The number of monitoring sites per country is given in parenthesis.

Data source: Armenia: Environmental Monitoring and Information Center SNCO, Ministry of Nature Protection; Azerbaijan: National Environmental Monitoring Department of the Ministry of Ecology and Natural Resources; Belarus: National Environmental Monitoring System by the Ministry of Natural Resources and Environmental Protection; Georgia: National Environmental Agency of the Ministry of Environmental Protection and Agriculture; Environment Quality Monitoring Division of the State Hydrometeorological Service of the Ministry of Agriculture, Regional Development and Environment; Moldova: Ministry of Agriculture, Regional Development and Environment; Ukraine: Ministry of Ecology and Natural Resources.

9.0 mg NO_3-N/l for salmonid waters, and 1.1 mg P/l). These thresholds are, however, very high compared to EU standards, and do not necessarily reflect poor ecological conditions in the water bodies.

The current concentrations of nitrate and phosphate in Lake Paliastomi are low. Georgia also provided recent data on groundwater nitrate concentrations (for 2016-2017). The concentrations were generally low and far below the national threshold (50 mg NO_3-N/l, in line with the EU Drinking Water Directive 98/83/EC) (EU, 1998). All but one of the 34 monitoring sites had an average concentration below 10 mg NO_3-N/l.

In Moldova, all but two river sites were in the lowest nitrate concentration class. The two sites with higher concentrations (5.9 and 6.7 mg NO_3-N/l) were both in the Danube river basin. Moldova did not provide phosphate data for rivers, but the total phosphorus data show that the situation is worse than for nitrate. More than half (58 %) of the sites had total phosphorus concentrations above 0.1 mg P/l, and of these three were above 0.4 mg P/l.

The three lakes/reservoirs in Moldova all belong to the lowest nitrate concentration class. Lake Ghidighici had the highest current total phosphorus concentration (0.19 mg P/l). The two reservoirs were both below 0.1 mg P/l.

In Ukraine, the majority (64 %) of river sites were in the lowest concentration class for nitrate, and there were no sites in the three highest concentration classes. The highest average concentration was found in the Danube (main river), Siversky Donets and Vistula river basin. River phosphate concentrations were generally high, with 85 % of the sites in the three highest classes, including 28 sites with concentrations higher than 0.4 mg P/l. The Siversky Donets river basin had the highest average concentration, with all sites in the highest concentration class. However, all river basins except the Prut and the Tisa basins had average concentrations above 0.1 mg P/l.

Outlook

Key messages

It is expected that water demand will grow and intersectoral competition will intensify over time in the EaP countries. This will persist within the national territories as well as between upstream and downstream water users in the transboundary river basins.

The European Green Deal will certainly change the overall approach to the challenges of climate change and biodiversity loss in the coming years. In the EaP context, this call for action in various areas, such as the approximation of water laws to the EU WFD, institutional integration and development of sufficient expertise, as well as implementation of integrated and sustainable management of water resources. The current national policy dialogues under the EU Water Initiative are providing intersectoral and interagency platforms to discuss strategic planning and reforms in water sectors in the EaP countries.

With EU support, all EaP countries have harmonised their water quality data with the EU Water Information System (WISE – water quality) data dictionary. Data harmonisation should expand over other WISE components, such as water quantity, emissions and spatial data. This will enable comparable and interoperable data and information to be obtained at the region level which is crucially important for supporting EU water diplomacy in the region.

The EEA has provided substantial technical and expert support towards developing water information systems in Armenia, Azerbaijan and Georgia. These systems will facilitate data sharing across the water agencies as well as integration of water data at the national and local level. However, further maintenance and sustainability of the information systems must be ensured by the respective host institutions.

Data integration at the national and local scale present large gaps in the water area. Several national institutions host a number of thematic and small information systems. However, in many cases, these systems are operated in isolation with limited capacity to interact with other similar systems. Integration of those systems together with the database integration in line with SEIS principles would be beneficial for both practitioners and decision-makers.

The EaP countries benefited from European and Eionet expertise and experiences in developing water indicators in accordance with the EEA methodology. However, within the time frame of the ENI SEIS II East project, only a few selected indicators could be developed. Thematic coverage of the indicators needs to be expanded in the future to underpin knowledge-based policymaking in the area of water in the EaP countries.

There is still a need to further improve expert capacity in data processing and undertaking the relevant assessment. Stability within the pool of experts and ensuring the continuous development of expert capacity needs to be planned with a long-term perspective.

EU support has recently focused on strengthening monitoring programmes in the EaP countries. In that context, the EU Copernicus Programme has the potential to accelerate and support quick and up-to-date monitoring of various variables such as snowpack and land-use changes in the EaP countries. Developing the CORINE Land Cover Inventory for capital regions of the EaP countries has been initiated by the EU since 2016.

Implementation of the United Nations System of Environmental-Economic Accounting (SEEA) for water in the EaP countries would provide essential inputs in the process of river basin characterisation and the implementation of water services (in line with EU WFD, Article 5).

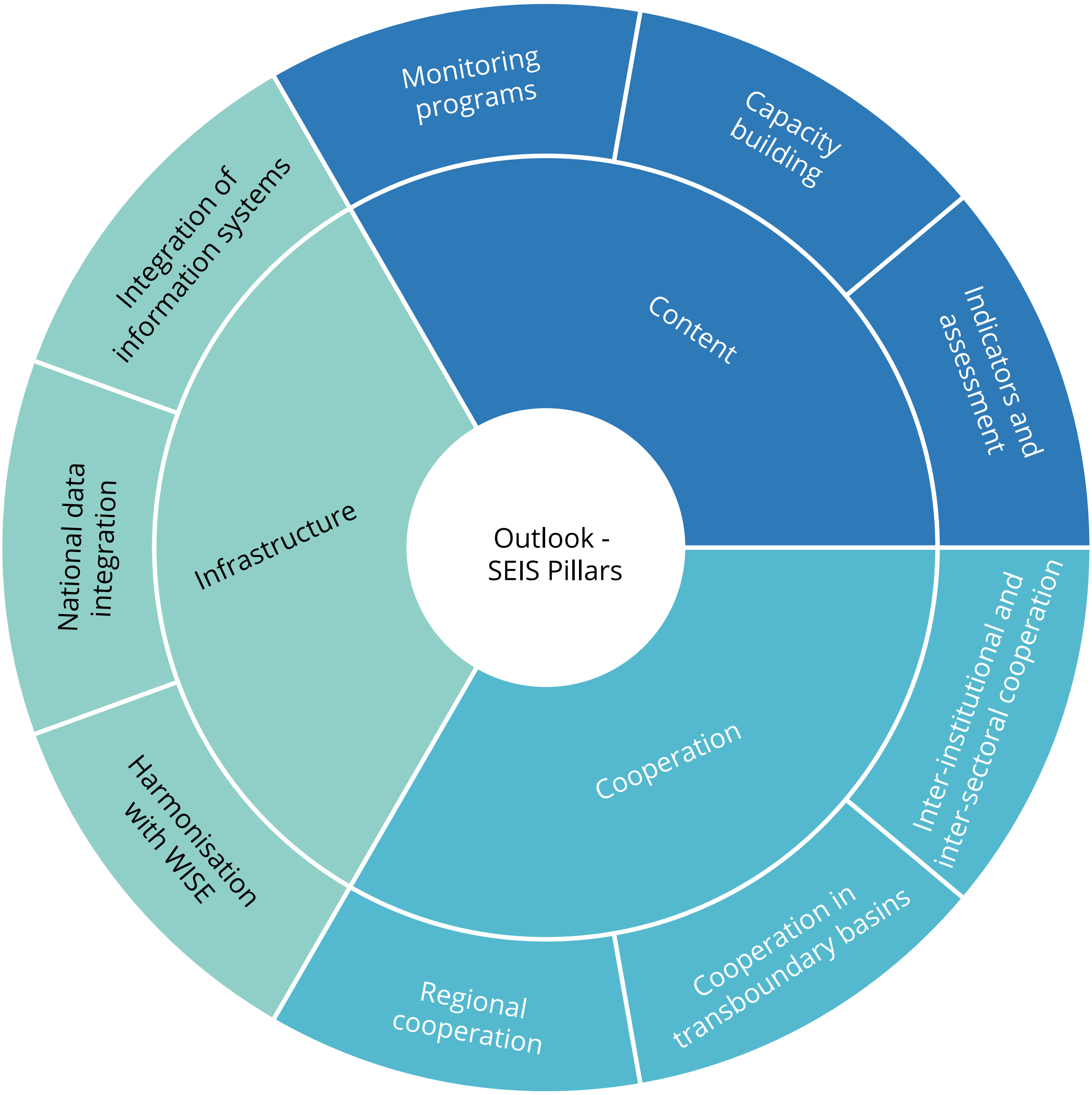
In the context of this report, in which the main focus has been on strengthening implementation of the SEIS principles, the key activities for the future are addressed in line with the three pillars of the SEIS (see also Figure 6.1):

- needs and opportunities for *cooperation* at the regional and national levels;
- implementation of relevant *content* to support knowledge-based policymaking; and
- further needs in improving the *infrastructure* for data and information management.

6.1 Regional cooperation

The European Green Deal will certainly change the overall approach to the challenges of climate change and biodiversity loss in the coming years. However, its success is very much dependent on cooperation at the regional and global levels. The drivers of climate change

Figure 6.1 Strengthening implementation of the three SEIS pillars in the EaP countries



Source: Design of the infographic has been taken from (OECD, 2015) and adjusted to the content of this chapter.

and biodiversity loss are global and are not limited by national borders (European Commission, 2019). Measures for improving resource efficiency and the circular economy could be those priority areas where the EU and the EaP countries would develop a joint sustainable path for the future.

In the context of protecting and sustainably managing water resources in the EaP countries, the partnership between the EU and these countries has already proven effective by delivering a number of tangible results in the EaP countries (EC, 2020) — for example, essential monitoring programmes, river basin district management plans, water information systems and also enhanced national policy dialogues among the national water agencies. All these pave the way towards the IRWM to be put in place not only at the local or national level, but also at the regional level, which is strategically important for the region's peace and security.

In the coming years, the EU will place its emphasis on supporting its immediate neighbours. The ecological transition for Europe can only be fully effective if the EU's immediate neighbourhood also takes effective action (EC, 2019b). In that context, the European Green Deal and water diplomacy might be major stimuli for various socio-economic and environmental domains in the EaP countries.

The ENI SEIS II East project has already achieved the added value of mobilising the Eionet experiences and expertise which brings not only specific, in-depth scientific and technical competencies towards the sustainable management of water resources, but also an extensive knowledge of European know-how. This is essential to ensure the protection of water resources and freshwater ecosystems in the EaP countries.

6.1.1 Cooperation in transboundary basins

EU water legislation places the river basin management approach at the core of water management policy. The EaP countries draft RBMPs in line with the EU WFD, starting with selected river basins and eventually covering the whole country, many with international support. For example, Belarus and Ukraine prepared the Upper Dnieper River Basin Draft River Management Plan with the support of the EU and EPIRB (European environmental protection of international river basins) Environmental protection of transboundary river basins (Koszta et al., 2016). With support from the EPIRB project and the EUWI+ for the Eastern Partnership (EUWI+, 2019), which is developing a series of additional RBMPs, EaP countries are improving their knowledge and skills for developing and implementing RBMPs. These include: water body delineation and typology; classification of the status of water bodies based on available data; identification of data and information gaps to improve monitoring; delineation of protected areas; identification of pressures; risk assessment; proposing environmental objectives; economic analysis and development of programmes of measures, stakeholders and public involvement; and awareness-raising activities. The main project beneficiaries are the environment ministries, which gives hope that EaP countries will soon start establishing management plans themselves ([13]).

However, the countries still have a number of important institutional and managerial challenges to face. Specifically, attention should be given to the establishment and functioning of river basin councils, the development of models and practices for stakeholders and public involvement, the development of a sustainable funding mechanism for RBMP implementation, and the production of robust and reliable data. At the regional level, bilateral and multilateral cooperation on transboundary basins should be strengthened both within the region and with EU Member States and other relevant states.

6.1.2 Interinstitutional and intersectoral cooperation

As the focus on water is a cross-cutting issue across the natural environment, socio-economic development and public health and well-being concerns, water resources management cannot be undertaken in isolation. Implementing appropriate measures, either to ensure the sustainability of water resources and water-dependent ecosystems or to secure the water supplies on which society and the economy depend, water management requires the involvement of numerous stakeholders. As underlined by the OECD (OECD and UNECE, 2014), sectoral competition for water in EaP countries is already intensifying as water demands grow over time. These trends require urgent actions to be taken in various domains of water resources management, including changes in the legal framework, better integration of institutions and water-use sectors, the introduction of strategic planning, greater financial sustainability, and the development of sufficient human resources. The current national policy dialogues under the EU Water

([13]) More information on the implementation of EU-funded projects at: https://www.euneighbours.eu/en/east/eu-in-action; see more information on the EUWI+ at: https://euwipluseast.eu/en/

Initiative are providing intersectoral and interagency platforms to discuss strategic planning and reforms in water sectors in the EaP countries.

6.2 Content-related work

6.2.1 Monitoring programmes

The EEA's European environment – state and outlook 2020 report (SOER 2020) (EEA, 2019c)Europe faces environmental challenges of unprecedented scale and urgency. Although EU environment and climate policies have delivered substantial benefits over recent decades, Europe faces persistent problems in areas such as biodiversity loss, resource use, climate change impacts and environmental risks to health and well-being. Global megatrends such as demographic change are intensifying many environmental challenges, while rapid technological change brings new risks and uncertainties. Recognising these challenges, the EU has committed to a range of long-term sustainability goals with the overall aim of 'living well, within the limits of our planet'. Achieving these goals will not be possible without a rapid and fundamental shift in the character and ambition of Europe's responses. Europe needs to find ways to transform the key societal systems that drive environment and climate pressures and health impacts — rethinking not just technologies and production processes but also consumption patterns and ways of living. This will require immediate and concerted action, engaging diverse policy areas and actors across society in enabling systemic change. Europe stands at a critical juncture in 2020. Its leaders have opportunities to shape future developments that will not be available to their successors. The coming decade will therefore be of decisive importance in determining Europe's opportunities in the 21st century. These, in short, are the overarching conclusions of The European environment — state and outlook 2020 (SOER 2020 highlights the importance of 'comprehensive integrated assessment to date, and the first to address rigorously systemic challenges...'. The EEA's Assessment of Assessments report also pointed out that data and information on water and water resources management in Europe has increased tremendously (EEA, 2011). There has also been a similar trend in the EaP countries. However, there is a strong need to adapt the content of monitoring programmes and data collection to modern IWRM, for example, in line with the EU WFD. Similarly, whereas data and information is relatively abundant in certain areas, such as water quality and streamflow, water agencies are still far from integrating various sectoral data. The EaP countries are moving towards developing the similar data model to that of the EU WFD and WISE State of Environment reporting, through EU support. As this process is long term, efforts must be continued and tailored to the specific needs of each EaP country in the coming years.

A key process concerns sharing available data and information among national water agencies, as well as with external stakeholders, along with integrating all data relevant to water resources management, while simultaneously enhancing countries' monitoring capacities. This will help to provide a robust baseline for developing and implementing water-focused environmental policies, not only at the national level, but also at the regional level — an essential process in improving cooperation among transboundary river basins.

With the experiences already available following implementation of the EU WFD, as well as data harmonisation and sharing under Eionet, voluntary dataflow will bring tremendous inputs for national and regional data exchange in the EaP countries.

Innovative monitoring technologies, including satellite data, automated monitoring technologies, and potentially crowdsourcing of environmental data, have great potential for improving data collection, reducing the costs of monitoring, and enhancing confidence in EU WFD status classification (EC, 2019a). The EU Copernicus programme ([14]) has the potential to expand its products over the EaP countries in the future. This may improve the effectiveness of the monitoring programmes and produce reliable data and information via calibration and validation with *in-situ* data which have been developed under various EU funded projects, for example, EUWI+.

6.2.2 Capacity building

In many cases, even though the administrative organisation of water state services and agencies are in place and operational, competent expert capacity is crucial to appropriately interpret available data and information on water resources. This also builds 'institutional memory' for accumulating knowledge and experience essential in the area of IWRM. However,

([14]) Copernicus is the EU's Earth Observation Programme providing data from satellite observation on our planet and its environment. See more information at: https://www.copernicus.eu/en staff turnover, combined with frequent reorganisation in the water agencies or respective ministries, causes the loss of such institutional memory and lowers the water agencies' capacity to be effective. For instance, Moldova reorganised its Ministry of Environment three times between 2017-2019. Similarly, Georgia changed the structure of its Ministry of Environment twice in the same period.

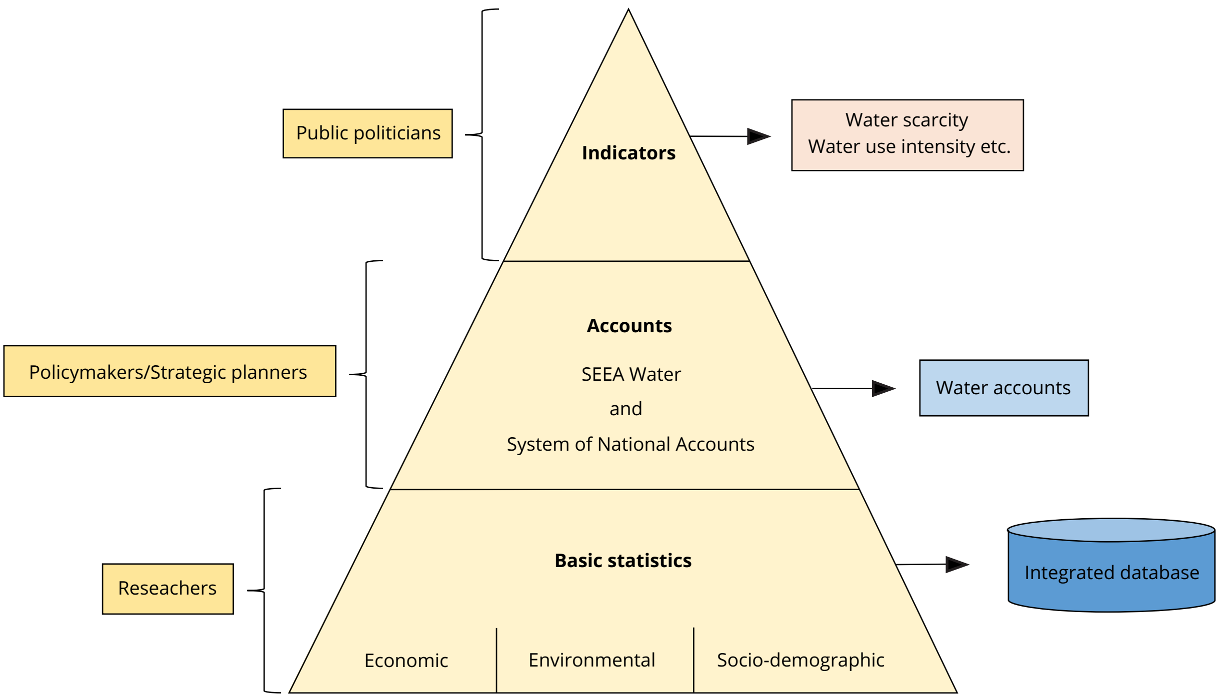
6.2.3 Supporting knowledge-based policymaking

The importance of using available data and information to support knowledge-based policymaking should be underlined. A set of UNECE water indicators, C1-C5 and C10-C11, that has been used as the main inputs to developing this report, has been developed jointly with national experts by following the EEA indicator template. The overall purpose of this work was to build capacity at the national and regional level in using available water data to support knowledge-based policymaking. Indicator development also emphasised standardising and sharing the datasets needed for indicator composition. Further maintenance and sustainability of similar datasets should be ensured in the future. This includes mobilisation of water data experts who deal with knowledge building and environmental assessment, as well as IT/data experts who offer technical support in data processing, dissemination and sharing.

The United Nations SEEA Central Framework (UN, 2012) integrates economic and environmental data to provide a comprehensive view of the interrelationships between the economy and the environment, and the stock of environmental assets. It contains internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics and accounts. It is a formally recognised statistical standard by UN member countries. As there is a sequential link between data collection, water accounts and indicators (Figure 6.2), developing the water accounts will help in the design of monitoring programmes, organisation of the databases, as well as streamlining and developing indicators in the EaP countries. In addition, developing the water accounts will support the integration of environmental and economic data.

Furthermore, the water accounts would provide essential inputs into the process of developing the river basin district management plans — for example, characterisation of river basins and implementation of water services, as also stated in EU WFD, Article 5 (EC, 2015)as pre-requisite to sound and sustainable quantitative management of water resources. A water

Figure 6.2 Indicator pyramid and its relationship with developing water accounting through the SEEA



Source: Adapted from Mazza et al. (2013).

balance is based on mass conservation. It reflects that the rate of change in water stored in a hydrological unit (e.g. catchment.

As the water accounts link environmental information with economic data and information, defining the programme of measures can also benefit from input from the water accounts. With the EU's technical support, and as a pilot activity, Belarus has developed physical water flow accounts for 2018, which are presented in Annex I. Azerbaijan also developed physical water asset and flow accounts at the country level, with the technical support of the EEA.

6.3 Infrastructure

6.3.1 National data integration

In the EaP countries, water-monitoring systems are mainly implemented as a state service, divided into regional divisions in the areas of hydrometeorology (water quantity), geology (groundwater), hydrochemistry (water quality), hydrobiology (ecology) and public health (drinking water). Although all countries have monitoring programmes on water resources and water use, the usability of that data in policymaking needs further evaluation and improvement as the data are mainly collected and managed in a very fragmented manner among several governmental services and agencies. This often creates bottlenecks in the compilation and organisation of water-quantity data — for example, in developing water asset and flow accounts with the aim of identifying water availability and sectoral pressures on water resources (Globevnik et al., 2018).

State statistical offices collect data on water resources an annual basis from various state water services and agencies and publish (bi)monthly bulletins or annual statistical books. In the area of water quantity, in some cases, they simply do not collect the data on different variables. For example, Ukraine's State Statistics Committee only collects data on water abstraction. As regards water quality, the respective water agencies inform on any exceedance of limit values but do not deal with integrated status assessments and trends over long periods. Overall, water policy recommendations are missing.

State water services and agencies in the EaP countries are generally very reluctant to share their data and information on different domains of water management, which inhibits comprehensive integrated assessments at both the national and regional level. The challenges ahead include: developing a positive attitude towards data sharing; the need to assess the environmental status of water resources, notably by regularly monitoring its decisive biological quality elements; and identifying key pressures on water.

It should be underlined that the integration of water data from various sectors and sources will underpin a reliable and robust interpretation with available data, not only to design the current policy and programmes, but will also certainly support the development of IWRM in the region and at the local scale.

6.3.2 Water Information systems

The EaP countries have advanced at different levels as regards either developing or using existing (water) information systems. For instance, Moldova is currently developing an automated information system called 'the State Water Cadastre'. The system is designed to host data and information on various areas of water, for example, water resources, water resources management, hydraulic structures, protected areas, water balance, etc. The State Cadastre System will be an integral part of the Integrated Environmental Information System to increase efficiency in data processing and eliminating potential duplication in gathering information.

As a pilot activity under the EU-funded ENI SEIS II East project, Armenia, Azerbaijan and Georgia have developed water information systems (in Georgia) and the EcoPortal (in Armenia and Azerbaijan) by replicating the overall structure and philosophy of WISE.

In 2020, the information systems deployed in Armenia, Azerbaijan and Georgia offer the cooperating institutions the following functionalities:

- a data dictionary and harmonised water-quality dataset, which enables dataset comparability between different institutions;
- SQL database, data-processing protocols and procedures for water-quality indicator production; and
- a web portal, which enables the presentation of data and information through text blocks, dynamic and interactive charts, and GIS visualisations.

Effective use of the established information systems depends on two key processes. These should be followed and reviewed once the systems have been in place for some time, enabling all the involved stakeholders to use them.

The first process is to enhance staff expertise in using the information systems. The ultimate goal is capacity building to establish a functioning team of both water domain and IT experts working in synergy, and able to successfully communicate the issues and requests. The institutional working procedures that use the information system should be well established, documented on a centralised platform, and replicable.

The second process is that technical features of the portal should be reviewed for their efficiency and upgraded where needed. While the information systems were built in a way to be easily upgraded, the focus of further technical development should be on the following ([15]):

- Deployment of different databases containing water data, thereby centralising national datasets and facilitating their sharing; this would also reduce the need for many data managers in individual institutions, largely missing now.

- Establishment of data-management procedures; this includes replicable processes of data collection, quality assurance/quality control (QA/QC), storage, dataset assessment, and the production of dissemination products (charts, maps, etc.); only basic data-management procedures are currently in place, but can serve as a starting point to develop processes further.

- Development of more environmental indicators, potentially expanding beyond the topic of water; these environmental indicators should be based on clearly defined data-analysis procedures.

- Collecting and managing spatial datasets, enabling spatial analysis and presentation of data on interactive maps; currently, only basic spatial presentation is available in the existing information systems.

6.3.3 Data harmonisation with Water Information System for Europe (WISE)

There is a significant need for harmonised data and information to support cooperation in the transboundary basins in the EaP countries, particularly in Armenia, Azerbaijan and Georgia. Efforts under the implementation of EU-funded projects, such as ENI SEIS II East, aim to partly overcome the problem of data and information availability and harmonisation at the regional level by developing water indicators using the EEA's methodology, as has already been implemented in EEA member countries. Data on BOD and nutrients in the EaP countries have already been harmonised with WISE in accordance with the WISE data dictionary. However, wider implementation of this data harmonisation in the respective national water agencies and the expansion of data harmonisation to water quantity still requires further development in the future. Efforts by the EUWI+ under the development of RBMP plans may support data harmonisation at the regional level.

([15]) Some development in that direction had already started under EUWI+ at the time this report was developed.

References

Asian Development Bank, 2005, *Country Environmental Analysis—Azerbaijan*, Manila, Philippines (https://www.adb.org/documents/country-environmental-analysis-azerbaijan) accessed 31 March 2020.

Belstat, 2020, 'News', National Statistical Committee of the Republic of Belarus (https://www.belstat.gov.by/en/) accessed 31 March 2020.

Bisselink, B., et al., 2020, *Climate change and Europe's water resources*, Technical report No EUR 29951 EN, Joint Research Centre, (https://ec.europa.eu/jrc/sites/jrcsh/files/pesetaiv_task_10_water_final_report.pdf) accessed 6 February 2020.

Brown, A. and Matlock, M., 2011, *A Review of Water Scarcity Indices and Methodologies*, The Sustainability Consortium (https://www.sustainabilityconsortium.org/tsc-downloads/a-review-of-water-scarcity-indices-and-methodologies/) accessed 31 March 2020.

Council of Ministers of the Republic of Belarus, 2016, *State programme "Comfort accommodations and an enabling environment for 2016-2020*, Republic of Belarus (http://www.government.by/upload/docs/file8c3586a94739667b.PDF) accessed 21 April 2020.

Dniester-Commission, 2020, 'Website of the Dniester Commission', Republic of Moldova and Ukraine, (https://dniester-commission.com/en/) accessed 31 May 2020.

EBRD, 2016, 'Yerevan Water Supply Improvement Project', European Bank for Reconstruction and Development (https://www.ebrd.com/work-with-us/projects/psd/yerevan-water-supply-improvement-project.html) accessed 6 July 2020.

EC, 2008, Communication from the Commission to the Council, the European Parliament, The European Economic and Social Committee and the Committee of the Regions 'Towards a Shared Environmental Information System (SEIS)' (COM(2008) 46 final) of 1 February 2008.

EC, 2015, *Guidance document on the application of water balances for supporting the implementation of the WFD*, Technical Report - 2015 - 090, European Commission (http://dx.publications.europa.eu/10.2779/352735) accessed 3 June 2020.

EC, 2019a, Fitness Check of the Water Framework Directive and the Floods Directive, Commission staff working document, (SWD(2019) 439 final), (https://ec.europa.eu/info/publications/fitness-check-monitoring-and-reporting-environment-policy_en).

EC, 2019b, 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' (COM(2019) 640 final of 11 December 2019).

EC, 2020a, 'Eastern Partnership', European Commission (https://www.consilium.europa.eu/en/policies/eastern-partnership/) accessed 6 January 2020.

EC, 2020b, Joint communication to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions 'Eastern Partnership policy beyond 2020 - Reinforcing Resilience - an Eastern Partnership that delivers for all' (JOIN(2020) 7 final of 18 March 2020), (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020JC0007&from=EN) accessed 6 January 2020.

EEA, 2005, *EEA core set of indicators: guide*, EEA Technical report No 1/2005, European Environment Agency.

EEA, 2009, *Water resources across Europe: confronting water scarcity and drought*, EEA Report No 2/2009, European Environment Agency.

EEA, 2011, *Europe's environment: an assessment of assessments*, EEA Report, European Environment Agency (https://www.eea.europa.eu/publications/europes-environment-aoa) accessed 05 August 2020.

EEA, 2012a, *Climate change, impacts and vulnerability in Europe 2012 - An indicator-based report*, EEA Report No 12/2012, European Environment Agency (https://www.eea.europa.eu/publications/climate-impacts-and-vulnerability-2012) accessed 6 February 2020.

EEA, 2012b, 'European catchments and Rivers network system (Ecrins)', European Environment Agency (https://www.eea.europa.eu/data-and-maps/data/european-catchments-and-rivers-network) accessed 31 March 2020.

EEA, 2012c, 'Water for agriculture', European Environment Agency (https://www.eea.europa.eu/articles/water-for-agriculture) accessed 31 March 2020.

EEA, 2017, *Climate change. impacts and vulnerability in Europe 2016: an indicator-based report*, EEA Report No 1/2017, European Environment Agency.

EEA, 2018, *European waters assessment of status and pressures 2018*, EEA Report No 7/2018, European Environment Agency (https://www.eea.europa.eu/publications/state-of-water) accessed 8 June 2020.

EEA, 2019a, 'Nutrients in freshwater in Europe - CSI 020', European Environment Agency (https://www.eea.europa.eu/data-and-maps/indicators/nutrients-in-freshwater/nutrients-in-freshwater-assessment-published-9) accessed 6 January 2020.

EEA, 2019b, 'Oxygen consuming substances in European rivers - CSI 019', European Environment Agency (https://www.eea.europa.eu/data-and-maps/indicators/oxygen-consuming-substances-in-rivers/oxygen-consuming-substances-in-rivers-9) accessed 6 January 2020.

EEA, 2019c, *The European environment: state and outlook 2020: knowledge for transition to a sustainable Europe*, European Environment Agency (https://www.eea.europa.eu/publications/soer-2020) accessed 6 June 2020.

EEA, 2019d, 'Use of freshwater resources in Europe', European Environment Agency (https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4) accessed 6 February 2020.

EEA, 2019e, 'Global and European temperature', European Environment Agency (https://www.eea.europa.eu/data-and-maps/indicators/global-and-european-temperature-9/assessment) accessed 6 February 2020.

EEA, 2020, 'ENI SEIS II East: Implementation of the Shared Environmental Information System (SEIS) principles and practices in the ENP East region', European Environment Agency (https://eni-seis.eionet.europa.eu/east) accessed 6 January 2020.

Elizbarashvili, M., et al., 2017, 'Georgian climate change under global warming conditions', *Annals of Agrarian Science* 15(1), pp. 17-25 (https://linkinghub.elsevier.com/retrieve/pii/S1512188717300118) accessed 6 June 2020.

EU, 1998, Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption (OJ L 330/32, 5.12.98), (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31998L0083&from=EN) accessed 6 July 2020.

EU, 1999, Partnership and cooperation agreement between the European Communities and their Member States, of the one part, and the Republic of Azerbaijan, of the other part (OJ L 246/3 17.9.1999), (https://eur-lex.europa.eu/resource.html?uri=cellar:51504229-9952-4e18-80e7-489c110a1991.0017.02/DOC_1&format=PDF) accessed 6 June 2020.

EU, 2000, 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 (OJ L 327/1 22.12.2000 of 23 October 2000).

EU, 2018, Water Diplomacy - Council conclusions, (13991/18 of 19 November 2018), (https://www.consilium.europa.eu/media/37022/st13991-en18.pdf) accessed 10 June 2020.

EU, 2020, Council Conclusions on Eastern Partnership policy beyond 2020 (No 7510/1/20 of 11 May 2020), (https://www.consilium.europa.eu/media/43905/st07510-re01-en20.pdf) accessed 6 April 2020.

EUWI+, 2019, 'European Union Water Initiative +', EU Water Initiative for Eastern Partnership (https://euwipluseast.eu/en/) accessed 31 March 2020.

Falkenmark, M., et al., 1989, 'Macro-scale water scarcity requires micro-scale approaches', *Natural Resources Forum* 13(4), pp. 258-267.

FAO, 2009, *Transboundary River Basins – Kura Araks River Basin*, Food and Agriculture Organization, Rome, Italy (http://www.fao.org/3/ca2130en/CA2130EN.pdf) accessed 17 March 2020.

IW:LEARN, 2017, 'Georgia and Azerbaijan share rivers and plans for a water rich future', IW:LEARN (https://news.iwlearn.net/georgia-and-azerbaijan-share-rivers-and-plans-for-a-water-rich-future) accessed 31 March 2020.

Globevnik, L., et al., 2018, *Support for the implementation of the ENI-SEIS East 2017-2018 regional and country work plans in the thematic area of water*, ETC/ICM, Leipzig, Germany.

Howard, G. and Bartram, J., 2003, *Domestic Water Quantity, Service, Level and Health*, No WHO/SDE/WSH/03.02, World Health Organisation (https://apps.who.int/iris/bitstream/handle/10665/67884/WHO_SDE_WSH_03.02.pdf?sequence=1&isAllowed=y) accessed 6 July 2020.

Israfilov, R., et al., 2014, 'Groundwater exploitation and its impact on the environment in Azerbaijan', *Seismoprognosis observations in the territory of Azerbaijan* 11(1), pp. 51-55.

Koszta, I., et al., 2016, *Upper Dnieper River Basin: Draft management plan*, Environmental Protection of International River Basins project, Kyiv, Ukraine (http://www.rec.org/publication.php?id=553) accessed 31 March 2020.

Krakovskaya, S., et al., 2012, *Reducing vulnerability to extreme floods and climate change in the Dniester Basin (Dniester-III: floods and climate")*, ENVSEC project, Ministry of Emergencies of Ukraine National Academy of Sciences of Ukraine Ukrainian Hydrometeorological Institute Kiev, Ukraine (https://dniester-commission.com/wp-content/uploads/2018/12/Climate_analysis_report_eng_17Mar14.pdf) accessed 6 June 2020.

Mendez England and Associates, 2016, *Final Report on the Inventory of Groundwater Wells, Natural Springs and Fish Farms in the Ararat Valley*, Yerevan, Armenia (http://www.aspired.wadi-mea.com/mdocs-posts/final-report-on-the-inventory-of-groundwater-wells-natural-springs-and-fish-farms-in-the-ararat-valley-draft-version/) accessed 31 March 2020.

NASA, 2020, 'U.S. Releases Enhanced Shuttle Land Elevation Data', National Aeronautics and Space Administration, Washington D.C., USA (https://www2.jpl.nasa.gov/srtm/) accessed 25 June 2020.

OECD, 2015, *OECD Principles on Water Governance*, Organisation for Economic Co-operation and Development, Paris, France (https://www.oecd.org/cfe/regionaldevelopment/OECD-Principles-on-Water-Governance-en.pdf) accessed 9 June 2020.

OECD and UNECE, 2014, *Integrated Water Resources Management in Eastern Europe, the Caucasus and Central Asia*, European Union Water Initiative National Policy Dialogues progress report 2013, Organisation for Economic Co-operation and Development and United Nations Economic Commission for Europe, New York, USA and Geneva, Switzerland. (http://www.unece.org/fileadmin/DAM/env/water/publications/NPD_IWRM_study/ECE_MP.WAT_44_en.pdf) accessed 2 February 2020.

Raskin, P., et al., 1997, *Comprehensive assessment of the freshwater resources of the world*, Stockholm Environmental Institute, Stockholm, Sweden (https://www.sei.org/mediamanager/documents/Publications/SEI-Report-WaterFutures-AssessmentOfLongRangePatternsAndProblems-1997.pdf) accessed 05 August 2020.

Republic of Moldova, 2011, Law of the Republic of Moldova of December 23, 2011 No. 272.

Rucevska, I., 2017, *Climate change and security in the south Caucasus*, Republic of Armenia, Republic of Azerbaijan and Georgia- Regional assessment, Environment and Security Initiative (https://www.osce.org/files/f/documents/3/1/355546.pdf) accessed 6 June 2020.

Salvetti, M. S. G., 2015a, 'Water and wastewater services in the Danube region: Moldova country note. World Bank, Washington D.C., USA (http://documents.worldbank.org/curated/en/262431468190744899/Water-and-wastewater-services-in-the-Danube-region-Moldova-country-note) accessed 6 July 2020.

Salvetti, M. S. G., 2015b, *Water and wastewater services in the Danube region: Moldova country note*. Water and wastewater services in the Danube region, World Bank Group (http://documents.worldbank.org/curated/en/262431468190744899/Water-and-wastewater-services-in-the-Danube-region-Moldova-country-note) accessed 6 July 2020.

Sertyeşilişik, E., 2017, 'Azerbaycanın su kaynaklarının ekonomi politiği', *Journal of International Social Research* 10(54), pp. 365-371.

Statistical Committee of the Republic of Armenia, 2018, *The land resources and irrigated lands by significance, types and years, Armenia*, Statistical Committee of the Republic of Armenia (https://armstatbank.am/pxweb/en/ArmStatBank/ArmStatBank__8%20Environment__(E,F)%20Land%20and%20Agriculture/EE-f1.px/?rxid=53ccad11-4c54-4f4c-98d2-bd46723429fb) accessed 31 March 2020.

Statistical Committee of the Republic of Armenia, 2020b, 'ArmStatBank', Statistical Committee of the Republic of Armenia (https://armstatbank.am/pxweb/en/ArmStatBank/?rxid=0947bacc-9878-4ef6-8215-3cf37ba4abf2) accessed 21 April 2020.

Strosser, P., et al., 2017, *The potential benefits of transboundary co-operation in Georgia and Azerbaijan: Kura Basin*, Organisation for Economic Co-operation and Development, Paris, France (http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/WKP(2017)1&docLanguage=En) accessed 31 May 2020.

The State Statistical Committee of the Republic of Azerbaijan, 2019, 'Environment Protection', The State Statistical Committee of the Republic of Azerbaijan (https://www.stat.gov.az/source/environment/?lang=en) accessed 31 March 2020.

Toropov, P. A., et al., 2019, 'Large-scale climatic factors driving glacier recession in the Greater Caucasus, 20th–21st century', *International Journal of Climatology* 39(12), pp. 4703-4720.

Trémolet, S., ed., 2011, *Meeting the challenge of financing water and sanitation: tools and approaches*, Organisation for Economic Co-operation and Development, Paris, France.

UN, 1997, Convention on the Law of the Non-navigational Uses of International Watercourses (51/229), United Nations, New York, USA.

UN, 2010, Resolution adopted by the General Assembly on 28 July 2010. 64/292. The human right to water and sanitation (A/RES/64/292), United Nations, New York, USA.

UN, ed., 2012, *System of environmental-economic accounting for water: SEEA-water*, United Nations, New York, USA.

UN, 2015, Resolution adopted by the General Assembly on 25 September 2015 [without reference to a Main Committee] (A/RES/70/1 of 21 October 2015), United Nations, New York, USA (https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E) accessed 6 July 2020.

UN, 2018, 'SDG indicators database', United Nations, New York, USA (https://unstats.un.org/sdgs/indicators/database/) accessed 31 May 2020.

UN, 2020a, 'High-level Political Forum: Sustainable Development', United Nations, New York, USA (https://sustainabledevelopment.un.org/hlpf) accessed 31 March 2020.

UN, 2020b, Chapter XXVII, Environment, Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Helsinki, 17 March 1992, United Nations, New York, USA (https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-5&chapter=27&clang=_en) accessed 31 May 2020.

UNECE, 2000a, *1st Environmental Performance Review of Armenia*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2000b, *1st Environmental Performance Review of Armenia*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2000c, *Environmental performance reviews - Armenia, second review*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2000d, *First environmental performance review of Armenia*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2007a, *Environmental monitoring: Guidelines for the application of environmental indicators in eastern Europe, Caucasus and Central Asia*, United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/fileadmin/DAM/env/europe/monitoring/Belgrade/CRP1.Indicators.En%20edited.MK..pdf) accessed 23 April 2020.

UNECE, 2007b, *Environmental performance reviews: second review. Ukraine*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2007c, *Our Waters: Joining hands across borders, First Assessment of Transboundary Rivers, Lakes and Groundwaters, Convention on the Protection and Use of Transboundary Watercourses and International Lakes*, United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/fileadmin/DAM/env/water/blanks/assessment/assessmentweb_full.pdf) accessed 6 July 2020.

UNECE, 2011a, *Environmental performance reviews Azerbaijan, Second Review*, Environmental Performance Reviews Series No No. 31, United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/fileadmin/DAM/env/epr/epr_studies/azerbaijan%20II.pdf) accessed 6 July 2020.

UNECE, 2011b, *Environmental performance reviews Azerbaijan, Second Review*, Environmental Performance Reviews Series No No. 31, United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/fileadmin/DAM/env/epr/epr_studies/azerbaijan%20II.pdf) accessed 6 July 2020.

UNECE, 2011c, *Environmental performance reviews: second review. Azerbaijan*, United Nations Economic Commission for Europe, Geneva, Switzerland. (https://www.unece.org/fileadmin/DAM/env/epr/epr_studies/azerbaijan%20II.pdf) accessed 6 July 2020

UNECE, 2011d, *Second assessment of transboundary rivers, lakes and groundwaters*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2011e, *2nd Environmental Performance Review of Azerbaijan*, United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/index.php?id=17343).

UNECE, 2012, *The Treaty between the Government of the Republic of Moldova and the Cabinet of Ministers of Ukraine on Cooperation in the Field of Protection and Sustainable Development of the Dniester River Basin*, United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/fileadmin/DAM/env/water/activities/Dniester/Dniester-treaty-final-EN-29Nov2012_web.pdf) accessed 2 February 2020.

UNECE, 2014a, *Environmental performance reviews: third review. Republic of Moldova*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2014b, *Environmental performance reviews: third review. Republic of Moldova*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2014c, *Environmental performance reviews: third review. Republic of Moldova*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2015, *Results and lessons learned from the Georgian National Policy Dialogue on Integrated Water Resources Management under the European Union Water Initiative*, United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/fileadmin/DAM/env/water/publications/NPD_Publication_2013/ge_policy_brief_en_final.pdf) accessed 6 July 2020.

UNECE, 2016a, *Environmental performance reviews - Belarus, Third review*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2016b, *Environmental Performance Reviews-Belarus*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2016c, *Environmental performance reviews: third review. Belarus*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2016d, *Environmental performance reviews: third review. Georgia*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2016e, *Environmental performance reviews: third review. Georgia*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2016f, *Environmental performance reviews: third review. Georgia*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2016g, *Environmental performance reviews: third review. Georgia*, United Nations Economic Commission for Europe, Geneva, Switzerland.

UNECE, 2016h, *Report on progress in establishing the Shared Environmental Information System in support of regular reporting in the pan-European region, Eighth Environment for Europe Ministerial Conference Batumi, Georgia 8–10 June 2016*, United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/fileadmin/DAM/env/EMA/ece.batumi.conf.2016.8.e.pdf) accessed 6 June 2020.

UNECE, 2020a, 'Guidelines for the Application of Environmental Indicators', United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/env/indicators.html) accessed 23 February 2020.

UNECE, 2020b, 'Protocol on water and health - Targets set by parties', United Nations Economic Commission for Europe, Geneva, Switzerland (https://www.unece.org/env/water/pwh_targets_set.html) accessed 6 July 2020.

UNENGO, 2015, *River basin management plan for the upper Dnieper pilot basin of Ukraine*, UNENGO (http://blacksea-riverbasins.net/sites/default/files/RBMP_Upper%20Dnieper_UA_EN_final_1.pdf) accessed 6 July 2020.

Vystavna, Y., et al., 2018, 'Water laws of Georgia, Moldova and Ukraine: current problems and integration with EU legislation', *Water International* 43(3), pp. 424-435.

WHO, 2015, *Sanitation, drinking-water and hygiene status overview. Country Highlights - Georgia*, Report WHO/FWC/WSH/15.54, World Health Organization, Geneva, Switzerland (https://www.who.int/water_sanitation_health/monitoring/investments/georgia-11-nov.pdf?ua=1) accessed 05 August 2020.

WHO/UNICEF, 2019, 'Joint Monitoring Programme for Water Supply, Sanitation and Hygiene- Estimates on the use of water, sanitation and hygiene - global database', World Health Organization, Geneva, Switzerland (https://washdata.org/data/downloads#WLD) accessed 31 May 2020.

World Bank, 2017a, *Republic of Armenia - Support to Armenia's Second Generation Water PPPs*, No ACS22367, World Bank, Washington D.C., USA (https://ppiaf.org/documents/5694/download?otp=b3RwIzE1NzIxMTkzOTA=) accessed 6 July 2020.

World Bank, 2017b, 'World Bank Data What is an “international dollar”?' World Bank, Washington D.C., USA (https://datahelpdesk.worldbank.org/knowledgebase/articles/114944-what-is-an-international-dollar) accessed 22 June 2020.

World Bank, 2020, 'The World Bank Database on gross domestic products of the Republic of Moldova', World Bank, Washington D.C., USA (https://data.worldbank.org/country/moldova) accessed 1 March 2020.

Yıldız, D., 2017, *Transboundary Rivers and Water Diplomacy in the South Caucasus*, No 10, Hydropolitics Academy, Ankara, Turkey (https://www.academia.edu/32785616/Transboundary_Rivers_and_Water_Diplomacy_in_the_South_Caucasus) accessed 16 March 2020.

Yu, W., et al., 2014, *Toward Integrated Water Resources Management in Armenia*, World Bank, Washington D.C., USA (https://elibrary.worldbank.org/doi/book/10.1596/978-1-4648-0335-2) accessed 7 June 2020.

Annex 1 Physical water flow accounts for Belarus (2019)

As a national pilot activity, EEA has provided expert capacity-building and technical support to Belarus in the development of a physical water supply and use tables of the water flow accounts, in line with the United National System of Environmental-Economic Accounting for Water (UN, 2012). Belarus has developed physical water flow accounts for the years 2016-2019. Below are examples for 2019.

Physical water flow account (water supply table) for Belarus (million m³)

2019	Row number	Abstraction of water; production of water; generation of return flows								Flows from the rest of the world (import)	Flows from the environ-ment	Total supply
		Section by NACE Rev. 2.0							House-holds			
		Agriculture, forestry and fishing	Mining	Manu-facturing	Electricity, gas, steam and air conditioning supply	Water supply; sewerage, waste management and remediation activities	Construction	Other industries				
		(A)	(B)	(C)	(D)	(E)	(F)	(G-S)				
A	B	1	2	3	4	5	6	7	8	9	10	11
Water abstraction from the environment	01										1.374,53	**1.374,53**
Surface water	02										555,86	555,86
Groundwater	03										818,67	818,67
Distribution and use of abstracted water	04	367,31	1,28	175,07	178,92	470,58	11,65	27,53		-		**1.232,34**
For distribution	05	43,80	0,41	28,31	119,89	418,56	9,31	1,42		-		621,70
For own-use	06	323,51	0,87	146,75	59,03	52,03	2,34	26,11				610,64
Wastewater in treatment facilities	07	8,29	0,41	147,52	26,35	77,21	0,74	69,35	349,09	-		**678,95**
Wastewater to treatment	08	4,32	0,41	79,78	18,85	28,55	0,72	67,07	349,09	-		548,79
Own treatment	09	3,96	0,00	67,74	7,50	48,66	0,02	2,29		-		130,16
Return flows of water to the environment	10	215,65	30,57	122,96	133,83	510,76	2,82	24,86	-			**1.041,44**
To inland water resources	11	198,95	30,54	121,33	133,18	510,59	2,72	23,41	-			1.020,72
Surface water	12	188,13	30,49	110,94	99,45	429,80	2,60	19,85	-			881,26
Groundwater	13	10,82	0,06	10,39	33,72	80,79	0,11	3,56	-			139,46
of which:												
Losses in distribution	14	0,00	-	0,53	7,90	32,99	-	0,29	-			41,71
Other losses	15	0,02	-	0,53	7,44	37,23	-	0,00	-			45,21
To other sources	16	16,70	0,03	1,63	0,65	0,17	0,10	1,45	-			20,73
Evaporation of abstracted water, transpiration and water incorporated into products	17	156,46	3,44	52,28	41,14	2,15	0,03	12,10	65,49			**333,09**
Evaporation of abstracted water	08											
Transpiration	09											
Water incorporated into products	20											
Total supply	21	747,70	35,70	497,82	380,24	1.060,70	15,24	133,84	414,58	-	1.374,53	**4.660,35**

Source: (Belstat, 2020).

Physical water flow account (water use table) for Belarus (million m³)

2019	Номер строки	Abstraction of water; intermediate consumption; return flows							Final consump-tion (house-holds)	Accu-mulation	Flows to the rest of the world (export)	Flows to the environ-ment	Total use
		Section by NACE Rev. 2.0											
		Agriculture, forestry and fishing	Mining	Manu-facturing	Electricity, gas, steam and air conditioning supply	Water supply; sewerage, waste management and remediation activities	Construction	Other industries					
		(A)	(B)	(C)	(D)	(E)	(F)	(G-S)					
A	B	1	2	3	4	5	6	7	8	9	10	11	12
Water abstraction from the environment	01	367,33	34,14	198,54	194,25	540,80	11,65	27,82					**1.374,53**
Surface water	02	233,30	-	106,55	73,54	112,51	10,77	19,19					555,86
Groundwater	03	134,03	34,14	91,99	120,71	428,29	0,88	8,63					818,67
Distribution and use of abstracted water	04	364,95	1,51	204,44	96,16	46,95	3,45	100,31	414,58		-		**1.232,34**
Distributed water	05	41,44	0,64	57,69	37,13	6,42	1,10	74,20	403,08		-		621,70
Own-use	06	323,51	0,87	146,75	59,03	40,53	2,34	26,11	11,50				610,64
Wastewater in treatment facilities	07	15,42	0,06	94,84	89,82	472,95	0,14	5,72			-		678,95
Wastewater received from other units	08	11,45	0,06	27,10	82,33	424,30	0,12	3,44			-		548,79
Own treatment	09	3,96	0,00	67,74	7,50	48,66	0,02	2,29			-		130,16
Return flows of water to the environment	10											1.041,44	**1.041,44**
To inland water resources	11											1.020,72	1.020,72
To other sources	12											20,73	20,73
Evaporation of abstracted water, transpiration and water incorporated into products	13											333,09	**333,09**
Evaporation of abstracted water	14												
Transpiration	15												
Water incorporated into products	16												
Total use	17	747,70	35,70	497,82	380,24	1.060,70	15,24	133,84	414,58		-	1.374,53	**4.660,35**

Source: (Belstat, 2020).

European Environment Agency

Water availability, surface water quality and water use in the Eastern Partnership countries
An indicator-based assessment

2020 — 74 pp. — 21 x 29.7 cm

ISBN 978-92-9480-291-0
doi:10.2800/635170

TH-AL-20-022-EN-N
doi:10.2800/635170

European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark
Tel.: +45 33 36 71 00
Web: eea.europa.eu
Enquiries: eea.europa.eu/enquiries

Publications Office
of the European Union

European Environment Agency