WATER GLOBAL PRACTICE

Romania Water Diagnostic Report

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Moving toward EU Compliance, Inclusion, and Water Security



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Executive Summary

1. Objective and Scope of This Report

This report was prepared by the World Bank to support its water sector dialogue with the Government of Romania. It aims to provide stakeholders, especially from the Romanian Government and the European Commission (EC), with a comprehensive stock-taking of the situation in the Romanian water sector in 2017, 10 years after the country joined the EU. The report documents the current situation, discusses the main lessons learned from reforms in water resources management, water supply sanitation and irrigation, and identifies the key water challenges faced by Romania. While not pretending to cover all possible water-related issues (due *inter alia* to limited access to some information), it seeks to identify the key policy issues and indicate what steps the government could consider in the near future.

This report looks at the situation in the water sector in Romania through the lens of water security, with a focus on compliance with EU water legislation and the **inclusion** of the poor. Water security is a broad concept that encompasses ensuring sustainable use of water resources, delivering affordable services to all, and mitigating water-related risks in a context of change—the goal being to **build a water secure future for the people, the economy and the environment in a context of global changes**. In the case of Romania, the over-arching concept of water security is closely linked to compliance and inclusion. Compliance with EU water legislation that covers large pans of sustainable water management has been a priority over the past decade, as part of the harmonization with the EU "*Environmental Acquis*" and broader EU integration agenda. Inclusion of the poor in Romania is also a topic of singular importance to the water sector, as the country is an outlier among the EU countries for having a large population without access to piped potable water and flush toilets.

Starting by taking stock of the situation in water management in Romania under the two dimension of EU compliance and inclusion, 10 years after the country joined the EU, **the report then** zooms in the three sub-sectors, namely water resources management (including flood protection), water supply and sanitation services (WSS), and irrigation; a dedicated "spatial analysis" chapter reviews the situation in each of the 11 river basins. The report then **expands the analysis to embrace the broader concept of water security,** adding *inter alia* the dimensions of sustainability, long-term resilience and preparedness to those of compliance and inclusion, thus comprehensively discussing the question whether Romania is sufficiently equipped to deal with the many water challenges it faces. This discussion concludes with a list of potential areas for government interventions towards water security.

A **Snapshot of the Romanian Water Sector** following this executive summary presents key facts on the current situation in a two-page table.

2. Where Does Romania Stand? Taking Stock of 10 Years of EU Membership in Water Management for Compliance and Inclusion

Compliance with the Complex Body of EU Water Legislations Is Proving Challenging and Costly

By joining the EU in 2007, Romania undertook a legal obligation to comply with EU water legislation. This includes a series of older directives focused on either pollution abatement (Urban Wastewater Treatment and Nitrates Directives) or monitoring (Drinking Water and Bathing Water Directives), as well as the more recent Water Framework Directive (WFD) that aims at good water status through a result-based approach at river basin level. As this complex body of legislation was largely designed before 2000 by, and for, richer countries, compliance has presented major challenges for the country with a per capita gross domestic product (GDP) well below the EU average. For almost two decades (including the pre-accession period), water reforms and financing (mostly from EU cohesion funds) have focused on EU compliance, yet it has been estimated that 29 billion[1] euros would still be needed to achieve it. It is therefore essential to take stock of what has been achieved, what remains to be done, and what may have been missed because of the compliance focus.

Compliance with the Urban Wastewater Treatment Directive (UWWTD) has been by far the most difficult task—and is likely to remain such for at least another decade. The country started from a very low base in terms of sewerage infrastructure and had negotiated the most generous interim deadlines (final compliance in 2018) amongst EU-13 countries. Yet, despite having carried out massive investments together with implementing supporting reforms, it is today the worst performer amongst EU countries for compliance with the UWWTD. Implementation of the UWWTD has been closely linked to the WSS reform and affected by the various challenges it encountered including resistance by local authorities against joining regional public utilities, resistance of households to connect to newly installed sewerage networks, slow absorption of EU funds, and the absence of a strategy for small rural agglomerations.

A major infringement case from the EC for non-compliance with the UWWTD is now unavoidable, as the 2018 deadline (under the accession treaty) **will be missed**. The deadline for compliance in agglomerations with more than 10,000 PE. was December 2015, and December 2018 is the deadline for small rural agglomerations (between 2,000 and 10,000 PE). By the end of 2016, while a large portion of the pollution load in agglomerations with more than 10,000 PE was collected and treated—84.5 percent and 78.5 percent respectively—less than 15 percent of the pollution load in rural agglomerations was collected and treated. It is clear that UWWTD compliance will take many years to be achieved and will require major efforts and actions on the part of the government.

For other EU water directives, the compliance performance of Romania has been more consistent. River Basin Management Plans (RBMPs) for the WFD were of good quality and submitted to the EC on time. Romania has a good performance for river quality, with 71 percent of rivers having a good or high ecological status in 2015. Romania benefits from a long tradition of river basin management and charging for water use. Having mapped flood risks and submitted Flood Management Plans (FMPs), Romania also fully complied with the requirements of the Floods Directive. For the other directives, such as the Nitrates Directive, Bathing Water Directive (BWD), and Drinking Water Directive (DWD), a few challenges remain but there are no other impending threats of infringement.

Beyond Compliance: There Is a Major Inclusion Gap for the Poor

The current EU legislation does not address universal access to potable WSS. While stipulating potability parameters for the households already connected to piped water systems, DWD does not require all households to be connected to piped water supply and has no reporting requirement for small scale water supply systems serving less than 50 people. It also ignores potability issues for households that have to rely on their own wells for self-supply. Similarly, the UWWTD only requires that domestic sewerage be properly collected and treated before discharge into the environment—not that all households have access to adequate in-house sanitation (flush toilets).

There is currently a significant access gap for piped water, with about 4.5 million Romanians lacking access to piped water within their house. In 2015, the connection rate to piped water systems stood at about 63 percent nationwide, up to 77.6 percent when piped in-house self-supply is factored in (about 2.8 million people—usually richer households—have in-house piped water from their own private well) according to the data of the latest (2016) household survey. As the connection rate increased by only 8 percentage points over the past decade, under a "business-as-usual" scenario universal access to piped water would not be achieved before 2040, at best.

This is a major public health issue, since about half of those lacking access to piped water—close to 2.5 million people or 12 percent of the national population—are reported to be self-supplied through unsafe, non-potable water sources. This is because many of the self-supplied households use shallow wells subject to potential fecal contaminations due to the under-development of sewerage networks and widespread lack of appropriate sanitation across the country (especially in rural agglomerations).

There is an even higher access gap for access to flush toilets, with more than 6 million Romanians having no flush toilets in their homes. Only 68.3 percent of the national population had access to toilets within the houses in 2016 (according to the latest household survey). The connection rate to sewage collection systems stood at 48 percent nationwide in 2015, and only a small proportion of unconnected households have in-house flush toilets with individual sanitation systems. It appears that many households are resisting connection to newly built (under the push for compliance with the UWWTD) sewerage networks, because what they want is improved in-house sanitation (upgrading from pit latrines to flush toilets), not connection to sewer networks.

This WSS access gap is largely a legacy of Romania's past, but it makes the country a complete outlier in the EU, where it is the only member country that does not provide an almost universal piped water access. Romania has a worst access rate than all non-EU countries in the Danube basin except Moldova. The communist regime in Romania was quite unique amongst Eastern-bloc countries for not having ensured access to WSS services for all. As a consequence, in the early 1990s Romania had a considerable investment backlog, including both a large portion of urban areas not connected to piped WSS systems, and most of its rural towns and villages without any WSS network infrastructure. Reducing this access gap is, and for many years will be, a major challenge for the country, especially in a context of outmigration and sharp population decline in rural areas.

The WSS access gap is also largely a poverty issue, especially in rural areas. The gap is higher in rural areas (where poverty is concentrated), as well as marginal urban areas, and tends to be higher in regions and counties with higher poverty level. In 2015, piped water coverage in rural areas stood at only 29 percent nationwide, against 94 percent in urban areas. The much higher rates of poverty in rural areas take a special significance, since Romania has the largest proportion of rural population (46 percent) amongst EU countries. There are also discrepancies in WSS access between Roma and non-Roma, mostly in urban marginal areas (with special challenges there due to issues of land use, property titles, and the rule of law more generally).

Because of the recent WSS tariff increases, affordability is now becoming a concern for poor families. Large WSS tariff increases took place over the past decade, so as to ensure that sufficient funds were available to co-finance and operate the infrastructure needed for service provision and compliance—and are expected to continue. It appears that by 2016 the average WSS tariff nationwide had already reached 2.9 percent of average household's income and exceeded 5 percent of household income for poor households.

3. Zooming In: Water Resources Management under Risks

Water Resources Availability: Romania Is Almost a Water-Stressed Country

Romania is close to being a water-stressed[2] country. With a per capita annual water availability of 1,930 m^3 (utilizable), just above the 1,700 m^3 threshold for water stress, Romania is one of the most water-stressed countries in Europe on a per capita basis, which underlines the importance of sustainable water management. More than half of the utilizable freshwater resources come from the Danube, making the country highly dependent on water flowing from upstream countries. Furthermore, **there are major discrepancies in water availability between river basins.** Out of 11 river basins, five fall under the threshold for water stress, and two (*Arges-Verdea* and *Dobrogea*) are below water scarcity threshold (1,000 m^3), while another one (*Buzau-Ialomita*) is close to water scarcity. The Danube river plays a key role in some rivers basins (in the southeast), but its use is restricted by both topographic conditions and international agreements.

The overall water consumption has fallen drastically since the 1990s—down from 20.4 (close to the current level of utilizable resources) to 6.5 BCM per year for all uses (irrigation, industry and domestic)—being by far **the largest drop in water abstraction over that period amongst**

EU-13 countries. This was the result of structural reforms of the past three decades, which affected all aspects of water management, though the highest drop occurred in irrigation, with an eightfold reduction.

Until now, this drastic drop in demand has provided a buffer for water resources management giving the country—from a quantitative point of view—a false sense of water security that will be challenged by climate change.

Climate Change Is Expected to Have a Major Impact on Water Resources and Management in Romania

Among the Danube basin countries, Romania is expected to be the one most affected by climate change overall. Climate change is expected to significantly increase the frequency and magnitude of floods, including flash floods, and droughts. This will be especially the case in the southeast, which has the highest concentration of arable lands and irrigation infrastructure in the country. A semi-arid climate will gradually be established here over the next two to three decades.

Climate change will put further strain on chronically underfunded water resources management by requiring *inter alia* major investments in dams' storage and flood protection in order to increase storage for droughts and improve protection from flooding downstream. National Administration "Romanian Waters" (ANAR) has been suffering from a series of institutional and financial weaknesses—including insufficient revenues from bulk water tariffs—which hinder adequate maintenance of hydraulic assets. In addition, the government has not allocated sufficient funds to cope with the large investment needs.

Romania Is One of the European Countries Most at Risk of Floods

Floods cost on average 140 million euros per year to the Romanian economy. The country is ranked in the EU just after Poland, the Slovak Republic and the Czech Republic in terms of floods risks. Annual floods in different parts of the country over the 2002-13 period are estimated to have incurred economic losses of more than 6.3 billion euros (with the two catastrophic floods in 2005 and 2010 causing more than a 100 deaths and total economic losses of 2.4 billion euros). The average annual cost of floods has been estimated at 150 million euros for the 2000-15 period. In seven (out of the total of 42) Romanian counties the average annual economic losses due to floods exceed 4 percent of local GDP.

The current flood protection infrastructure in Romania suffers from maintenance backlog. While a considerable flood protection system had been developed, it is not fully functional due to lack of resources for proper operation and maintenance (O&M) over the past two decades. ANAR, the national water agency responsible for the operational management of water resources nationwide, is affected by several institutional shortcomings, including lack of predictable funding for both O&M and investment, as well as land use issues, which all together prevent it from properly managing flood risks.

The main requirements for flood protection investments duly identified under the Flood Directive amount to 3.7 billion euros. However, the requirements under this Directive are limited to risk assessment and submitting the Flood Risks Management Plans (FRMPs) to the EC—and there is no obligation to report on executing these plans and carrying out identified investments.

Major Investments in Dams Are Needed for Safety, Storage Capacity and Retrofitting

Many Romanian dams are structurally unsafe, and have to be operated well below their original design level to ensure safety of populations downstream. Built between 1970 and 1990, these dams have seriously deteriorated due to lack of proper maintenance and rehabilitation. Many of these dams also do not implement proper environmental flows as required by the WFD—a situation worsened by the private development of micro hydropower plants, which were often installed in protected habitats, leading to an infringement case initiated by the EC in 2015 under the Habitat Directive.

Major investments are needed for dam safety, to rehabilitate deteriorated dams and ensure that they can be operated safely at their original design capacity. There are also dams whose construction was stopped in the 1990s and that remain uncompleted. Although Romania still has a large untapped potential for increasing its total water storage, rehabilitation and completion of these dams appears the least costly solution, compared to building new dams, for increasing total water storage capacity.

Dam rehabilitation would need to be carried out in parallel with retrofitting, so as to adapt to new demands and legislation. The demographics and economics of Romania have changed considerably since these dams were designed and built about half a century ago. The water demand patterns have shifted swiftly after the 1990s structural reforms. Climate change is also modifying the hydrological regimes. Finally, new regulatory requirements, such as compliance with environmental flows, are in place under the EU legislation. Any investment into old dams should therefore carefully review and revise their operational modes to adapt them to new multipurpose uses.

4. Zooming In: Water Supply and Sanitation Reforms

Compliance Has Driven WSS Utilities Reforms, with Emphasis on Regionalization

Commercialization and regionalization of WSS services have been the backbone of the reforms of the past decade. Poorly performing and highly fragmented municipal operators have been replaced by 43 regional public operators and two large private operators which provide piped water service to 11 million people, or more than 70 percent of the connected population. This was achieved by putting in place a new institutional framework in which municipalities delegated WSS services to new public Regional Operating Companies (ROCs). The municipalities supervise their performance through Intercommunity Development Associations (IDAs). Tariff levels were gradually raised to now cover full O&M costs plus some capex. There is no question that a lot has been achieved in reforming WSS utilities in Romania over the past decade.

However, the regionalization is still largely incomplete with large utilities serving only about 55 percent of the total population. About 1.6 million people are still served by local municipal utilities, and close to 7 million people (2015) are not connected to centralized piped water networks and rely on self-supply (typically from private wells)—with many having to fetch water from outside of the house premises. To incentivize municipalities, access to EU grant funds for capex was made conditional on joining a ROC. Yet, many municipal authorities have been resisting joining an IDA, and a significant portion of those who did so had as of 2016 not yet delegated their WSS services to a ROC. There are also cases of municipalities joining a ROC and withdrawing from it afterwards. Concerns over high tariffs and local political considerations seem to be key reasons behind the resistance to regionalization.

Many public regional utilities created a decade ago are now achieving reasonably satisfactory performance—but there is scope for operational improvement. Tariff levels have increased significantly, and many ROCs now fully cover their O&M costs, generate some financial surplus from cash-flow, and have been able to access commercial (non-sovereign) financing to co-finance EU grants for infrastructure investments. Yet, many still show weak operational and financial performance with high water losses (the national average level for Non-Revenue Water (NRW) stands at about 50 percent) and relatively low labor productivity. Although a national regulator has been in place for more than a decade, much remains to be done to enhance the regulatory framework with proper benchmarking and appropriate performance incentives.

The limited progress on closing the potable water access gap, as well as on compliance with the UWWTD in small agglomerations in rural areas, can be at least partly linked to the difficulties of the regionalization process. Paradoxically, while the rationale for the regionalization reform was to facilitate expanding access in rural areas—lowering the costs through scale economies, and addressing local capacity shortages—the current model is having the opposite effect. **The push to establish creditworthy public utilities has resulted in reducing the incentives for them to expand in poor and rural areas,** because doing so reduces their operational performance and financial viability, especially in the overall context of demographic decline and outmigration. At the current pace of growth of the coverage with piped water services, Romania would be able to achieve universal access between 2040 and 2050 only—and whether this is an acceptable deadline for an EU country is open to question.

Regionalization and expanding access in rural areas face additional challenges which were highlighted by a parallel household survey carried out by the WB (Danube Water Program) on the WSS access gap in rural areas in the Danube countries in 2016-17. Rural areas in Romania have a high concentration of poverty, and many rural households did not want to connect to newly installed piped water and sewerage systems mainly due to additional recurrent costs represented by a WSS bill. There is also a mismatch between the compliance requirements under the UWWTD—which is about ensuring environmentally safe disposal of domestic sewage through connection to a sewerage network (or appropriate individual sanitation)—and what many households want, namely to upgrade from pit latrines to flush toilets. The study also showed that rural customers tend to feel that they receive less customer attention from ROCs than from municipal operators.

The regulatory methodology to ensure WSS tariffs affordability for the poor should be revised. Currently, the national regulator ANRSC applies a regulatory pricing rule that limits WSS tariff levels to 2.5 percent of an average household's income. This rule, although simple, is inherently flawed since it focuses on affordability for middle-income families, and does not take into consideration the income level of the poorer families. This is especially so in a country like Romania that has considerable social disparities. The reason this has not yet been a major social problem is that most of the poor do not have access to piped water (and therefore do not receive a bill), and also because tariffs in poorer rural areas served by municipal operators tend to be lower than those in areas served by the regional utilities. Nonetheless, tariff affordability is one of the key reasons why many households connect to newly installed WSS networks.

5. Zooming In: Water for Irrigation

The Legacy of Large Irrigation Infrastructure Has Only Been Partly Dealt With

Romania has a major **legacy of large irrigation infrastructure built before the 1990s.** With about 3 million hectares, it possesses the largest irrigation-equipped area in Central and Eastern Europe that is concentrated in the Lower Danube in the southeast of the country. Several decades ago, it used to be ranked third amongst all European countries—just behind Spain and Italy—for its irrigated surface. Irrigation has always played an important role in Romanian agriculture due to the significant year-to-year rainfall variability, as well as the wide disparity in water endowment between river basins. However, most of this infrastructure has been largely abandoned following the market-oriented reforms implemented over the past two decades, and only less than 10 percent of the previously equipped irrigation area is being used by farmers.

The economics of irrigated agriculture changed drastically after Romania switched to a market economy. The dismantlement of large state farms resulted in a myriad of small privately-owned farms, with many of the new farmers having little financial and technical capacity and focusing on subsistence farming. The subsequent **move to full cost recovery for irrigation tariffs** proved successful in some areas, but also left many irrigation perimeters being virtually abandoned, with no demand from farmers as many perimeters relied on extensive pumping to convey water to higher elevations. As a consequence, the national irrigation agency (ANIF) is now concentrating on a limited number of irrigation schemes for which revenues could cover O&M costs—with the rest of the irrigation infrastructure being abandoned and deteriorating.

While **there is no exit strategy for the many irrigation perimeters that are deemed economically non-viable**, there is also a **large number of economically viable perimeters that are under-utilized** because they have been in need of major rehabilitation for many years. At least **about a third of the existing irrigation perimeters are economically viable** (or could become economically viable with proper support given to farmers). This represents a **major loss in economic development potential for poor rural areas**. Climate change is also expected to increase the need for irrigation in some parts of the country, especially in the lower Danube, further justifying the rehabilitation of some perimeters.

Overall, it has been estimated that as many as 820,000 hectares were economically viable, and in need of major rehabilitation, for a total investment cost of about 1 billion euros. This 2013 figure was revised in 2016 by MARD to 1.9 million hectares with the same budget, thus raising questions about appropriate costing and the need for better prioritization. No exit strategy has yet been outlined for the many irrigation perimeters that are considered economically nonviable. As Romanian agriculture seeks to move towards higher value crops, and climate change impacts strengthen, improved access to reliable irrigation services may become important again.

6. Looking Forward: Is Romania Ready for the Water Challenges Ahead?

Romania Is Facing Many Challenges to Achieve Compliance, Inclusion and Water Security

Although challenges for compliance, inclusion and water security are prevalent all across Romania, **there are several hotspots where the challenges are particularly acute: in the lower Danube, in the river basins of *Arges-Vedea* and *Buzau-Ialomita*, and the north of the** *Prut-Barlad* **basin** (border with Moldova). They combine high poverty, high proportion of rural population, low WSS access rate, low compliance with the UWWTD, high climate change impact, high drought risk, high flood risk, and overall water scarcity. Other localized hotspots exist in the *Somes-Tisa, Siret* and *Banat* basins.

Money is a major constraint for a country like Romania: **the overall financial gap for compliance, inclusion and water security is huge, but not known**. The remaining cost of overall compliance with EU water legislation has been estimated at 29 billion euros in the second RBMPs (submitted in 2016). The overall investment required to achieve inclusion and water security (dams, floods, irrigation, climate change) is not known, but totals many billions of euros. For investments already identified (WSS, floods), the allocated EU grant funds up to 2020 fall well below the needs. Only about 6 billion euros has been allocated for WSS investments (Large Infrastructure Operational Program [LIOP] and National Program for Local Development [PNDL]), and 246 million euros for flood protection (LIOP).

The second major constraint is widespread institutional weaknesses that still affect many Romanian water players. Despite the considerable capacity building efforts that have taken place over the past two decades as part of the sector reforms to catch up with more advanced EU countries, much remains to be done. This is reflected in the slow rate of absorption of EU funds, slow decision-making processes at the political level, and slow preparation and execution of investment projects. This is also reflected in the performance gap that still exists between Romanian WSS utilities and those in more advanced countries.

Transversal economic and demographic challenges constitute the third major constraint to the development of the Romanian water sector. The demographic decline and outmigration phenomenon in rural areas makes it difficult to carry out efficient planning for centralized water supply and sewerage systems beyond the short term. The widespread presence of urban slums, in almost all urban agglomerations across the country is a major hindrance to achieving universal WSS access and UWWTD compliance in urban areas.

Despite all these challenges, Romania has no choice but to move towards compliance, inclusion and water security—because **the cost of inaction would be considerable**. This would include not only major financial penalties for non-compliance with the UWWTD but also lost economic development and job creation opportunities in poor rural areas following rehabilitation of viable irrigation perimeters, the impact which poor WSS services has on rural out-migration, continuing high economic losses due to floods, and deterioration of assets (dams, irrigation), which will be key to handling the impact of climate change. There is already an increase in the number and magnitude of floods and droughts, and water stress and scarcity are beginning to be felt in some parts of the country.

There Is a Lack of Vision on How to Pursue WSS Reforms and Ensure UWWTD Compliance

There is currently no strategy on how to close the WSS financial gap (both for capex and opex), which in turn makes the dual goal of achieving compliance and inclusion elusive. This is especially worrisome as the Romanian WSS sector remains heavily dependent on EU grant funding, despite significant tariff increases that took place in recent years. Cohesion funds are expected to be reduced after 2020, while massive investments (water for inclusion and sewerage for compliance) are still needed for at least a decade. There are no plans for dealing with a future shortage of EU funds for WSS services.

The current WSS services delivery model ought to be revisited so as to improve inclusion, while at the same time safeguarding the valuable achievements in commercialization of public utilities. The lack of incentives for regional operators to expand into poor areas must be addressed, possibly by combining commercial financing with budget transfers to compensate for the financial shortfalls, so that expansion does not affect the creditworthiness of utilities. At the same time, the regulator should put more emphasis on pushing utilities to improve their efficiency, so as to reduce the need for future tariff increases.

Closing the piped water access gap should become a matter of national priority for Romania—both because this is a serious public health issue, and because it reflects poorly on the good standing of Romania as an EU country (the current access rate is lower than in many developing countries of Latin America and North Africa). It is also a crucial issue of inclusion, as the most affected by far are poor families and lagging regions. Furthermore, the new revision of the DWD may introduce obligations for member states on universal access—and transform the piped water access gap into a compliance issue.

Compliance with the UWWTD will be extremely challenging and is likely to take at least another decade. While Romania has proposed to the EC a revised deadline for final compliance in 2027—nine years after the legal deadline—this is still ambitious and would require major efforts and political commitments. There is currently no strategy for compliance in smaller agglomerations (below 10,000 PE) in which the sewerage infrastructure is mostly undeveloped and which pose special challenges (total pollution load of 5.1 million PE). As for large agglomerations (total pollution load of 14.8 million PE), even though the overall development of sewerage infrastructure appears broadly on track, the resistance of many households to connect to newly installed sewerage networks, as well as the specific challenges of urban marginalized neighborhoods, may jeopardize achieving legal compliance in large urban areas over the next five years.

The fact that achieving WSS compliance and inclusion go hand-in-hand should be acknowledged: providing access to piped water is an integral part of the UWWTD compliance effort in rural areas. It does not make sense to connect households to sewerage networks without connecting them to piped water. WSS tariff levels are a major cause of resistance to connecting for households and to joining regional utilities for mayors. This affects both compliance and inclusion—and the resistance will continue until a social WSS tariff targeted at poor families has been put in place. Another impediment to achieving WSS compliance and inclusion is the delicate issue of urban marginalized areas (slums), where promoting access to WSS services must be carried out in parallel with urban revitalization programs. To deal with these challenges—which are unique among EU-13 countries—applying the lessons learned from other countries, such as Portugal for UWWTD compliance and closing the piped water access gap, and Brazil or Colombia for dealing with WSS access in urban slums through revitalization programs, would be beneficial.

Also, as it is unlikely that universal piped water access could be achieved over the next decade, **Romania needs to define a strategy to ensure access to safe potable water for those households that will still rely on self-supply from private wells in the medium term.** Romania is not on track for complying with Target Six under the Sustainable Development Goals (SDGs), which requires that access to both safe and affordable drinking water and adequate sanitation for all be achieved by 2030. Currently **about 12 percent of the population are reported to rely on unsafe and non-potable water sources** (JMP[3]). Even though fecal contamination of shallow wells is expected to fall once UWWTD compliance is achieved, this will not be sufficient. A dedicated strategy is needed on how to ensure safe drinking water for those households in rural areas which, for many years to come, will still not be served by the large WSS utilities.

Finally, **the current WSS tariff levels and structure raise serious equity issues**. **The introduction of a social water tariff targeted at the poor** is becoming urgent, as poor families served by regional public utilities are likely to already be paying more than 5 percent of their disposable income for WSS services. The experience of other EU countries that have introduced such social water tariffs in recent years—Belgium (Flanders), Spain, Portugal, Italy, England, Malta, France and Greece—could be of much value. **Cancelation of the VAT rebate for piped water** (9 instead of the standard 19 percent) should be considered, since this subsidy essentially benefits the rich and the middle class, and fails to reach the majority of the poor families (with only 63 percent of the population connected to piped water networks).

The corresponding proceeds could then be directed towards financing the proposed social water tariff for the poor.

The Management of Hydraulic Assets—Dams, Floods Infrastructure and Irrigation—Needs Rethinking

As already mentioned, **Romania is expected to be seriously affected by climate change, which will increase water resources risks due to more floods and droughts**. This means that Romania will need to: (a) invest even more in flood protection starting with what is currently identified under the FRMPs, (b) increase its total dam storage capacity to mitigate the impact of both floods and droughts, and (c) rethink the need for irrigation services in the most affected areas. The challenges raised by these major endeavors provide a unique opportunity for the country to rethink how it manages its large water resources infrastructure.

Given the high flood risks and high level of average economic losses, **implementing the 3.7 billion euros of flood management investments under the FRMPs should be viewed as a "no-regret" investment**—even though this is not a legal obligation under the Floods Directive. However, since less than 10 percent of this amount has been earmarked for funding by EU grants until 2020, additional sources of funding must be identified.

ANAR, the operational arm of water management in Romania, requires strengthening and modernization to enable sustainable management of water resources and infrastructure. Bulk water tariffs have not been adjusted since 2010: they are too low to cover the full costs of O&M, and well below those in other EU countries (except Bulgaria). Long term asset management and prioritization is made difficult by the uncertainties of the annual budget process. Institutional shortcomings, such as land uses and institutional coordination for floods protection, should also be addressed.

While rehabilitation or completion of many existing dams should be the lowest cost option for increasing the overall water storage capacity, the total cost of such an investment is unknown and there is no timetable for implementation. These investments should be considered in parallel with **opportunities to re-operationalize** (retrofit) these old dams to new multi-purpose uses, beyond their original design, so as to adjust to new needs. This should include adapting to new demand patterns, new hydrological regimes (with climate change) and new regulatory requirements (environmental flows). Unless retrofitting is made an integral part of these rehabilitation works, there are risks that valuable opportunities to further leverage economic development and water security could be lost.

While Romania has the largest installed irrigation infrastructure of all Central and Eastern European countries, **there is a lack of strategic vision for irrigation at the national level.** Such irrigation strategy should address the key role of irrigation for fostering high value crops, especially in a context of climate change with increasing drought risks and the establishment of a semi-arid climate in the arable lands of the lower Danube. It should combine rehabilitation of the most viable existing perimeters with the promotion of irrigation efficient technologies at farmers' level, with an exit strategy for the many non-viable irrigation perimeters.

There Exist Several Untapped Opportunities for Enhancing the Development of the Water Sector

Water tourism could offer a valuable opportunity to benefit from the good ecological status of many Romanian rivers—especially the pristine rivers of Transylvania—by promoting sustainable development projects in remote poor rural areas. Other Central European countries, such as Slovenia and Croatia, have successfully developed fishing tourism with sustainable fisheries management on their most beautiful mountain rivers. This would be an attractive way to monetize the good ecological status of Romanian rivers (WFD) for the benefit of local populations. Tourism in the Danube Delta is also an important local economic activity, which would benefit from any improvement in the overall water quality of the Danube.

A significant portion of the hydropower potential of Romania is still untapped. Currently, between 25 and 30 percent of the country's power generation comes from hydropower. Yet, the total installed capacity (6,400 MW) has been reported to represent only 18 percent of the total (theoretical) hydropower potential. However, further development would have to be aligned with the requirements of the WFD regarding hydro-morphological alterations of surface water bodies, as well as the Habitat Directive. It would require that Romania *inter alia* improves its framework for **implementing environmental flows** so that hydropower can be further developed in an environmentally sustainable manner.

Despite all the difficulties and efforts required, EU compliance should not be viewed solely as a legal obligation—as it also brings many opportunities for the development of a greener economy. Implementing the UWWTD should create opportunities for economic, human and environmental development, especially in poor rural areas and lagging regions. The many opportunities include the massive sewerage construction works for compliance with the UWWTD and subsequent O&M (Wastewater Treatment Plants require skilled labor), developing a local industry for sludge management of individual sanitation systems, biogas generation and wastewater reuse in agriculture. Finally, **the job creation potential due to the huge civil works backlog for water management infrastructure is considerable**—with billions of euros that will need to be invested over the next two decades. This includes large scale rehabilitation of water distribution networks for leakage reduction, and massive construction and rehabilitation work for irrigation perimeters, floods protection and dams.

7. What To Do Next

Prioritization Is Needed to Deal with Financial and Institutional Gaps

Because of the magnitude of the tasks at hand, **it is crucial for the Romanian Government to engage in a prioritization exercise for investments** across all the spectrum of water management. It would be unrealistic to expect that Romania would be able to fund such a huge investment backlog over the next decade, especially in the context of potentially declining EU cohesion funds. It would be equally unrealistic to expect that such massive investments could be properly executed in less than a decade, even if the required funds were available. Capex prioritization should be based on a sound cost-benefit analysis (considering the triple goals of compliance, inclusion and water security) and take a realistic view of the implementation capacity of both public executing agencies and the Romanian construction industry—so as to ensure proper absorption of capex funding and avoid losing scarce EU grants.

In parallel with this prioritization exercise, **wide-ranging actions should be taken to gradually close existing financial and institutional gaps**. The modernization of the financial framework in the sub-sectors of water management should continue, the system has to move towards O&M and investment costs recovery through tariffs and applying the "polluter pays principle"; and in order for Romania to benefit from past experiences and lessons learned in other EU countries, peer-to-peer exchanges on specific priority topics should be encouraged.

It must be fully recognized that prioritizing in the face of the manifold challenges facing the Romanian water sector is a difficult exercise. It shall certainly involve difficult political decisions and trade-offs. While making these decisions is strictly the remit of the Romanian Government, this report suggests to focus on **four thematic priorities to accelerate Romania's pace towards compliance, inclusion and water security**: (1) **achieve UWWTD compliance by 2027**, (2) **revisit the WSS reform** to ensure sustainable services for all, (3) **rethink the management of hydraulic assets** (dams, flood protection, irrigation) to adapt them to changing demand and needs, and (4) better use the leverage of the water sector for **green growth**.

A **series of 16 practical actions** for the short term identified within these four thematic priorities are hereby submitted for the consideration by the Romanian Government. The following table ES.1 summarizes proposed actions and identifies the main institutional player(s) that would be in charge of direct implementation.

TABLE ES.1. Thematic Priorities and Practical Actions

Thematic priority 1: Achieve UWWTD compliance by 2027	
MWF	1. Updated Implementation Plan (IP) based on field inventory;
MWF (with MRDPAEF)	2. Database for reporting progress to the EC every 6 months;
	3. Strategy for UWWTD compliance in rural agglomerations;
Thematic Priority 2: Revisit WSS reform to ensure sustainable access for all	
MRDPAEF	4. Review feasibility of WSS social tariff (with PSIA study);
MRDPAEF & MOF	5. Launch a national program for commercial NRW reduction;
MWF & MoH	6. Develop a new national WSS utilities strategy involving all actors;
	7. Consider dropping the VAT rebate for potable water and re-allocating proceeds for funding capex based on social-equity goals (territorial solidarity) or financing a new social water tariff for the poor;
	8. Develop a framework for ensuring monitoring and access to safe drinking water for self-supplied households in rural areas;

table continues next page

TABLE ES.1. continued

Thematic Priority 3: Ensure sustainable management of hydraulic assets under changing conditions	
MWF and ANAR	9. Institutional and financial diagnostic of ANAR;
MARD	10. Introduction of a new floods protection charge to accelerate the implementation of flood protection investments under the FRMPs;
	11. Inventory of dams in need of rehabilitation and retrofitting;
	12. Prepare a pilot integrated water security program in one water security hotspot (at basin or county level);
	13. Prioritization of irrigation perimeters rehabilitation investments;
Thematic priority 4: Leverage water sector development for green growth	
MWF and MARD	14. Pilot for wastewater reuse in one water scarce area;
MWF	15. Local development pilot on river water tourism (no-kill fishing zone);
ANAR & Hidroelectrica	16. Develop an enhanced framework for environmental flows.

Source: World Bank elaboration.
Note: ANAR = National Administration "Romanian Waters"; EC = European Commission; FRMP = Flood Risk Management Plans; IP = Implementation Plan; MARD = Ministry of Agriculture and Rural Development; MOF = Ministry of Finance; MRDPAEF = Ministry of Regional Development and European Funds; MWF = Ministry of Waters and Forests; NRW = Non-Revenue Water; PSIA = Poverty and Social Impact Assessment; UWWTD = Urban Waste Water Treatment Directive; VAT = Value-added Tax; WSS = Water Supply and Sanitation.

BOX ES.1. Snapshot of the Romanian Water Sector

General data and key players

Permanent population: **19.9 million—46 percent rural** (highest rate amongst EU countries).

Romania is almost entirely located in the **Danube river basin**, and covers 29 percent of its area.

Ministry of Water and Forestry (MWF) is the lead policy maker.

National water agency ANAR with about 9,500 staff and the annual turnover of 265 million euros manages water resources infrastructure nationwide.

Ministry of Regional Development, Public Administration and European Funds (MRDPAEF) leads WSS policies by administering corresponding EU cohesion funds (LIOP).

Local administrations are responsible for WSS services, with provision either delegated to regional public operators Regional Operating Companies [ROCs] and private operators, or through municipal departments (some corporatized).

ANRSC is the national WSS services regulator.

Ministry of Agriculture is in charge of irrigation, with national irrigation agency **ANIF** in charge of operation of public irrigation perimeters.

box continues next page

BOX ES.1. continued

Summary investment data (best estimates)

Capex still needed for **EU water legislation compliance: 29 billion euros** (based on 2nd River Basin Management Plans [RBMPs])

Capex for **closing the piped water access gap: 6 billion euros**

Capex for **flood risk protection: 3.6 billion euros** (FRMPs)

Capex for rehabilitation of **viable irrigation perimeters: more than 1 billion euros**

Capex for **dam rehabilitation and retrofitting**: not yet known

Only about 6.25 billion euros funded so far through EU grant funds until 2020

Water Resources

78,905 km of rivers, with the lower Danube marking the southern border with Bulgaria

11 river basins: Crisuri, Banat, Somes-Tisa, Mures, Jiu, Olt, Arges-Vedea, Siret, Buzau-Ialomita, Prut-Barlad and Dobrogea

Utilizable water resources: 38.4 billion m^3/year of which more than half comes from the Danube (20 billion m^3/year)—out of a total of 135 billion m^3/year of potential water resources

Freshwater availability: 1,930 m^3 per capita—**close to water stress** (threshold 1,700 m^3/cap)

High variability in water resources availability between river basins (5 river basins under water stress) and between years (from about 22 to 64 billion m^3 usable water)

Drastic fall in water demand/abstraction after the 1990s, from 20.4 to 6.5 billion m^3/year

Romania is **among the best performers on the Water Framework Directive (WFD) among the EU countries**:

- 66 percent of surface water bodies with good or high ecological status (but wide discrepancies between basins) against EU goal of 60 percent, and 90 percent of groundwater with good chemical status
- but poor condition of lakes and coastal waters (Danube delta is affected by upstream countries).

Romania is **amongst the EU countries most at risk of floods** (with Poland and the Czech republic)

Economic cost of floods represents about 150 million euros per year (average 2000-16)

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BOX ES.1. continued

246 large dams (half for hydropower), **many of which have to be operated below their original design level to ensure safety,** are in need of major rehabilitation work, along with retrofitting to adjust to changing demand and climate conditions, and new regulations (environmental flows)

Water Supply and Sanitation

Only 12.6 million people connected to centralized (piped) WSS services (2015)

Most of them (9 million) are supplied by **43 regional public utilities** (ROC), the rest supplied by private operators (2.1 million, including Bucharest) and about 900 local public operators (1.5 million)

Connection rate to piped potable water networks: 64 percent (**only 29 percent in rural areas,** 2015)

Rate of access to piped potable water: 77.6 percent (including piped self-supply, 2016) **4.5 million Romanians do not have access to piped potable water,** mostly in rural areas affected by outmigration, and about **half of these are relying on unsafe water sources** (12% pop.)

Connection rate to sewerage networks: 48 percent (2015)

Only 68.3 percent of the population has access to toilets in house. More than 6 million Romanian do not have access to flush toilets—mostly in rural areas (2016)

The WSS access gap makes Romania a complete outlier amongst EU countries and behind Serbia and Ukraine—raising **serious issues of inclusion for the poor** (rural areas and marginal groups)

Romania is **the worst performer amongst EU countries for UWWTD compliance.** The distance to compliance in December 2016 stood at:

- Article 3 (collection): 85 percent in large agglo. but only 17 percent in agglo. C (2,000-10,000 PE)
- Article 4 (treatment): 79 percent in large agglo. but only 15 percent in agglo. C
- Article 5 (more stringent treatment): only 45 percent of total load treated at tertiary level.

Average WSS tariff for domestic (ROCs): about 6 RON/m^3 or **1.3 euros/m^3** (without VAT, 2017)

Significant tariff increases in recent years leading to **growing concern about affordability for the poor** (average WSS bill for ROCs standing at 2.9 percent of average households' income in 2015)

box continues next page

BOX ES.1. continued

Performance of ROCs: metering 94 percent, NRW 50 percent, 6.5 staff per 1,000 connections (2016)

Many ROCs are generating an operating cash-flow surplus and are creditworthy, with a total of about **410 million euros in non-sovereign commercial debts** outstanding (37 loans, 24 with EBRD)

Irrigation

Romania has the largest irrigated area of all Central and Eastern European countries, with about **3 million hectares equipped with irrigation** (built before the 1990s)

Major structural reforms over the past two decades have led to extreme fragmentation of farms (45 percent of all EU farms are in Romania), a move towards full cost recovery tariffs (O&M), and a drastic **fall in irrigation demand** (volume of irrigation water has fallen eight fold since 1990)

Currently **less than 10 percent of the equipped irrigated area is being used** (mostly in Braila and Galati counties), while the rest of the irrigation infrastructure is abandoned and deteriorating

About a third of the total equipped irrigated area is deemed economically viable, and in need of rehabilitation—significant economic development opportunities are being lost in rural areas

For the other, non-viable, perimeters (high pumping cost, no demand) an **exit strategy** is needed

Water Security—Hotspots

Romania will be seriously affected by climate change, with increased magnitude and frequency of droughts and floods, and the establishment of a **semi-arid climate in the southeast**

A specific analysis of water security in this study combined the dimensions of poverty, WSS access, EU compliance, water scarcity, flood and drought risks, and climate change impact

3 hotspot river basins for water security: **Prut-Barlad**, **Arges-Vedea** and **Buzau-Ialomita**

Main hotspots for water security at counties level are all those **along the lower Danube—Dolj, Olt, Teleorman, Giurgiu, Ilfov and Calarasi—**as well as the counties of **Botosani, Vaslui and Susleava in the northeast** (borders with Ukraine and Moldova).

Notes

1. A billion is 1,000 million.
2. The indicator of water scarcity was developed by Malin Falkenmark and presented in his paper: Malin Falkenmark (1989) "The massive water scarcity now threatening Africa; why isn't it being addressed?," Ambio, pag. 112-18. Another paper that presents the water scarcity indicator in detail is National Technical University of Athens (2004), "Indicators and Indices for decision making in water resources management" Water Strategy Management Newsletter, Issue 4, 2004.
3. WHO/UNICEF Joint Monitoring Programme for Water Supply|| Sanitation and Hygiene (JMP).

Abbreviations

ABA	Water Basin Administration
AFDJ	Lower Danube River Administration
AMRSP	Municipal Authority for Public Services Regulation
ANAR	National Administration “Romanian Waters”
ANIF	National Agency of Land Reclamation
ANRE	National Regulatory Agency on Energy
ANRSC	National Regulatory Agency on Communal Services
ANSVSA	National Sanitary Veterinary and Food Safety Authority
ARA	The Romanian Water Association
BAU	business as usual
BCM	billion cubic meters
BOD	biochemical oxygen demand
BOT	build-operate-transfer scheme
BWD	Bathing Water Directive
CAP	Common Agricultural Policy
CEE	Central and Eastern Europe
CIS	Common Implementation Strategy
CONSIB	Romanian Commission for Safety of Dams and other Hydraulic Works
CROMB	Romanian Committee of Large Dams
CSA	State Council of Waters
CSWD	Commission Staff Working Document
DESWAT	destructive water abatement and control of water disasters
DFO	Dartmouth Flood Observatory
DG ENV	Directorate-General for Environment
DG REGIO	Directorate-General for Regional and Urban Policy
DMA	District Metering Area
DRPC	Danube River Protection Convention
DSS	decision support system
DWD	Drinking Water Directive
DWP	Danube Water Program
EAFRD	European Agricultural Fund for Rural Development
EBC	European Benchmarking Cooperation
EBITDA	earnings before interest, taxes, depreciation and amortization
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECA	Europe and Central Asia
ECB	Development Bank of the Council of Europe

EEA	European Environment Agency
EFTA	European Free Trade Association
EIB	European Investment Bank
EM-DAT	The International Disaster Database
EQS	Environment Quality Standard Directive
ETP	evapotranspiration
EU	European Union
EUR	Euro
FHRM	flood hazard and risk maps
FMP	Flood Management Plan
FPMP	Flood Protection Management Plans
FRMP	Flood Risk Management Plans
FWUA	Federation of Water Users Associations
GDP	gross domestic product
GEF	Global Environment Facility
GIS	Geographic Information System
GNP	gross national product
HBS	Household Budget Survey
HDI	Human Development Index
HQ	Headquarters
HRMEP	Hazard Risk Mitigation and Emergency Preparedness Project
IAS	Individual and/or Appropriate System
IAWD	International Association of Water Utilities of the Danube Basin
IBRD	International Bank for Reconstruction and Development
ICOLD	The International Commission On Large Dams
ICPDR	International Commission for the Protection of the Danube River
ICT	information and communication technologies
IDA	Intercommunity Development Association
IED	Industrial Emissions Directive
IFI	International Financial Institutions
INHGA	National Institute of Hydrology and Water Management
INPCP	Integrated Nutrient Pollution Control Project
IP	Implementation Plan
IPCC	Intergovernmental Panel on Climate Change
IRRP	Irrigation Rehabilitation and Reform Project
ISPA	Instrument for Structural Policies for Pre-Accession
ISRII	Investment Strategy for Rehabilitation of Irrigation Infrastructure
ISU	Inspectorate for Emergency Situations
IT	information technology
IWA	International Water Association

JASPERS	Joint Assistance to Support Projects in European Regions
JMP	Joint Monitoring Program (WHO-UNICEF)
KW	Kilowatt
LAC	Latin American and Caribbean
LHDI	Local Human Development Index
LIOP	Large Infrastructure Operational Program
LWSZ	Large Water Supply Zones
M&E	monitoring and evaluation
MARD	Ministry of Agriculture and Rural Development
MIC	Middle Income Country
MOF	Ministry of Finance
MoH	Ministry of Health
MRDF	Maintenance, Replacement and Development Fund
MRDPAEF	Ministry of Regional Development and European Funds
MUDP	Municipal Utilities Development Program
MW	Megawatt
MWF	Ministry of Waters and Forests
NES	National Energy System
NMA	National Meteorological Administration
NO3	Nitrate
NRW	Non-Revenue Water
NSI	National Statistics Institute
NVZ	Nitrate Vulnerable Zone
O&M	operations and maintenance
OECD	Organization for Economic Co-operation and Development
PBC	Performance-Based Contract
PE	population equivalent
PER	Public Expenditure Review
PFRA	Preliminary Flood Risk Assessment
PHARE	EU pre-accession instrument financed by the EU
PIU	Project Implementation Unit
PNDL	National Program for Local Development
PNDR	National Program for Rural Development
PO4	Phosphate
PPP	public-private partnership
PSIA	Poverty and Social Impact Assessment
RAIF	Autonomous Agency of Land Reclamation
RAMSAR	Ramsar Convention on Wetlands
RBMP	River Basin Management Plan
REFIT	Regulatory Fitness and Performance Program

ROC	Regional Operating Company
RON	Romanian Leu, currency of Romania
RRMB	National Registry of Large Dams
SAMTID	Small and Medium Town Infrastructure Development
SAPARD	Special Accession Program for Agriculture and Rural Development
SAU	Scheme Administrative Units
SCPA	Strategy for Consolidating Public Administration
SHP	Small hydropower plants
SIMIN	Romanian National Integrated Meteorological System
SIPRMII	Strategic Investment Program for Rehabilitation and Modernization of Irrigation Infrastructure
SOP	Sectoral Operational Program
SoS	State of the Sector
SPP	Pressure Pump Station
SRL	Limited Liability Company
SRSS	Structural Reform Support Services (EC)
SWSZ	Small Water Supply Zones
TAU	Territorial administrative units
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Program
USA	United States of America
USD	United States dollar
UWWTD	Urban Waste Water Treatment Directive
VAT	value-added tax
VSWSZ	very small water supply zones
WATMAN	Water Management Integrated System
WB	World Bank
WCD	World Commission of Dams
WFD	Water Framework Directive
WHO	World Health Organization
WHO-UNICEF	WHO-UNICEF Joint Monitoring Program
WPP	Water Partnership Program (WB)
WRM	Water Resources Management
WSS	Water Supply and Sanitation
WUA	Water Users' Association
WWTP	Wastewater Treatment Plant

Chapter 1 Introduction

1.1. Objectives of the Study

This report was prepared by the World Bank, to support its water sector dialogue with the Government of Romania. It aims to provide stakeholders with a comprehensive stock taking of the situation in the Romanian water sector in 2017, 10 years after the country joined the EU and almost three decades after the 1989 Romanian revolution. It has two objectives: (a) analyze and document the current condition of the various sub-sectors (water resources management, potable water supply and sanitation, irrigation), and (b) identify the main lessons learned from successes and failures of recent reforms and the key challenges for Romania on the path towards water security, full compliance with EU water legislation, and a sustainable and inclusive water management.

This report does not purport to present a complete and comprehensive analysis of the water sector in Romania, even though the amount of data compiled and analyzed is significant. For instance, analyzing the financial framework and flows in the water sector (as is typically done under a Public Expenditure review, Per) is beyond the scope of this report.

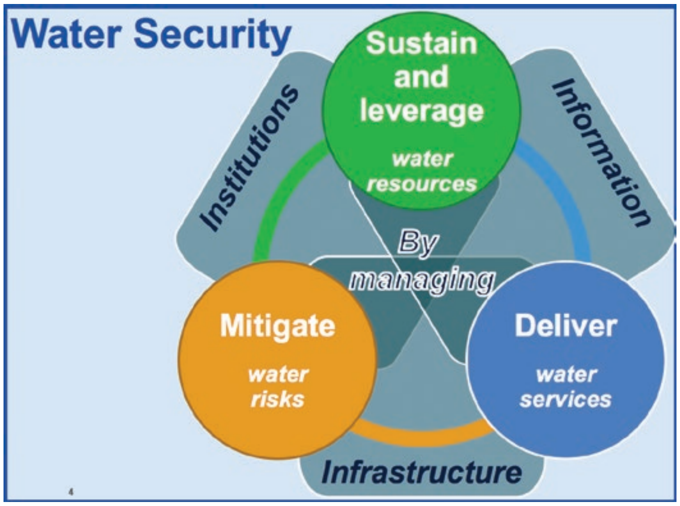
Equally important is to highlight that **this report does not provide definite answers to the many challenges facing the Romanian water sector, but rather seeks to identify key issues and raise the right public policy questions**—so as to alert the key decision-makers in the government and feed into the ongoing sector dialogue. It is also hoped that gathering and publishing in one report the information on various water sub-sectors that had previously been scattered across multiple institutions and documents shall be of value to many outside stakeholders—including the European Commission (EC), International Financial Institutions (IFIs) and NGOs—involved in supporting the development of a sustainable water sector in Romania.

1.2. Analytical Framework: Compliance, Inclusion, and Water Security

Achieving water security for a country is about combining three goals: **ensuring sustainable use of water resources to meet all needs, delivering affordable services to all, and mitigating water-related risks** in the context of changing climate, demographic and economic trends. This requires not only efficiently developed and managed water infrastructure, but also capable and properly incentivized institutions, as well as due sharing of information (including with the general public). As such, the concept of water security includes the notion that water resources must be sufficient to meet all needs, but is much broader. The concept of water security is schematized in figure 1.1 below.

The analysis in this report looks at the situation of the water sector in Romania through the three lenses of compliance with EU water legislation, **inclusion** i.e., ensuring access and affordability of water for all, and **water security**. While water security is a wider, over-arching concept (encompassing sustainable use of water resources, affordable services for all,

FIGURE 1.1. The Concept of Water Security



Source: Water security.

and mitigation of water-related risks), in the specific context of Romania it is highly dependent on the dual issue of compliance and inclusion. Compliance with the EU water legislation (as part of the harmonization with the EU "*Environmental Acquis*") has been a national priority since the country joined the EU in 2007 (being a major legal commitment under the accession treaty), and has proved very challenging. Inclusion for the poor also is a topic of unique importance, as Romania is an outlier compared to other EU countries for its large proportion of the population still without access to piped potable water and flush toilets.

Consequently, **the analysis in the report starts by focusing on the two key issues of compliance and inclusion**—taking stock of the situation of the Romanian water sector a decade after the country joined the EU. Then, after a detailed analysis of the situation in each sub-sector (water resources management, water supply and sanitation, irrigation), **a broader view of water security—not only in terms of compliance and inclusion but also broadening the discussion to encompass long-term resilience and water risks preparedness**—is taken in the concluding chapter. In practice, the various dimensions of water security are closely intermingled. EU legislation aims at sustainable water management and therefore already covers many (but not all) aspects of water security. As for inclusion, it is an integral part of water security, because a country cannot claim to have achieved water security unless all of its population, and especially the poor, have access to affordable water and sanitation services and are protected from water-related hazards.

1.3. Structure of the Report

This report is organized into 8 chapters, starting with this introductory one:

The second chapter takes stock of the current situation in the water sector in Romania, focusing on the EU compliance and inclusion issues. A brief background overview of the sector and institutional players is followed by a detailed analysis of where Romania stands in terms of compliance with the EU water legislation, which has been the over-arching priority for the country since 1999 when Romania officially became a candidate country. It also addresses the issue of inclusion by looking at the access to Water Supply and Sanitation (WSS) services, which is not explicitly covered by the EU water legislation but is a major and thorny issue for Romania.

The third, fourth, and fifth chapters present an analysis of the situation in each sub-sector of water management. The objective is to provide a detailed analysis to support the findings outlined both in the initial stock-taking chapter, and in the seventh chapter. Chapter 3 deals with water resources management under risks (floods and dams), chapter 4 with the reforms of potable water supply and sanitation services, and chapter 5 with irrigation services.

The sixth chapter provides a spatial analysis of water security by river basin, drawing on the detailed analysis (including maps) contained in the previous chapters. It looks at nine key dimensions of water to provide an analysis of water security for each of the 11 Romanian River Basins identifying the main hotspots for water security that call for specific actions and policies.

The seventh chapter takes a broader perspective on the future challenges facing the water sector in Romania for compliance, inclusion and water security. It goes beyond the scope of the first chapter by adding to compliance and inclusion the other dimensions of water security, including long-term resilience and preparedness, and institutional viability. It identifies further challenges that had not been previously analyzed, including some transversal challenges cutting across several sectors, and discusses how they could be dealt with to achieve compliance, inclusion and water security.

The eighth chapter summarizes the seven key areas upon which the government may focus in the short term, drawing on the priority policy issues identified in the seventh chapter.

Chapter 2 Taking Stock of 10 Years of EU Membership: Compliance and Inclusion

After presenting a short overview of the key players in the Romanian water sector, this chapter takes stock of the current situation of water management in Romania, 10 years after the country joined the EU. It focuses on analyzing the status of compliance with the various EU water directives (both in terms of what has been achieved and what challenges remain). This chapter also addresses the issues of inclusion, through the access gap and affordability of WSS services not currently covered under the EU water legislation but a major issue in Romania.

2.1. Overview and Institutional Framework

2.1.1. Romania and the Danube River Basin

Romania is almost entirely located (97.4 percent) in the Danube River Basin, and has 29 percent of the area and 21.7 percent of the population of the entire basin. About one third of the Danube River's length is located in Romania and is partial border with Serbia, Bulgaria and Ukraine. The Danube River Basin, with a total area of 801,463 km^2, is considered the most international river basin in the world, draining waters flowing from 19 European countries (map 2.1).

The Danube basin is not only the largest single river basin in Europe, but also the only one spawning a large number of countries—both EU member states and others (Western Balkans and Ukraine).

MAP 2.1. Danube River Basin Map

Source: ICPDR.

As Romania is entirely located in the Danube basin and at its receiving end, it is heavily influenced by water management in upstream countries. This is a peculiar situation in Europe where the majority of river basins are limited to a single country, with only a few shared between two or three countries (map 2.2). The fact that many countries in the Danube basin are not members of the EU (Serbia, portions of Bosnia, Montenegro, Ukraine and Moldova) and therefore not subject to its stringent body of water legislation, especially on pollution control and abatement, raises special challenges for Romania that, as the last country downstream in the basin, receives pollution from all other countries.

Cross-boundary cooperation supported by the International Commission for the Protection of the Danube River (ICPDR) therefore plays a crucial role in Danube water management. In this sense, water policies in Romania are influenced not only by compliance with the EU water legislation, but also by compliance with the various international agreements entered into under the ICPDR, which includes both EU and non-EU countries. This started with the Belgrade declaration on navigation in 1948, was followed by the Bucharest declaration on water quality and monitoring in 1985, the preparation of Danube environmental program

MAP 2.2. Maps of River Basins in EU Countries

Source: EEA 2012a.

BOX 2.1. The International Commission for the Protection of the Danube River

The ICPDR is an international organization established in 1998 and consisting of 14 member states and the European Union. Headquartered in Vienna, it deals not only with the Danube River itself but also with the whole Danube River Basin including its tributaries and groundwater resources. It is based on the "Convention for the Cooperation for the Protection and Sustainable Use of the Danube River"—generally referred to as a the "Danube River Protection Convention" (DRPC)—that was signed in Sofia in 1994 by Germany, the Czech Republic, Austria, the Slovak Republic, Hungary, Slovenia, Croatia, Serbia, Montenegro, Bosnia-Herzegovina, Bulgaria, Romania, Moldova, Ukraine, and the European Union. Its role is to offer a neutral forum for member states to coordinate the implementation of their respective national water policies under the DRPC, and a platform to review progresses made; it is financed by contributions from all member states. It is governed by a permanent secretariat supported by several expert groups, with two meetings of its governing body annually.

(EPDRB) in 1991, the Strategic Action Plan (SAP) for the Danube in 1994, and the convention for sustainable water use approved in 1993 and ratified in 1998-culminating with the Danube River Management Plan that was approved in 2009. Implementation of water policies within the Danube River Basin is coordinated under the ICPDR (box 2.1).

Romania is still largely a rural country, with 46 percent of the population living in rural areas (the highest proportion amongst all EU countries)—and this has a significant impact on water management. It has a total area of 238,391 km^2 and a total population of 22.3 million inhabitants of whom only **19.9 million are permanent residents**[1] (NSI data as of 2012 census). The administrative structure consists of around 2,861 local authorities (communes) with an average population of around 3,000 people. As many as 12,373 villages exist in rural areas, 92 percent of which have less than 1,000 inhabitants, underlining the low density and scattered pattern of rural settlements. At the regional level, the country is organized into 42 counties, as shown in map 2.3.

2.1.2. Ministry of Water and Forestry and ANAR

The current institutional setup in the water sector includes a wide range of public and private actors with the **central role held by the Ministry of Water and Forests (MWF), which is the policy maker in charge of strategic planning on water resources management**. This includes hydrology, flood protection of population, economic activities and environment, and conservation of aquatic ecosystems. MWF is also in charge of mobilizing funds and managing investment programs to improve the quality of water bodies, the safety of hydraulic infrastructure in the river basins, and managing emergency situations occurring within the river basins. The MWF is also the line ministry responsible for compliance with all EU water legislation; it represents Romania in relations with the European Union institutions on all water management related matters.

MAP 2.3. Topographic Map of Romania with County Boundaries

Source: ARA.
Note: In brown: Carpathian Mountains.

MWF is supported by the National Administration "Romanian Waters" (ANAR), the public agency that is the technical and operational arm for the management of water resources infrastructure nationwide (with the exception of dams dedicated to hydropower generation). ANAR[2] operates as a semi-autonomous administration (public institution of national interest) under the MWF. The administration is organized into a total of 11 River Basin Administrations (ABAs) with their Main Offices located in a key city in the respective river basin, headquarters with central services, and the National Institute of Hydrology and Water Management (INHGA). ANAR is in charge of the management of water resources, surface and groundwater protection from depletion and degradation, as well as rational and balanced distribution of these resources. ANAR is also in charge of nationwide quantitative and qualitative monitoring of all water abstraction and restitution of waste water in natural water bodies.

The Water Law #107/1996 (with subsequent amendments) is the core legislation that regulates the water sector in Romania, including provisions concerning the quantitative and qualitative management of all surface and subsurface water resources. It follows the general principles defined in the previous Water Law #8/1974 that was enacted after the catastrophic 1970 floods. The Water Law includes provisions concerning protection of population and socio-economic activities against harmful effects of waters through structural and non-structural interventions, monitoring of water resources and condition of hydraulic infrastructure to secure its safe operation and regular maintenance, planning of water management activities, financial arrangements for sustainable functioning on sound economic grounds, as well as the system of control and sanctions for breaching its provisions. The Water Law is complemented by a package of secondary legislation including the implementation norms, regulatory acts, and technical norms to streamline its implementation.

Romania has a long-established tradition of managing its water resources by river basin (box 2.2) and has recovered (part of) the associated costs from the users through fees.

BOX 2.2. Romania Has Almost a Century of River Basin Management Experience

The evolution of water management in Romania was influenced by the hydrologic regime of water resources, with great variability in time and space. While ever since the XVIII century dykes and temporary reservoirs have been constructed in response to floods, at the end of the XIX century the first water law established public ownership of main rivers. The first law on water management was enacted in 1924 and was followed by the creation of river basin authorities. River basins were identified in 195,556. Romania has a long history of flood risk, and the first attempts at issuing flood risk management plans (FRMPs) go back to early 1930s, but the first operational plans at country level were issued in 1950s.

The first consolidated institution for water management at country level was the State Council of Waters (CSA) established in 1956, which took over the responsibilities of the General Directorate for Hydro-meteorology from the Ministry of Naval and Aerial Transport. Then, in 1959 CSA was assigned more important tasks with respect to planning and construction. In 1967 CSA was dismantled and its responsibilities were transferred to the Land Reclamation Department of the Ministry of Agriculture, Water and Forests until 1971.

The national water authority was reinstated in 1971, after the big floods of 1970, under the National Council of Waters (CNA). After the establishment of CNA, planning, design, investment, management, operation and maintenance of water infrastructure became more coherent and guided by clearer objectives. The 1970 floods also led to an overall evaluation of the country's situation and issuing of the Water Law no. 8/1974. Between the years of 1971 and 1975, when many new dams, reservoirs, and dykes were created, a special attention was given to the improvement of flood protection along the main rivers located in central regions of the country. After 1975 came more complex water management projects and programs to improve the multipurpose use of water resources and water quality management for all main river basins in the country, within the framework of the long term national program for river basin development approved in 1976.

The CNA was replaced in 1990 by the Ministry of Environment that included a separate department for water management, which was subject to further changes until 2017 when the Ministry of Waters and Forests was separated from the Ministry of Environment. River basin directorates were consolidated under ANAR in 1993.

The first organization of water management by river basin was established in 1925 following the adoption of the "Law on Water Regime" in 1924, and has continued under various forms ever since—providing Romania with almost a century of experience of river basin management. Water management authorities operated either under the coordination of or subordinated to a central authority of water management (preceding the current ANAR), with full or limited legal liability. In spite of the administrative changes, the concept of river basin management has been preserved, resulting in a consistent approach to the development and management of hydraulic infrastructure. This arrangement proved valuable for implementing the Water Framework Directive (WFD), which mandates that water resources be managed by basin and that costs be recovered.

The INHGA is part of ANAR **structure** as the sole national specialized institute in the field of hydrology, hydrogeology and water management, set up in 2002 following the split of the National Institute of Meteorology and Hydrology and the establishment of the National Administration of Meteorology. INHGA is charged with technical studies and research to justify water management master plans for implementing national strategy for sustainable development of water resources and flood risk management. It also makes hydrological forecasts (including on floods) for national and cross-border benefit, in accordance with Romania's international agreements. INHGA safeguards a considerable amount of hydrological data on Romanian surface bodies, collected over eight decades.

2.1.3. Other Players in the Romanian Water Sector

The Ministry of Regional Development, Public Administration and European Funds (MRDPAEF) is a new ministry that resulted from the merger of the former Ministry of Regional Development and Public Administration with the Ministry of European Funds in January 2017. Through the merger, this ministry consolidated the management and financing of two large investment programs for the development of water and sanitation infrastructure: Large Infrastructure Operational Program—LIOP (financed from the national budget and EU funds) and National Program for Local Development—PNDL (financed from the national budget).

MRDPAEF has a leading role in the Water Supply and Sanitation (WSS) utilities sector through allocation of EU funding, with criteria driven by WSS reforms. In principle, while LIOP is considered the leading program to support Romania meeting the requirements of the EU directives on drinking water and urban wastewater treatment, PNDL provides additional funds for achieving compliance with the two directives. While LIOP has allocated about 2.4 billion euros for investments in wastewater collection and treatment, PNDL has allocated lei 8.61 billion (equivalent of 1.89 billion euros) for water supply, sewerage and wastewater treatment facilities in 2015-19, which represents, however, 29 percent of total program funds. The majority of PNDL funds allocated for WSS projects (94 percent) are targeted at rural areas.

WSS services are provided by a mix of 43 large regional public operators, 2 large private operators under mixed-ownership companies, and approximately 900 small local operators. The small operators are mostly municipal departments that are not ring-fenced from the other municipal services (and are referred to as "Communal operators") but they also include a number of corporatized enterprises under limited liability structure, the so-called "SRL-operators." Public regional operators (ROCs) serve by far the largest portion of the population connected to piped WSS services—9 million out of 12.6 million people (6.9 million out of 9.5 million for sewerage collection networks). Private operators serve about 2.1 million people—with 2 million people in Bucharest and Ploiesti served by an international operator, and about 0.1 million served by small local private operators elsewhere. Small municipal public operators serve about 1.5 million people.

The Intercommunity Development Associations (IDAs) regroup the local authorities who have delegated their WSS services to a regional public operator. There are 43 of them and they were established a decade ago, as one of the pillars of the regionalization reform. Their role is to supervise ROCs' performance under the delegated services contracts, as well as approve the Regional Development Plans, which are proposed by ROCs and include *inter alia* investment and tariff policies (ultimately approved by the national regulator).

The National Regulatory Agency for Community Public Utility Services (ANRSC) is the national water and sanitation services regulator. It is a public institution under the authority of MRDPAEF regulated by the Law of Community Services of Public Utility (#51/2006). It operates through a central office in Bucharest and seven regional offices (table 2.1). ANRSC has national regulatory, monitoring and control authority for all suppliers of public utility services at community level and all economic operators and public institutions with monopolistic

TABLE 2.1. ANRSC Territorial Coverage with Public Utilities (2016)

Localities connected to public services		Water supply and sanitation	Solid waste	Public lighting
Country	Total	3,180	3,180	3,180
	Connected	2,289	2,851	1,767
	% of total	72.0%	89.7%	55.6%
Urban	Total	320	320	320
	Connected	318	320	261
	% of total	99.4%	100%	81.6%
Rural	Total	2,860	2,860	2,860
	Connected	1971	2,531	1,506
	% of total	68.9%	88.5%	52.7%

Source: ANRSC Annual Report.

activity of public utility in the following fields: water supply, collection, treatment and disposal of waste water, solid waste collection, public lighting, and local public transportation.[3]

ANRSC sets the rules for tariff policies and rules on tariff adjustment requests by ROCs. Moreover, it elaborates the performance and benchmarking indicators for public utility companies, and maintains and updates the database established under the monitoring information system regarding the public utility infrastructure and operators' activity, as the support for preparation (for government's review and evaluation) of annual reports. It is financed independently from the national budget, through licensing fees plus a 0.1 percent contribution on the turnover of the service providers it regulates.

The Romanian Water Association (ARA) representing the various Romanian WSS utilities has played a key role in the development of the sector over the past 20 year. ARA has 48 member utilities that finance its activities. It has been involved in major investment programs implemented in the WSS sector in the past two decades, and played an active role in the design of the institutional set-up for regionalization. It also plays a leading role in the national WSS benchmarking process through the newly-established Romanian WSS center of excellence.

The Ministry of Agriculture and Rural Development (MARD) is the policy maker for agriculture and rural development. It is in charge of managing all public funds allocated for sector development from the national and EU budgets, and of the implementation of the corresponding programs. This includes managing the annual direct payments to farmers under the EU Common Agricultural Policy (CAP) and implementing the National Program for Rural Development (PNDR). MARD is also the policy maker on water management for agriculture through irrigation, drainage and soil erosion control measures.

The National Agency of Land Reclamation (ANIF) is the national irrigation services provider. A public institution operating under MARD, it is one of the main water users in Romania, although its **demand has dropped about eight fold since 1990, and only a fraction of its infrastructure is currently in a functional condition.** ANIF directly operates and maintains most of the public irrigation and drainage infrastructure in Romania—most of which was built during the 1960-89 period. It is also in charge of operating the public soil erosion control works. ANIF operates through a central office in Bucharest and 16 regional branches. The majority of the public irrigation schemes are located in the southern (Lower Danube Plain) and eastern (south of the Prut-Barlat basin, at the border with Moldova and Ukraine) parts of the country, while drainage works are spread all over the country. The water abstraction targets for irrigation are agreed annually between ANAR and ANIF, by river basin and point of abstraction, according to ANIF's long-term irrigation contracts with farmers and are subject to adjustment depending on water availability during droughts. ANIF also collaborates with the PNDR Management Authority on the rehabilitation and modernization of irrigation infrastructure.

"Hidroelectrica" S.A. is the national hydropower generation company operating over 130 hydropower plants and about half of all the dams in the country, including many large ones. It employs about 3,300 staff (2016, down from about 5,200 in 2012), and is 80 percent-majority controlled by the Government of Romania.[4] In its operation, "Hidroelectrica" is supposed to coordinate its production schedule with ANAR in such a way as to both secure the minimum flow required by downstream water users and ensure the safe transit of high flow rates during high rainfalls, and reduce the floods risks for the downstream population and businesses. Although a water user, "Hidroelectrica" is not a water consumer *per se*: it does not abstract water but, since it controls the timing and magnitude of water releases in its dams for power generation driven by electricity demand from the grid, it introduces abstraction restrictions for other users.

In recent years Romania has also seen the emergence of many small private hydropower producers operating micro-hydropower units on small rivers, mainly in the Carpathian Mountains. Although these micro-plants have a negligible contribution to the national power grid, they may have a significant negative environmental impact due to both possible hydrological and morphological alterations and lack of respect for environmental flows. Furthermore, many were established in protected wilderness areas (Habitat Directive, Natura 2000), causing the EC to launch an infringement procedure against Romania in 2015 for some micro-plants in three Natura 2,000 sites.

The National Regulatory Agency on Energy (ANRE) is the national regulator for the energy market (electricity, gas, thermal). It issues licenses, technical and commercial regulations, establishes methodologies for price and tariff calculation, and approves tariffs and prices. As part of its overall responsibilities, ANRE monitors the activity of hydropower production, including environmental compliance and sustainable use of water.

The Romanian Committee of Large Dams (CROMB) was established in 1931 as the Romanian chapter and co-founder (in 1928) of the International Commission of Large Dams (ICOLD). It is a professional association of dam experts with the aim to collect and valorize experiences on all technical, technological, economic and institutional matters pertaining to dams' safety, maintenance and their ecological and socio-economic impact on the sustainable use of water.

The Romanian Commission for Safety of Dams and other Hydraulic Works (CONSIB) is a consultative body providing technical support for coordination, monitoring, and guidance to MWF on the supervision of dams, reservoirs and other hydraulic works to secure their safe operation **and** management. In this capacity, CONSIB together with the dams' owners and managers reviews the organization of dam monitoring systems; it reviews the periodic technical expert reports on dams' safety, advises upon the operational rules for dams, recommends the preparation of technical reviews of hydraulic infrastructure with high failure risk and recommends to the dams' owners structural interventions to enhance the safety of infrastructure at risk.

The Lower Danube River Administration (AFDJ) is the national waterway authority on the Romanian portion of the Danube River—from its entrance in the Romanian territory at km 1,075 down to its mouth in the Black Sea- and the Sulina Branch, as well as a number of other smaller navigable branches of the Danube. It operates as an autonomous administration under the authority of the Ministry of Transport and Infrastructure. According to the provisions of the "International Convention Regarding the Regime of the Navigation on the Danube," it is responsible for maintaining the minimum navigation depths by dredging and operations and maintenance (O&M) of waterway infrastructure and equipment, including coastal and floating signaling. Its headquarters are located in Galati, with five sub-agencies. It must be noted that navigation poses a significant risk for the quality of the Danube. Of 455 incidents reported between 1983 and 2003, 30 resulted in serious water pollution (ICPDR website).

The Ministry of Health (MoH) is responsible for permanent monitoring programs implemented through the county-based directorates of public health based on the periodic testing of samples of drinking and bathing water taken in both urban and rural areas. The monitoring of drinking water is conducted for centralized water supply systems jointly by the water supply companies and the local directorates of public health and has two components: audit monitoring and control monitoring. The local public health authorities also monitor the quality of public wells in rural areas to determine whether their water matches the minimum drinking quality requirements, particularly in localities without centralized water supply systems where most of the drinking water is abstracted from shallow underground resources.

2.2. Compliance with EU Water Legislation: Where Does Romania Stand?

2.2.1. The EU Water Legislation: A Complex Body of Directives

Compliance with EU water legislation has been the over-arching priority for the Romanian water sector for almost two decades. Since the 1989 revolution, almost 90 percent of all financing for water infrastructure investment has come from EC grant funding (mostly Cohesion Funds since 2007), and water reforms have been driven by EC requirements to access funding (the rest of the funding was mostly co-financing with EU grants). On a more general level, convergence with the more advanced EU member states has been the main goal of the country.

During the negotiation process leading to the EU Accession Treaty, Romania committed to harmonization with the EU "Environmental acquis"—which includes the complex body of EU water legislation. Compliance with these directives and the associated calendar became *de facto* mandatory once Romania became a full EU member on January 1, 2007, although for some of these directives (e.g., the Urban Wastewater Directive), Romania was able, like all other EU-13 countries, to negotiate interim deadlines for compliance in recognition of the challenges involved.

The EU water legislation is comprised of a complex set of water directives and regulations with mandatory rules and recommendations for sustainable water management in all member states. EU water legislation was built gradually, as older member states were trying to address particular issues that came to the fore. While older member states were able to implement the directives one by one as they were being enacted, new member states are faced with the challenge of implementing them all at the same time (albeit with some interim deadlines), and the magnitude of this task should not be under-estimated.

The first set of water-related EU directives was enacted in the last century, and was largely input-based, spelling out obligations to invest in infrastructure to reduce pollution and to take specific measures (e.g., reporting under the Drinking Water Directive [DWD]). The Urban Waste Water Treatment Directive (UWWTD) and Nitrate Directive (both adopted in 1991) are emblematic of this "older" approach.

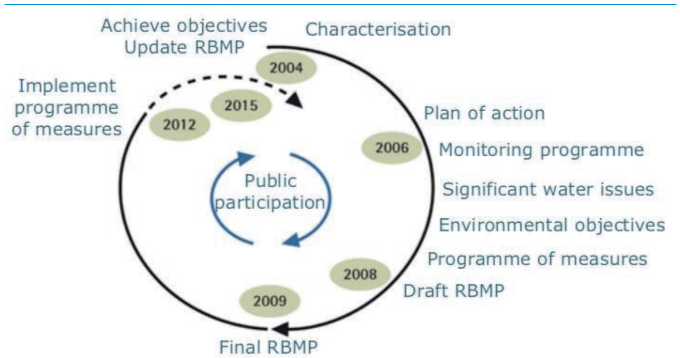
The WFD adopted in October 2000 introduced a radically new results-based approach. It established a new, integrated framework for the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries (transitional), coastal waters and ground waters, and is widely regarded as the most important piece of EU water legislation to date. It combines ambitious environmental objectives for European water bodies (see below) with policy requirements to promote sustainability, including moving towards full cost recovery through tariffs, implementing the polluter-pays principle, and generalizing the use of charges for all uses of water.

The directive requires member states to establish river basin districts and develop for each of them a river basin management plan (RBMP). The Directive relies on a cyclical process whereby RBMPs are prepared, implemented and reviewed every six years. The river basin planning cycle is based on four elements: characterization and assessment of impacts on river basin districts, environmental monitoring, the setting of environmental objectives, and the design and implementation of the program of measures (PoMs) needed to achieve them.

The main objective of the WFD is to maintain the "good status" of water bodies where it exists, to prevent any deterioration in the existing status of all water bodies and achieve at least good ecological status for all surface waters.[5] This concerns surface freshwaters (rivers and lakes), underground waters, as well as transitional and coastal waters. Each member state decides on and implement the best mix of investments and reforms necessary to achieve these goals. This is embedded in the RBMP process (figure 2.1) which involves successive steps of planning and implementation under 6-year programs, including public participation. While the WFD aims to foster sustainable water management amongst EU member states, it must be noted that it focuses largely on the qualitative status of water, and does not address the quantitative status of surface waters—even though this is obviously a key element of water security in the context of growing demand and climate change.

The original year set for achieving good ecological status for all waters was 2015, but this turned out to be too ambitious. The second and third cycle of RBMP implementation in 2016–21 and 2022–27 shall allow member states to fine-tune their efforts, with new programs of measures to be prepared for each updated RBMP. In practice, almost all EU countries failed to achieve the 2015 target for good ecological status, but are not in formal non-compliance yet since the WFD

FIGURE 2.1. The RBMP Process under the WFD (First Round 2009–15)



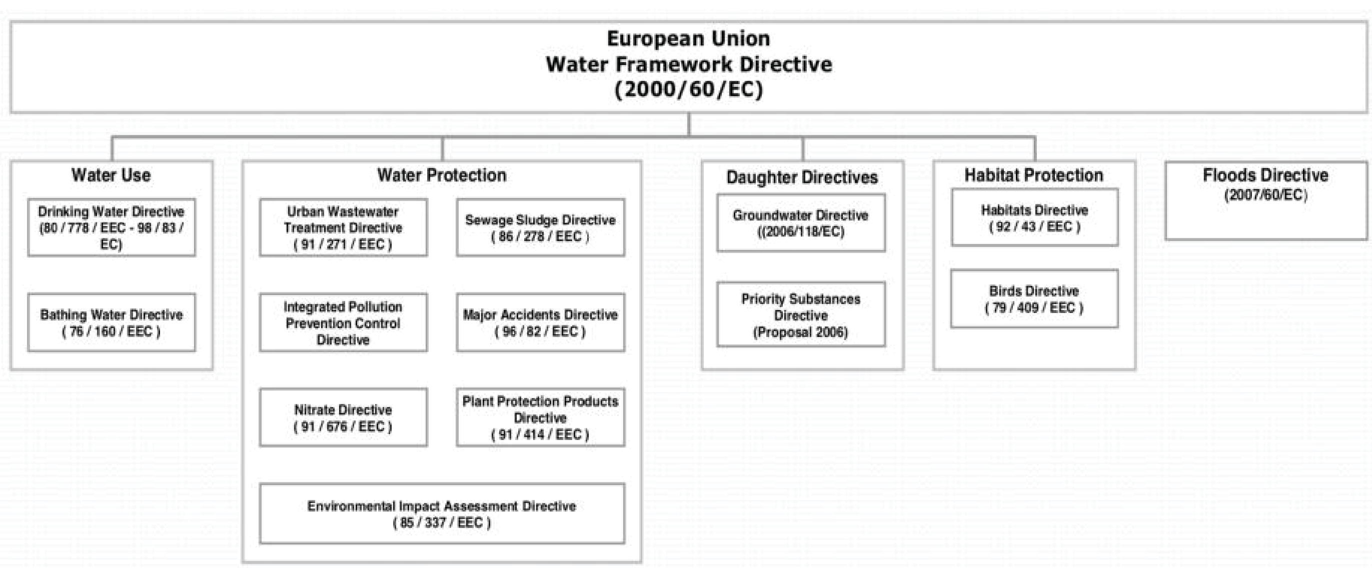
Source: EEA 2012a.
Note: RBMP = River Basin Management Plan.

allows for granting temporary exemptions for specific water bodies as requested by member states. It has also been recognized that good ecological status may be impossible to achieve for some polluted or heavily modified water bodies, which after another decade of exemptions could be classified as falling under less stringent environmental objectives, provided that countries can demonstrate that they had made every reasonable effort to achieve the good ecological status.

The WFD has been conceived as umbrella legislation encompassing all older EU water directives, the so-called "basic measures," as shown in figure 2.2. The most important ones are briefly described here and analyzed in the following sub-chapters. Among them are older directives, such as the UWWTD and the Nitrate Directive—both focused on reducing pollution discharge (from domestic and industrial effluents, and non-point agricultural sources respectively)—as well as the DWD and the Bathing Water Directive (BWD). The most recent piece of legislation is the Floods Directive enacted in 2007. Several other directives under the WFD umbrella are not specific to the water sector but do address some aspects of water management.

The UWWTD obliges member states to build and operate sewage collection systems (Article 3) and secondary treatment (Article 4) for all urban wastewater—defined as agglomerations with more than 2.000 population-equivalent (PE). It also requires the treatment of wastewater from industrial sectors (mainly the food processing industry). It aims to protect the aquatic environment from the adverse effects of sewage discharges and from the disposal of sludge (also Sewage Sludge Directive). Where excessive costs are associated with such investments or no environmental benefits can be identified to justify collective sewerage systems—as in

FIGURE 2.2. Chart of the Various EU Water-Related Directives, under the WFD Umbrella



Source: EEA.

low-density rural areas—other appropriate sanitation systems can be put in place if duly justified. The UWWTD also requires **additional, more stringent, treatment of wastewater in the so-called "sensitive areas"** (Article 5) for agglomerations above 10,000 PE, with more stringent requirements for the removal of nutrients (Nitrogen and Phosphorus), where the recipient water bodies are fragilized *inter alia* due to eutrophication (figure 2.3).

FIGURE 2.3. **Wastewater Treatment Standards under the UWWTD**

a) standard provisions

Parameter	Value (concentration)	Value (% reduction)
Biological Oxygen Demand BOD_5	25 mg/l	70 - 90 %
Chemical Oxygen Demand COD	125 mg/l	75 %

(24 hour average; either concentration or percentage of reduction shall apply)

b) additional provisions for 'sensitive areas'

Parameter	Value (concentration)	Value (% reduction)
Total nitrogen Plants of 10 000 - 100 000 p.e. Plants >100 000 p.e.	 15 mg/l 10 mg/l	70 - 80 %
Total phosphorus Plants of 10 000 - 100 000 p.e. Plants >100 000 p.e.	 2 mg/l 1 mg/l	80 %

(annual averages, either concentration or percentage of reduction shall apply)

Source: EEA.

The Nitrates Directive complements the UWWTD by dealing with non-point source pollution from agriculture. It is aimed at reducing water pollution caused by nitrates from agricultural sources through Codes of Good Agricultural Practices to be implemented by farmers on a voluntary basis, designation of Nitrates Vulnerable Zones (NVZs), and Action Programs to meet targets. The identification of polluted waters must address: (a) surface freshwaters used (or that could be used for drinking water) which contain or could contain more than 50 mg/l nitrates (if no action is taken); (b) subsurface waters (groundwater) which contain more than 50 mg/l nitrates or could contain more than 50 mg/l nitrates; and (c) natural freshwater (lakes, other freshwater bodies, estuaries and coastal waters) affected by or at risk of eutrophication. Member states are required to set up a monitoring system for all water bodies for nitrates concentrations and trophic status, and to report to the EC every four years. **The Groundwater Directive (2006)** complements the Nitrates Directive confirming that nitrate concentrations must not exceed the trigger value of 50mg/l, while allowing member states to set their own tighter limits.

The DWD deals with the quality of potable water for both domestic and industrial (food industry) uses. Enacted in 1980 and revised in 1998, it requires member states to monitor at least 48 parameters for all potable water distribution systems that serve more than 50 people or supply more than 10 m^3/day, as well as for all water supplied as part of an economic activity.[6] Member States have an obligation to report every three years to the EC on the quality of water intended for human consumption, for all individual supplies of water exceeding 1,000 m^3/day or serving more than 5,000 persons. Remedial measures are required in case of non-compliance with quality parameters, though member states may be exempt in specific cases.[7] Standards are set largely based on the World Health Organization (WHO) guidelines on drinking water quality.

It is important to highlight that the DWD formally covers drinking water quality only in large piped water systems (Large Water Supply Zones [LWSZ]). In practice, the DWD allows for derogations on reporting requirement for small water supply zones (SWSZ, between 10 and 1,000 m^3 per day, or serving between 50 and 5,000 people). Furthermore, it sets no monitoring requirements for "Very Small Water Supply Zones" (VSWSZ, piped water systems

TABLE 2.2. Requirements under the Drinking Water Directive Depending on the Size of Water Systems

Typology of water supply	Size of water systems	Requirements under DWD
Large Water Supply Zones (LGWZ)	> 5,000 people or 1,000 m^3/d	Monitoring and compliance with 48 potability parameters Reporting every 3 years to the EC
Small Water Supply Zones (SWSZ)	Between 50 and 5,000 people Between 10 and 10,000 m^3/d	Monitoring of 48 potability parameters Derogations possible for reporting requirements to the EC
Very Small Water Supply Zones (VSWSZ)	Less than 50 people or 10 m^3/d	No potability monitoring requirements No reporting to the EC
Self-supply with private well	-	DWD does not apply

Source: World Bank elaboration.
Note: DWD = Drinking Water Directive.

serving less than 50 people or 10 m^3/day), and does not cover households relying on self-supply (private boreholes or springs). This is summarized in table 2.2.

The BWD sets mandatory water quality standards for registered bathing sites—which can be coastal or inland waters (rivers and lakes)[8]—as well as monitoring and public information obligations, so as to safeguard public health. It requires member states to identify popular bathing places in fresh and coastal waters and monitor them for indicators of microbiological pollution (and other substances) throughout the bathing season (which normally runs from May to September). Even though it is the oldest EU water directive (enacted in 1976), it has multiple links with more recent directives aimed at improving the quality of superficial waters—whether through reduction of the pollution load (UWWTD and Nitrate directives) or the achievement of good ecological status under the WFD. It was updated in 2006 with the "New Bathing Water Directive" that *inter alia* simplifies the management and surveillance methods, and simplifies informing the public about water quality using four quality categories for bathing waters—"poor," "sufficient," "good" and "excellent."

The EU Floods Directive is the most recent addition to the EU water legislation adopted in September 2007 as part of the new WFD framework. It aims to improve flood management in EU countries so as to reduce as much as possible the risks that floods pose to health, environment, cultural heritage and economic activity. Implementation of the EU Floods Directive requires member states to carry out a three-step evaluation and planning process: (a) preliminary flood risk assessment (deadline 2011) identifying areas at risk of flooding; (b) drawing up of flood risk maps (deadline 2013); and (3) establishment of FRMPs focused on prevention, protection and preparedness (deadline 2015).

All these EU directives have been by now duly transposed by Romania in its national legislation, along with subsequent implementation regulations. As already mentioned, calendars for meeting the targets, including the road maps, were agreed prior to accession to the European Union. However, full compliance with their provisions is still to be reached in some cases, and Romania is at various stages of meeting the agreed targets, as will be seen in the detailed review that follows.

2.2.2. Compliance with the Urban Waste Water Treatment Directive Is a Major Challenge

2.2.2.1. Romania's Interim Deadlines for Urban Waste Water Treatment Directive Compliance

The initial UWWTD Implementation Plan (IP) was adopted in October 2004 as part of the negotiation process for Romania's accession to the EU, which became effective in 2007. The IP identified a total number of 2,609 agglomerations above 2,000 PE—including 263 above 10,000 PE and 2,346 between 2,000 and 10,000 PE. All national territory was classified as Sensitive Area under Articles 5(8) and 5(2, 3) of the Directive, thereby requiring all wastewater treatment plants for agglomerations with more than 10,000 PE to comply with more stringent treatment for nitrogen and phosphorus removal.

Like other new EU-13 member states, Romania negotiated an interim period for UWWTD compliance, with target for sewage collection and wastewater treatment in **agglomerations above 10,000 PE at the end of 2013 and 2015 respectively**, and target for **agglomerations between 2,000 and 10,000 PE at the end of 2018**. The details are presented in table 2.3. It is worth noting that Romania is one of a few countries that negotiated not only compliance deadlines related to the size of agglomerations, but also included target rates related to the total load generated at national level. It was able to negotiate the latest deadline of all EU-13 member countries, in recognition that it had the lowest rate of sewerage connection and wastewater treatment at the time (for comparison, the neighboring Bulgaria had committed to full compliance by the end of 2014).

TABLE 2.3. Romanian Compliance Deadlines

Romanian compliance deadlines (Accession Treaty, ref. OJ L 157, 21.6.2005, p.169-170)
Article 3 connection:
31 Dec 2010 – 61% of the load in p.e.
31 Dec 2013 – 69% of the load in p.e.
31 Dec 2013 – all agglomerations > 10,000 p.e.
31 Dec 2015 – 80% of the load in p.e.
31 Dec 2018 – all agglomerations
Article 4 secondary treatment and Article 5(2) more stringent treatment:
31 Dec 2010 – 51% of the load in p.e.
31 Dec 2013 – 61% of the load in p.e.
31 Dec 2015 – 77% of the load in p.e.
31 Dec 2015 – all agglomerations > 10,000 p.e.
31 Dec 2018 – all agglomerations

Source: Rakedjian.

The distance to compliance concept was introduced in 2014 by the European Commission. It started to be used during the eighth reporting exercise (that used data from 2012 as reference year). The rationale for the new concept was to gain a more accurate global view of the situation in each country and to better assess the advances in the development of sewerage infrastructure.

Contrary to the legal compliance approach, which focuses on verifying whether each agglomeration in the UWWTD action plan meets the collection and treatment objectives, the distance to compliance approach looks at overall sewage pollution loads—the distance to compliance representing the load that still has to be connected to a collecting system or an IAS (Individual and/or Appropriate System) and that still has to be treated at the level of the secondary or more stringent treatment. It therefore provides a more accurate view of the situation of the country, because the calculations are based on overall pollution loads, rather than the number of compliant agglomerations. Table 2.4 outlines the conceptual differences between these two approaches.

2.2.2.2. Romania's Compliance with UUWTD in 2014: Legal vs. distance to compliance

The ninth UWWTD compliance report—with analysis carried out in 2016 based on 2014 countries data—is the most recent analysis comparing the situation of Romania with other EU countries. While the report is still to be released, the various figures presented in this sub-chapter are extracted from a presentation given in May 2017 at the EC in Brussels.[9] Table 2.5 provides the

TABLE 2.4. Comparison of the Legal Compliance and Distance to Compliance Approaches

Legal compliance calculation
an agglomeration is compliant under Article 3 if the generated load discharged without treatment before connection to collecting system or individual and appropriate system represents 2% or less of the generated load and 2000 p.e. or less. An agglomeration is compliant under Article 4 and 5 if: o the agglomeration is compliant under Article 3, o the connected load discharged without treatment during collection is less than 1% and 2000 p.e. and, o the treatment requested (secondary and/or more stringent treatment) is in place and, o the performance requested are all met.
The distance to compliance approach
This is an approach that concerns the connection, the treatment and performance in place. The distance to compliance related to the connection is the exact load that is discharged without treatment. before connection to a collecting system or IAS. The distance to compliance related to the secondary or more stringent treatment in an agglomeration represents the exact load that is already connected to a collecting system but is not treated in a treatment plant that is equipped with a secondary or more stringent treatment. The distance to compliance related to the secondary or more stringent treatment performance represents the exact load that is connected to a collecting system but does not respect the secondary or more stringent treatment performance required by the UWWTD The margins accepted under the legal compliance assessment are not integrated in the distance to compliance concept.

Source: Rakedjian.

status of compliance for each EU country for collection (Article 3), secondary wastewater treatment (Article 4) and more stringent treatment (Article 5)—both by applying the legal compliance concept (first 3 columns) and the distance to compliance concept (last 4 columns). Despite the large time lag—with figures dating from 3 years ago—this is the most recent official source of data for UWWTD compliance.

In terms of legal compliance, Romania is by far the worst UWWTD performer amongst all EU countries. Most agglomerations declared a discharge without treatment for more than 2 percent or 2,000 PE (1,803 among 1,818) before connection, and were therefore declared non-compliant. The rate of compliance at agglomerations level was of only 2.6 percent for Article 3, 3.8 percent for Article 4 and 0.9 percent for Article 5. This obviously does not take into consideration the actual level of coverage of the sewerage systems, but that is corrected by using the distance to compliance approach.

Romania's UWWTD performance is much improved when the distance to compliance approach is applied. In 2014, the distance to compliance for Article 3 was only 11.2 percent (meaning that compliance was achieved for 88.8 percent of the load), 41.1 percent for Article 4 and of 75.1 percent for Article 5. The largest impact of switching from the legal to the distance-to-compliance approach is for Article 3 (collection), as shown in figure 2.4. Also, as the maps in map 2.4 show, in terms of the distance to compliance, Romania is not the worst performing country—with Cyprus and Bulgaria being ranked last instead for sewage collection (Article 3), and for wastewater treatment (Article 4) more advanced countries, such as Ireland and Malta, being singled out alongside Portugal and Slovenia. It must be nonetheless mentioned that the 88.8 percent compliance reported for the national load collection is to be regarded with to caution considering that the development of sewage collection network in rural areas (agglomerations between 2,000 and 10,000 PE), where half of the Romanian population lives, is largely non-existent.

Romania's difference in ranking between the legal compliance and distance to compliance criteria is linked to the choice made by the country to spread available EU funding through a large number of agglomerations across its territory. This has allowed to make very tangible progress in terms of volume of collected effluents and treated wastewater, when consolidated at the national level, and therefore can be considered to have been fully justified from an environmental protection perspective. However, even though it has allowed to initiate the development of collection networks and Wastewater Treatment Plants (WWTPs) in almost all urban agglomerations, none are yet in full compliance (for instance, only 2.6 percent of agglomerations are considered compliant for Article 3), and they are therefore counted under the legal compliance approach as "non-compliant" (legal compliance being a "pass or fail" criterion). Paradoxically, if Romania had chosen instead to focus its limited EU grant funding on a smaller number of agglomerations, it would probably be in a much better shape in terms of legal compliance even if consolidated environmental benefits would have been smaller. Focusing on legal compliance in a few agglomerations could also have raised issues of territorial imbalance.

TABLE 2.5. Status of Compliance for Each EU Member State

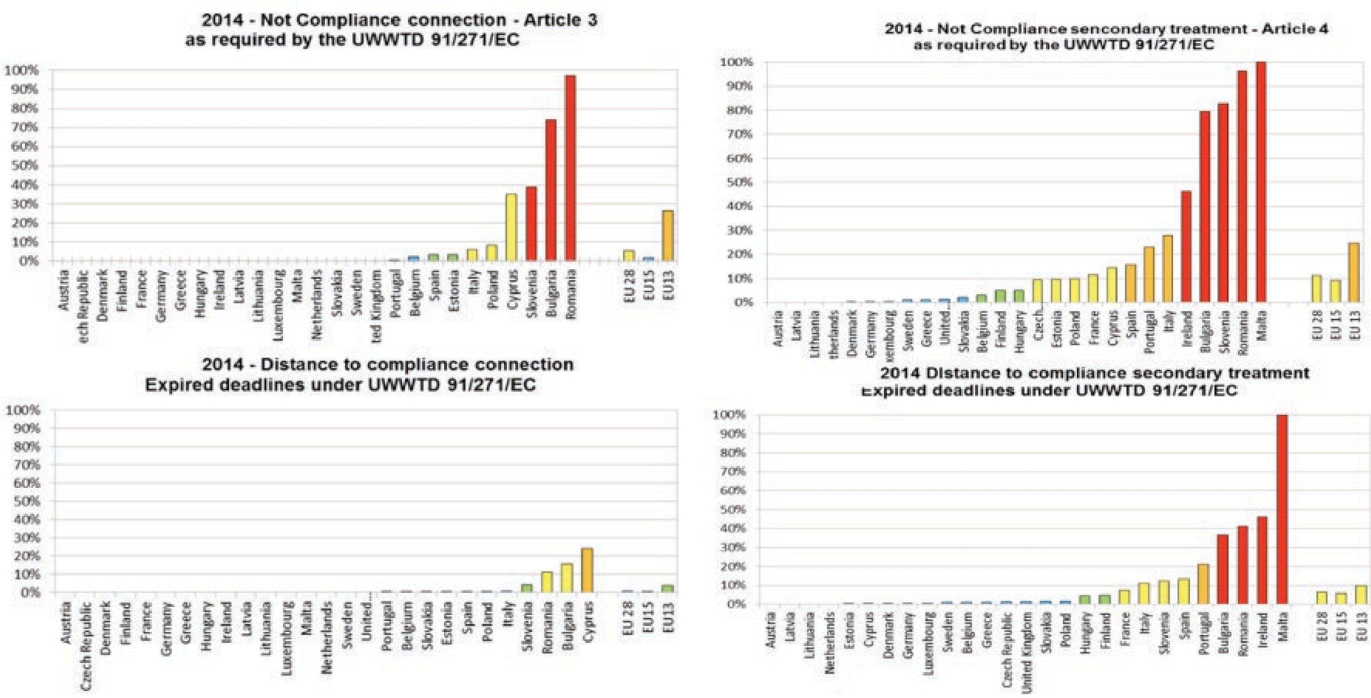
Country	legal compliance rate 2014			Evolution since last report			Distance to compliance 2014 expired deadline only		
	Connection Article 3	2nd treatment Article 4	3rd treatment Article 5	Connection Article 3	2nd treatment Article 4	3rd treatment Article 5	Connection Article 3	2nd treatment Article 4	3rd treatment Article 5
Austria	100.0%	100.0%	100.0%	→	→	→	0.0%	0.0%	0.0%
Belgium	97.8%	96.8%	91.1%	→	↘	↗	0.2%	1.1%	0.4%
Bulgaria	25.8%	20.4%	6.7%	↗	↗	↗	15.8%	36.9%	87.0%
Croatia	No expired deadline						Not provided		
Cyprus	65.0%	85.6%	85.3%	↘	↗	↘	24.2%	0.2%	0.0%
Czech Republic	100.0%	90.5%	62.7%	→	↗	↗	0.0%	1.4%	23.4%
Denmark	100.0%	99.8%	95.4%	→	↗	↘	0.0%	0.2%	4.6%
Estonia	96.8%	90.4%	90.7%	↗	↘	↗	0.5%	0.1%	0.2%
Finland	100.0%	95.2%	91.1%	→	↘	↘	0.0%	4.8%	6.3%
France	100.0%	88.5%	94.5%	→	↗	↘	0.0%	7.5%	3.2%
Germany	100.0%	99.8%	99.8%	→	→	→	0.0%	0.2%	0.2%
Greece	100.0%	98.8%	99.6%	→	↗	→	0.0%	1.2%	0.4%
Hungary	100.0%	95.2%	92.2%	→	↗	↘	0.0%	4.6%	7.8%
Ireland	100.0%	53.7%	19.6%	↗	↘	↗	0.0%	46.3%	79.7%
Italy	93.8%	71.9%	65.1%	→	↗	↗	0.8%	11.1%	12.9%
Latvia	100.0%	100.0%	95.7%	→	↗	↗	0.0%	0.0%	4.3%
Lithuania	100.0%	100.0%	98.4%	→	→	↗	0.0%	0.0%	1.6%
Luxembourg	100.0%	99.6%	45.3%	→	↗	↗	0.0%	0.4%	17.7%
Malta	100.0%	0.0%	0.0%	→	→	→	0.0%	100.0%	100.0%
Netherlands	100.0%	100.0%	100.0%	→	→	→	0.0%	0.0%	0.0%
Poland	91.7%	90.1%	67.4%	Assessment not possible during the 8th reporting			0.6%	1.8%	16.0%
Portugal	99.8%	76.9%	66.0%	→	→	↘	0.1%	21.3%	22.6%
Romania	2.6%	3.8%	0.9%	Comparison not possible change of methodology			11.2%	41.1%	75.1%
Slovakia	100.0%	97.9%	57.2%	→	→	↗	0.4%	1.7%	39.5%
Slovenia	61.1%	17.2%	50.1%	↗	↗	↗	4.5%	12.3%	42.3%
Spain	96.9%	84.1%	66.8%	↘	↘	↗	0.5%	13.3%	32.7%
Sweden	100.0%	99.0%	94.2%				0.0%	1.0%	3.6%
United Kingdom	100.0%	98.6%	92.8%	→	↗	↘	0.0%	1.4%	6.5%
EU 28	94.7%	88.7%	84.5%	↘	↗	↗	0.7%	6.3%	10.2%
EU 15	98.6%	90.8%	90.4%	↘	↘	↘	0.2%	5.7%	6.2%
EU 13	73.5%	75.3%	54.4%	↘	↗	↗	3.8%	9.8%	30.6%

Source: EC and Rakedjian 2016.

2.2.2.3. Status of UWWTD Implementation by December 2016

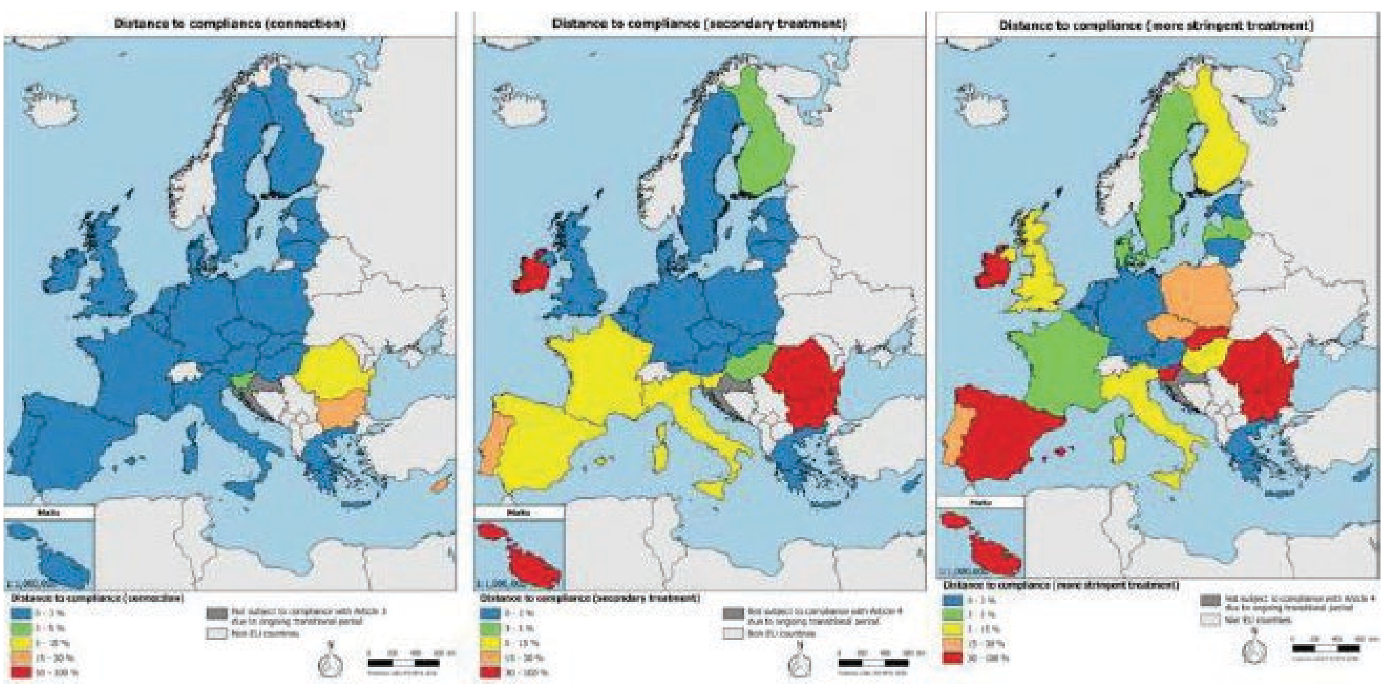
The tenth reporting exercise on UWWTD will be carried out by the EC in 2018 based on 2016 data. The year 2018 will be of particular importance, since it is also the last deadline for Romania to achieve full compliance with the UWWTD, including all agglomerations between 2,000 and 10,000 PE (Agglomerations C). This study includes an analysis of the most recent

FIGURE 2.4. **Legal Non-Compliance and Distance to Compliance under Article 3 and Article 4**



Source: EC and Rakedjian 2016.

MAP 2.4. **Distance to Compliance with Articles 3, 4, and 5 of UWWTD in EU Member States**



Source: EC and Rakedjian 2016.

data on the status of UWWTD implementation in Romania as it was presented in the interim report on compliance as of December 31, 2016 sent to the EC.

The current number of agglomerations above 2,000 PE has been significantly reduced compared to the initial 2004 IP. As of December 2016, ANAR reports a total of 1,917 agglomerations above 2,000 PE (of which 238 above 10,000 PE and 1,979 between 2,000 and 10,000 PE). This constitutes a reduction of 692 agglomerations since 2004, when 2,609 agglomerations were identified. A reduction of 6.85 million PE is also reported in the total wastewater load. The underlying reasons include the overall reduction in population and economic activities—with some rural villages falling under the 2,000 PE threshold, and many agglomerations witnessing a fall in the total load—as well as some re-assessment of agglomerations (grouping).

For compliance with Article 3, the connection rate to sewage collection systems stood at 84.5 percent in December 2016 for agglomerations above 10,000 PE, but only at 17.1 percent for agglomerations C (table 2.6). While compliance for Article 3 for agglomerations above 10,000 PE was supposed to have been achieved 3 years earlier, the distance to compliance is only 15.5 percent—a situation radically different from the distance to compliance for agglomerations C, which stands at 82.9 percent. This underlines the fact that investing in sanitation has been concentrated in larger agglomerations served by regional utilities (ROCs), while very little has been done in smaller and mostly rural agglomerations, even though agglomerations C still generate more than a quarter of the total load. **It is obvious that compliance for Article 3 for agglomerations C cannot be achieved by the December 2018 deadline**.

The geographical location of the agglomerations where sewage collection networks should be installed under Article 3 of the UWWTD is shown in map 2.5, together with status. Agglomerations with already existing sewerage collection systems are shown as blue dots. This is the case of almost all agglomerations above 10,000 PE, though in most cases the actual expansion of the sewerage networks is well below the UWWTD requirement. The agglomerations without any sewerage collection networks are shown as red dots. These are mostly small agglomerations below 10,000 PE (there are also a few cases of agglomerations between 10,000 and 15,000 PE). A large portion of the small agglomerations between 2,000 and 10,000 PE do not yet have any sewage collection systems, and the situation appears critical in two regions with high density of small agglomerations: the lower Danube plains, and the Prut-Barlad basin on the border with Moldova.

A similar pattern is observed for compliance with Article 4, with **78.5 percent of the load from agglomerations above 10,000 PE receiving wastewater treatment at secondary level,** but **only**

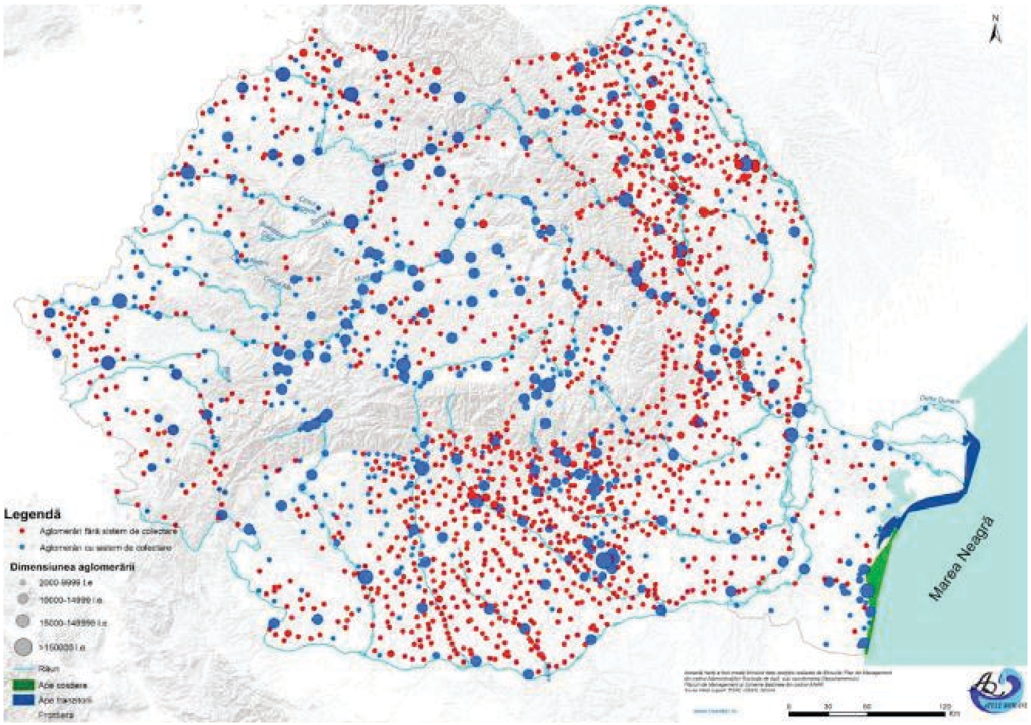
TABLE 2.6. Status of Compliance with Article 3 as of December 2016

Wastewater collection (Article 3)

Agglomerations	No	PE	PE connected to sewerage	Connection rate percent
Sensitive areas: Agglomerations of >10,000 PE	238	14,789,330	12,500,342	84.52
Agglomerations of 2,000–10,000 PE	1,679	5,123,556	878,460	17.13

Source: MWF 2016.

MAP 2.5. **Map of Agglomerations above 2,000 PE with Status of Sewerage Collection**



Source: ANAR 2016.
Note: Agglomerations with sewage collection systems in blue, without one in red.

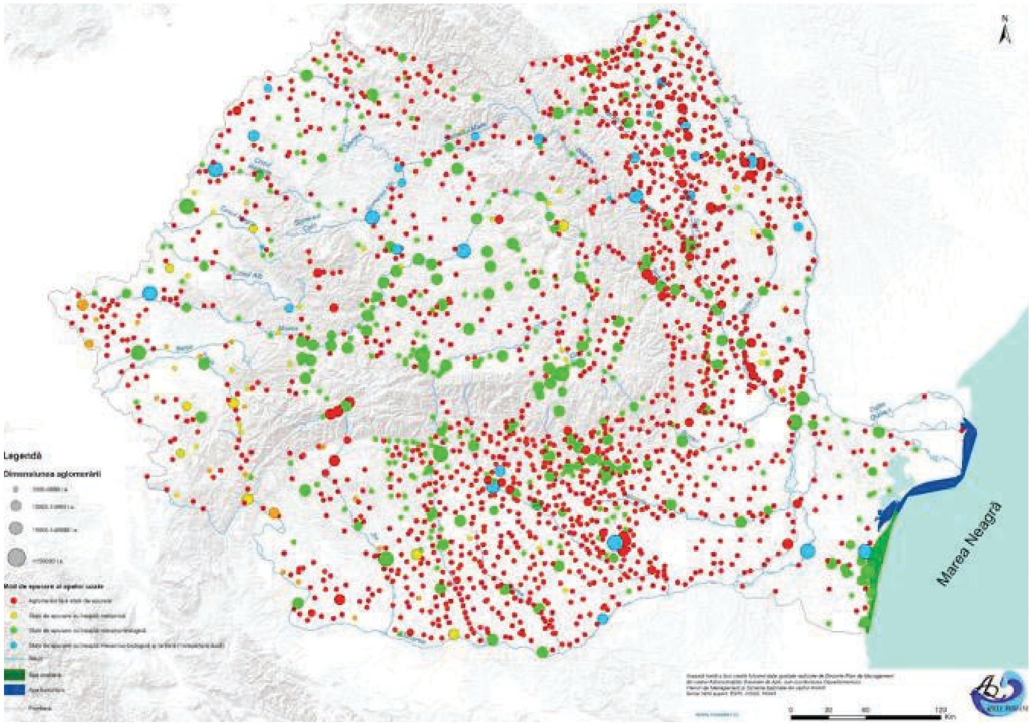
14.8 percent of the load from agglomerations C by December 2016 (table 2.7). For larger agglomerations, the distance to compliance stands at 21.5 percent one year after the expiration of the interim deadline of December 2015—which is not a bad result considering the challenge that the execution of such major investments represented for the newly created regional utilities over the past decade.

Just as for waste collection, **the compliance gap of 82.9 percent for wastewater treatment in agglomerations C is enormous,** and impossible to close by the December 2018 deadline. This is apparent in map 2.6 below which shows the status of development of WWTPs under the UWWTD IP. Agglomerations without any WWTP are shown in red, while the yellow, green and blue dots represent agglomerations with primary, secondary and tertiary treatment.

It must also be noted that **for larger agglomerations the gap between wastewater collection and treatment is as big as 6 percentage points, which means that a total load of 0.88 million PE is collected by sewer networks and discharged without treatment**—with serious negative environmental consequences. This load is concentrated at the points of discharge and is more environmentally damaging than before sewer networks had been installed.

For compliance with Article 5, only 72 percent of the total load arriving at a wastewater treatment plants, and 45 percent of the total generated load, was receiving more stringent treatment as of December 2016 (table 2.8). More stringent treatment is required due to Romania's

MAP 2.6. Map of Agglomerations above 2,000 PE with Status of WWTPs



Source: ANAR 2016.
Note: Agglomerations without WWTP: red, primary WWTP: yellow, secondary WWTP: green, tertiary WWTP: blue.

TABLE 2.7. Status of Compliance with Article 4 as of December 2016

Wastewater Treatment (Article 4)

Agglomerations	No	PE	PE connected to WWTPs	Connection rate %
Sensitive areas: Agglomerations of >10,000 PE	238	14,789,330	11,617,707	78.55
Agglomerations of 2,000–10,000 PE	1,679	5,123,556	760,729	14.85

Source: MWF 2016.
Note: WWTP = Wastewater Treatment Plant.

TABLE 2.8. Status of Compliance with Article 5 as of December 2016

Agglomerations	Total number of WWTPs	Type of treatment	No of WWTPs	PE connected to WWTPs
Sensitive areas: Agglomerations of >10,000 PE	236[a]	Primary	9	394,790
		Secondary	117	2,302,108
		More stringent	110	8,920,809
Agglomerations of 2,000–10,000 PE	502	Primary	25	18,901
		Secondary	447	701,814
		More stringent	30	40,014

Source: MWF 2016.
Note: WWTP = Wastewater Treatment Plant.
a. Some agglomerations have more than one WWTP (Constanta 2, Targoviste 2, Hunedoara 2, Maneciu 3).

decision to declare all its territory a sensitive area for the purposes of UWWTD. In larger agglomerations three quarters of the collected load is receiving more stringent treatment. Yet, in C agglomerations only one third of the load collected and mere 5 percent of the total load generated is receiving stringent treatment. This illustrates again that infrastructure investment efforts have so far been concentrated in larger agglomerations, with very little done in smaller agglomerations below 10,000 PE and in rural areas in general.

Despite the fact that the deadline for final compliance is less than a year away, the initial 2004 IP has not yet been updated, neither has a detailed IP with costs and deadlines for compliance for each agglomeration been prepared by MWF. This is a complex task that shall require looking at options to optimize the cost of compliance, close the financing gap for investment, improve the execution of investments and their subsequent sustainable operation, and improve the quality and frequency of reporting to the EC. However, an inter-ministerial committee comprising representatives of all ministries, is exploring the option of proposing December 31, 2023 and December 31, 2027 as compliance deadlines for agglomerations above 10,000 PE and between 2,000 and 10,000 PE respectively.

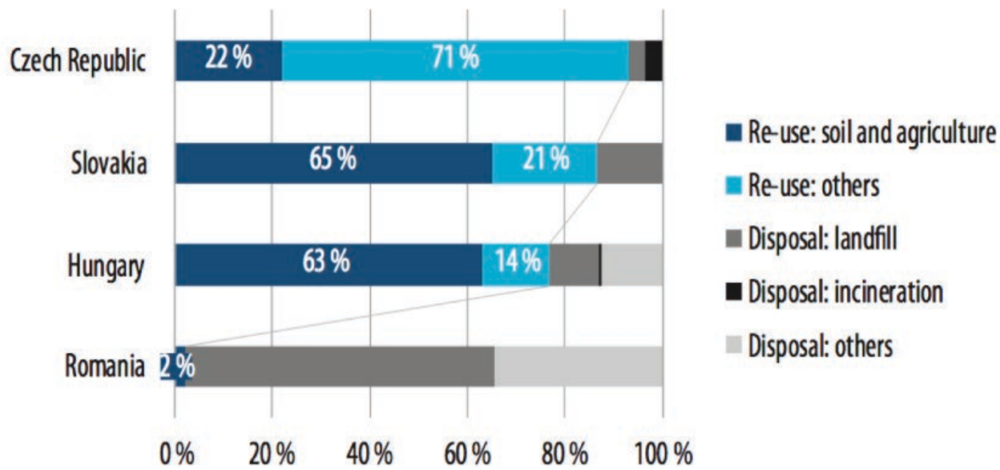
While the responsibility of monitoring and reporting, at national and European levels, on the status of UWWTD compliance lies with MWF, the involvement of many other players makes it difficult to follow the progress of the sewerage investment program. ANAR holds a central technical role in gathering the information required for periodic reporting on Romania's compliance with all water-related EC directives including UWWTD. However, other public institutions, namely the National Regulatory Agency on Communal Services (ANRSC), MRDPAEF/LIOP, county councils, and local or municipal councils also have specific and important information regarding the current planning, financing and implementation of investments.

Another issue requiring attention is sludge disposal from WWTPs. The 2015 report by the EC Court of Auditors compared sludge disposal practices from WWTPs in Romania, the Czech Republic, the Slovak Republic, and Hungary in 2012. The results extracted from the report are presented in the figure 2.5. Most of the sludge produced by WWTPs in the Czech Republic, the Slovak Republic, and Hungary is being reused for agriculture or compost production. In sharp contrast with these countries Romania deposited more than 60 percent of the sludge in landfills, and had most of the remaining sludge in temporary on site storage. Map 2.7 shows that for about half of the counties, more than 90 percent of the WWTP sludge is disposed in landfills. The development of a **national strategy for WWTP sludge management**, in order to reduce the environmental impact of current sludge disposal practices and to develop reuse in the context of a greener economy, appears desirable.

2.2.3. Nitrates Directive: Reducing Non-Point Source Pollution from Agriculture

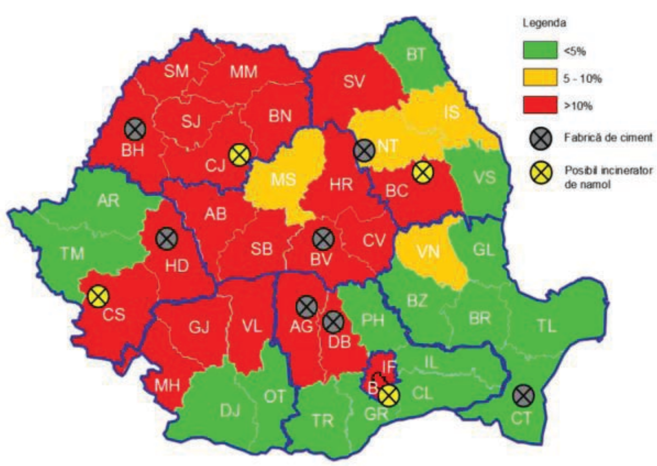
The Nitrates Directive entails a series of specific obligations to be met by each member state. The first required step is the assessment of areas vulnerable or potentially vulnerable to nitrates pollution including the identification of the sources of pollution,[10] and the intensity of nitrates

FIGURE 2.5. WWTPs Sludge Disposal Practices in Romania, the Czech Republic, the Slovak Republic, and Hungary



Source: EC Court of Auditors.
Note: Most of "reuse-others" in the Czech Republic and the Slovak Republic corresponds to compost production.

MAP 2.7. Planned Options for Sludge Recovery in Romania



Source: ANAR 2016.

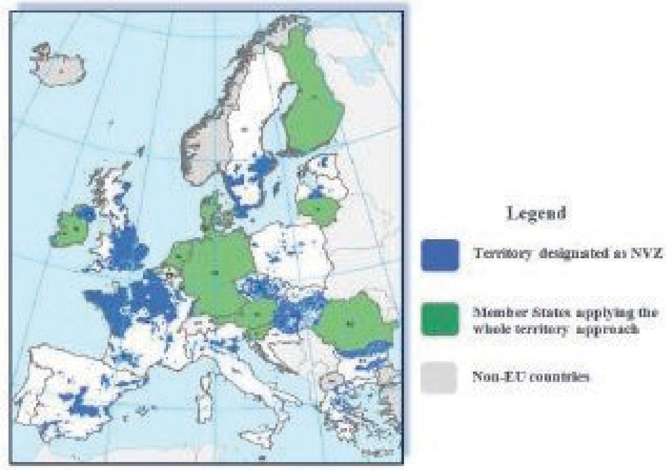
inflow in groundwater, followed by the designation of NVZ. The second step is the establishment of Codes of Good Agricultural Practice to be implemented by farmers on a voluntary basis.[11] The third step is the establishment of action programs to be implemented by farmers within NVZs on a compulsory basis.[12] Finally, it requires a national monitoring and reporting system with reports published every four years.[13]

Romania has so far fully conformed to the requirements of the Nitrates Directive. The country has duly identified vulnerable zones through an incremental process that is detailed below. It developed the Code of Good Agricultural Practices as required under the Directive, together with Action Programs for the protection of waters against nitrate pollution from agricultural sources (in accordance with articles 4 and 5 of the Directive).

Romania's good track record on the Nitrates Directive is worth highlighting, since many older EU countries have been subject to infringement procedures by the EC due to partial non-compliance. A total of 13 infringement cases were launched since 1999 against 9 EU member states: Belgium (3), France (2), UK (2), Germany, Italy, Spain, The Netherlands, Ireland and Luxembourg.

Romania is now one the few EU countries that has designated its entire territory a Nutrient Vulnerable Zone (map 2.8). As a sign of commitment to protecting water bodies and reducing the eutrophication problem in the Danube delta and the Black Sea, Romania has been gradually increasing the surface declared vulnerable zone and subject to more stringent actions to reduce nitrates pollution as defined in Nitrates Action Plans. The first designation of NVZ and of potentially vulnerable areas across Romania was made **in 2005**, before accession to the EU, mainly on the basis of historical pollution data. The first designation encompassed 255 localities accounting for 8.64 percent of the territory (14 percent of the overall agricultural area). **In 2008**, about 58 percent of the overall country area was designated an NVZ. **In 2013**, the Romanian authorities decided to apply "whole territory" approach to the implementation of the EU Nitrates Directive, meaning that the provisions of the national Action Plan for the protection of water from pollution caused by nitrates from agricultural sources no longer apply only to designated Nitrate Vulnerable Zones, but instead to the whole territory of Romania. This was motivated by Romania's commitment under the Convention for the Protection and Sustainable Use of the Danube River, to mitigate Black Sea eutrophication.

MAP 2.8. Status of Declaring NVZ in EU Countries



Source: EEA.
Note: EU = European Union; NVZ = Nitrate Vulnerable Zone.

The Code of Good Agricultural Practices was duly developed. It establishes the rules for proper management of manure coming from animal farms and for maximum quantities of N, P and K in crops fertilizers allowed by the Directive. **The first version of the code was prepared in 2002–03 and revised in 2005** to reflect the changes in the Romanian legislation and EU regulations (including considerable legislative changes in the agro-economic policy at the EU level) and incorporate feedback received from the stakeholders. The **2012 revision** reflected the latest harmonization with the EU legislation and helped to meet the environmental requirements of Cross Compliance as transposed for Romania. The code explicitly linked EU Directives and farm-level good agricultural practices, which it formulated in a format that was easy to follow for agricultural extension agents and for individual farmers. A revised version of the code was issued in 2015 (Ministerial Order 990/1809/2015) by the Ministry of Environment, MWF and MARD.

The preparation and implementation of the Nitrates Action Plan was supported by the World Bank with both financing and technical assistance. The "Integrated Nutrient Pollution Control Project" (INPCP)—confined to nutrient vulnerable zones at the time—was approved by the World Bank in October 2007 and was implemented between 2008 and 2017, with an IBRD loan of 50 million euros (US$68.1 million) and a GEF grant of US$5.5 million. As the only project in Romania dedicated to the Nitrates Directive, INPCP has supported the development of rural infrastructure needed to prevent nutrient pollution—mostly manure management stations at village level—along with grassroots awareness campaigns.

The main objective of the Nitrates Action Plan is to reduce and prevent water pollution caused by nitrates coming from agricultural sources and the eutrophication of surface waters, in the context of the provisions of the Framework Water Directive. The Action Plan includes a set of measures laid down in the directive, relating, for example, to periods when fertilization is prohibited, minimum storage capacity for livestock manure, and rules to control the spread of nutrients near water or on slopes, to reduce the risk of contamination.

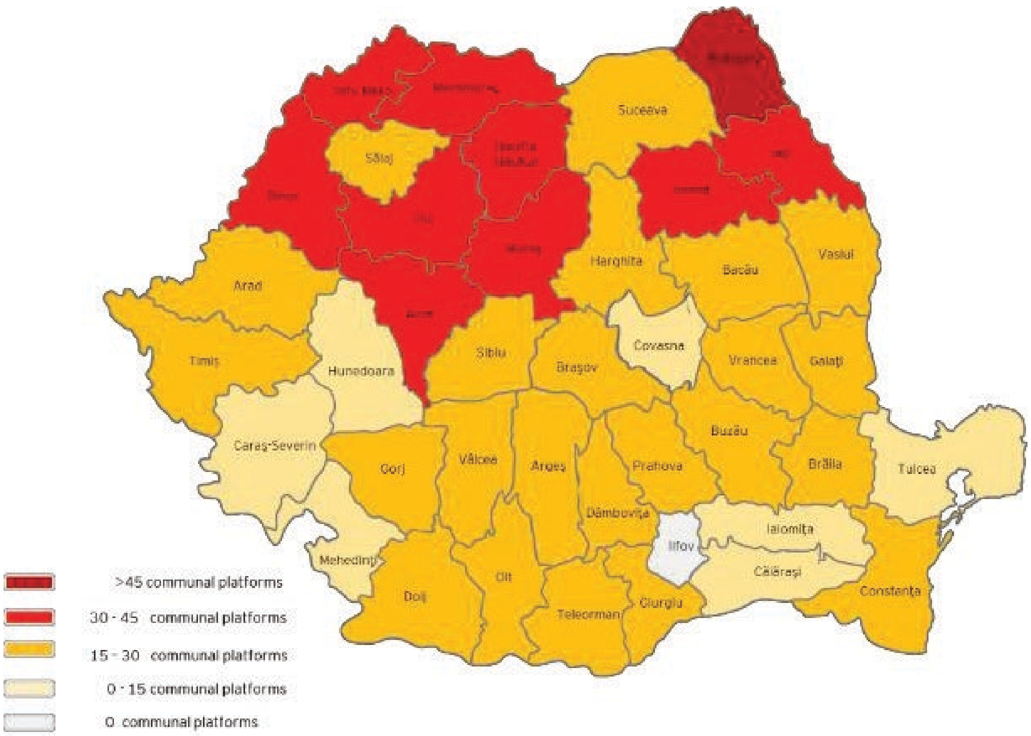
The implementation of the Nitrates Directive in Romania faces special challenges, first, because of applying the "whole territory" approach, and second, because of the special features of Romanian agriculture. About 33 percent of all EU farms are in Romania, most of them small (under 5 hectares) subsistence or semi-subsistence, not engaging in environmentally-friendly agricultural practices and thus contributing significantly to non-point nutrient pollution. The combination of a large number of farms and poor livestock management coupled with underdeveloped sanitation and low capacity of small farmers, leads to nitrate and microbial contamination of shallow groundwater and poses a general health risk for Romania's rural population.

The impact of the implementation of the Nitrates Action Plan appears to have been positive so far. The assessment of nitrates concentration from 2012 to 2015 demonstrates an overall improvement of groundwater quality from the point of view of pollution with nitrates. The monitoring of 851 points (springs and wells) showed a stable decline of the winter and annual mean concentration of nitrates in 85 percent of sections; decreasing trends for the maximum concentration was noted in 67 percent of sections. Compared to the previous reporting period (2008-11), an improvement in the trends for average nitrates (NO_3) concentrations during the winter and of average nitrates concentrations measured for lakes was also observed. The percentage of freshwater monitoring stations showing a decreasing trend in nitrate concentrations between the two reporting periods is higher than the one showing an increasing trend.[14] For lakes, the sections with decreasing and stable trends for the mean concentration of nitrates exceed 92 percent of all sections analyzed (260 monitoring points), with an improvement of about 12 percent compared to the previous period. There is a decreasing trend in groundwater nitrates concentrations between the two reporting periods, mainly for groundwater between 0 and 5 m, for captive groundwater and for karst groundwater. It should be mentioned that the 15-30 m deep groundwater bodies are more affected by the nitrate pollution, but this can be explained by the existence of historical pollution.

The **remaining issues can mostly be addressed by measures like limiting the land application of fertilizers and increasing the livestock manure storage capacity** covered under INPCP Additional Financing that scales up the efforts to reduce nutrient pollution to the country level. Manure storage capacities are currently insufficient for proper manure management at farm and rural households' level, and particular attention needs to be paid to improving animal and domestic waste storage facilities on small and very small farms. Additional Financing for 48 million euros was approved in 2016, and the implementation of a new set of activities started in April 2017, albeit at a slow pace.

A recent country diagnostic of intervention needs done by the World Bank under the INPCP project identified communal platforms for manure management as priority investments,

MAP 2.9. The Necessary Communal Platforms under the Nitrate Directive



Source: ANSVSA data.

as shown in map 2.9. Additional data were provided by the National Sanitary Veterinary and Food Safety Authority (ANSVSA).

The updated estimated cost of the full implementation of the Nitrates Directive in Romania over the next 10 years is almost 400 million euro (this amount does not take into account storing manure in individual storage facilities). A more detailed regional analysis has recommended the construction and operation of more than 940 communal platforms. The investment costs, however, cannot be sustained by the local budget alone, and therefore, additional non-reimbursable sources should be identified. The construction of the required manure platforms was estimated at about 272 million euros, and the funding required for the first four-year O&M period at 98 million euros. Appendix A details available financing options and the costs of the various interventions needed for implementing the Nitrates Directive.

2.2.4. Drinking Water Directive: The Majority of the Rural Population Falls out of Its Scope

Romania experienced some early difficulties with the transposition of the DWD into national legislation, which was completed only in 2010—three years after joining the EU. An infringement case was opened by the EC in 2009 for incompletely transposing the DWD (along with Bulgaria that same year and with Hungary the year before), but Romania amended its legislation promptly and the case was closed in 2010 (it took until 2015 for Bulgaria). For the DWD, the interim deadlines for most quality parameters were set for full compliance in December 2010, with extended deadline until December 2015 for ammonium, nitrates, aluminum, iron, lead, cadmium, pesticides, and manganese.

The focus of the DWD on large potable water systems (more than 5,000 people) makes it somewhat irrelevant for the context of Romania, where more than five million people in rural and marginalized areas don't have access to piped water, and a large portion of the population lives in small rural settlements served by small water systems that are outside of the scope of the DWD. As already indicated, not only does the DWD not require monitoring and compliance with potability parameters in the so-called very small water supply zones (VSWSZs, less than 10 m^3 per day and 50 people) but also allows for derogations on the reporting requirement for small water supply zones (SWSZs, less than 1,000 m^3 per day or 5,000 people).

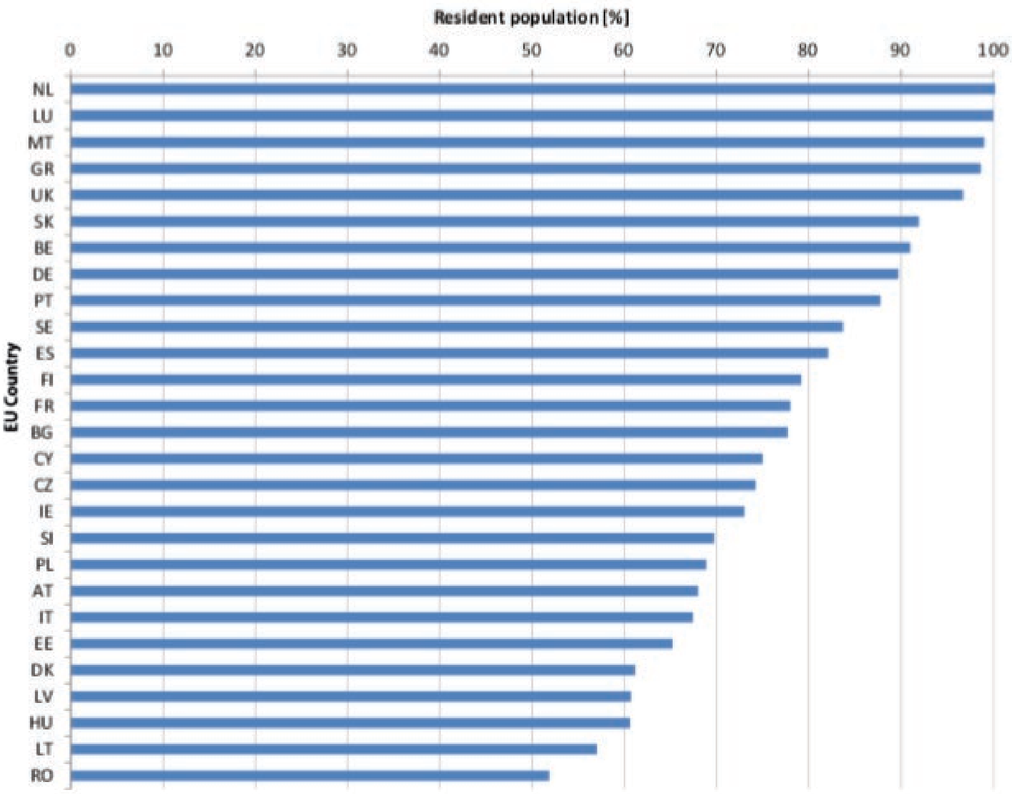
Only about 51 percent of the Romanian population rely on centralized water supply through LWSZs, and is directly fully covered by the DWD requirement for monitoring, reporting and compliance with the potability parameters. According to the County Directorates of Public Health 2015 report, there are a total of 335 LWSZs (more than 5,000 inhabitants or 1,000 m^3/day). A significant portion of the population is served by SWSZs with more lenient monitoring and compliance requirements.

Close to 40 percent of the Romanian population is not subject to the mandatory quality controls of potable water as required under the DWD. These include both the five million people self-supplied through private wells, as well as those supplied through VSWSZs. Romania has the lowest proportion of the population living in LWSZs of all EU countries as shown in figure 2.6. It is clear that, in its current state, the DWD does not address the drinking water issues of a country like Romania, with a large rural population and many self-supplied households.

As of 2015, there were still some compliance problems related to the quality of drinking water under the DWD, for both LWSZ and SWSZ. A 2017 review by the European Court of Auditors of the implementation of the DWD in Romania, Hungary and Bulgaria found that although Romania was granted two successive derogations on SWSZ reporting (until 2010 and 2015), at the end of 2015 there were still 335 SWSZ supplying an estimated 762,000 people for which potable water quality standards had still not been achieved, with coliforms exceeding targets in 1.8 percent of samples in 2013 in LWSZ.[15] The report also noted several reporting deficiencies: only 41 percent of LWSZ reported on trace elements, and in 2010 as many as 44 percent of SWSZ were not monitored at all. A 2015 review by the WB also reported that only 42 percent of SWSZ were fully compliant with the parameters of the DWD, and that the presence of fecal contamination (*Echerichia Coli*) was reported in more than 10 percent of the SWSZ.

Derogations for certain DWD quality parameters had been granted under the accession treaty, as outlined in table 2.9. Full compliance was supposed to be achieved by 2015. While it is

FIGURE 2.6. Resident Population in Large Water Supply Zones in EU Country (% of Total)



Source: EU Court of Auditors 2016.

TABLE 2.9. Status of Compliance with Article 3 as of December 2016

	Less than 10,000 inhabitants	10,000-100,000 inhabitants	More than 100,000 inhabitants
December 31, **2010**	Oxydability	Oxydability and turbidity	Oxydability, ammonium, aluminum, pesticides, iron, and manganese
December 31, **2015**	Ammonium, nitrates, turbidity, aluminums, iron, lead, cadmium, and pesticides	Ammonium, nitrates, aluminum, iron, lead, cadmium, pesticides, and manganese	n.a

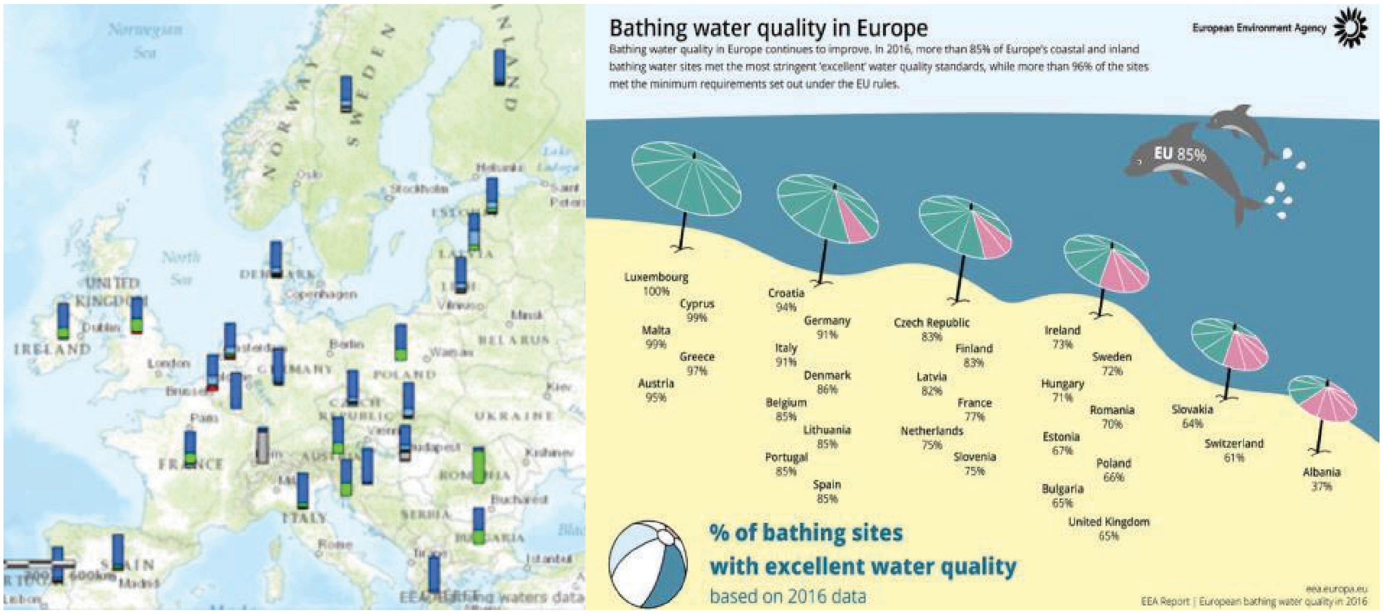
Source: MWF 2016.

possible that compliance with DWD will be achieved by 2020 with LIOP 2014-20 budgeted investments for LWSZ, the quality problems of drinking water for those unserved or served by small systems will likely remain—perpetuating a major issue of public health.

2.2.5. Bathing Water Directive: Still Some Way to Go

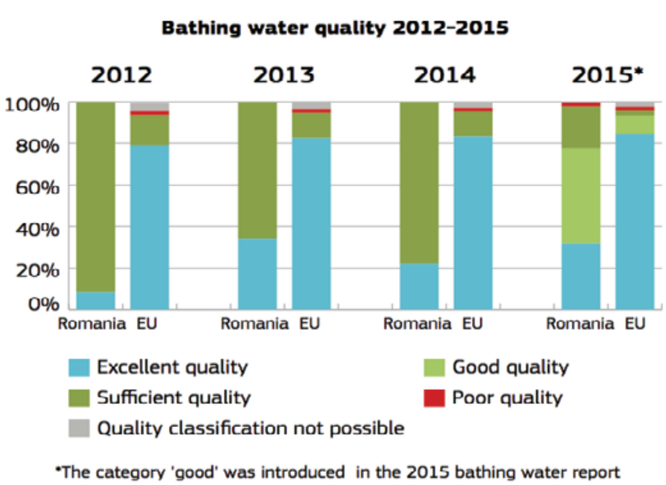
Romania still has some way to go for implementing the BWD and achieving good water quality for all bathing sites. As shown in map 2.10, the 2016 report by the European Environment Agency found that only 70 percent of registered bathing sites in Romania met the most stringent

MAP 2.10. Status of Bathing Water Sites in Europe under the BWD



Source: EEA 2016.

FIGURE 2.7. Evolution of Bathing Water Quality in Romania 2012–15



Source: EC 2017.
a. The category "good" was introduced in the 2015 bathing water report.

"excellent" bathing water quality standard—against an average of 85 percent across EU member states. Among the Mediterranean and Black Sea countries in the EU, only Bulgaria achieved a lower result, with 65 percent.

Still, the water quality at registered bathing sites has been improving in recent years. This is shown in figure 2.7. **In 2016, all bathing sites on the Black Sea were rated either satisfactory or excellent.** This represents a total of the 50 sites located on the Black Sea (48 in Constanta county), out of the total of 88 bathing sites registered in Romania under the BWD. Of these, 35 bathing sites were rated "excellent" and the other 15 sites (70 percent) were rated as "good." This is a notable result, considering the importance of tourism on the Black Sea and the eutrophication problem.

However, the bathing water quality for all sites located on inland waters is deemed unsatisfactory and is not currently reported to the EC. The other 38 registered bathing sites[16] are all located on inland waters (in 13 counties) and although they are largely deemed unsatisfactory for water quality, they have not been formally rated due to lack of adequate monitoring. This means that the overall national performance of Romania under the DWD, when bathing sites located on rivers and lakes are considered, is actually quite poor.

This can be explained by the fact that inland freshwaters are inherently more fragile that seawater bathing sites. A 2012 Report by the EAA on the state of European waters highlighted that Romania was among the EU countries with the worse situation in terms of the ecological status of lake water bodies—alongside with Greece, The Netherlands and Belgium. Measures for improving monitoring and the quality of inland bathing freshwaters, have been included in the second RBMPs under the WFD. It is expected though that this will remain a challenge for many years to come, largely due to the difficulties and delays for full implementation of the UWWTD.

2.2.6. Water Framework Directive: Status of Romanian Water Bodies

2.2.6.1. The WFD Introduces a Result-Based Approach for Sustainable Water Management

As already indicated, **the WFD has introduced a radically new approach for protecting European water resources and implementing EU water management policies.** The traditional, input-based approach of the older EU water directives (like the UWWTD) relied on the imposition of limits on emissions or discharge of specific pollutants. Conversely, the WFD introduces a result-based approach, focusing on the achievement of quality standards for all water bodies while leaving each member state to decide how to achieve them (although the input-based requirements of the older directives, especially the UWWTD and Nitrates Directive, remain fully in place and largely determine the outcome of the WFD as far as pollution abatement is concerned).

Central to the application of the WFD is the concept of achieving "good status"—both ecological and chemical—for all surface and groundwater bodies and reducing hydromorphological alterations. The definition of ecological status looks at the abundance of aquatic flora and fish fauna, the availability of nutrients, and aspects like salinity, temperature and pollution by chemical pollutants. Morphological features, such as quantity, water flow, water depths and structures of the river beds, are also taken into account. To achieve a good ecological status of water bodies, an integrated approach at river basin level is crucial, and starts with proper planning that includes: (a) identifying the main pressures on water resources; (b) assessing the risks; (c) monitoring to determine status (both qualitative and quantitative); and (d) setting objectives for sustainable management and implementing measures to achieve them. To achieve the good status, the WFD relies both on the actions to be implemented under the other water directives (the "basic measures" as under the UWWTD and Nitrates Directive) as well as "supplementary measures" for actions not yet covered by other directives that are to be included into the RBMPs (e.g., reducing non-domestic point-source pollution or wastewater treatment in agglomerations of less than 2,000 PE).

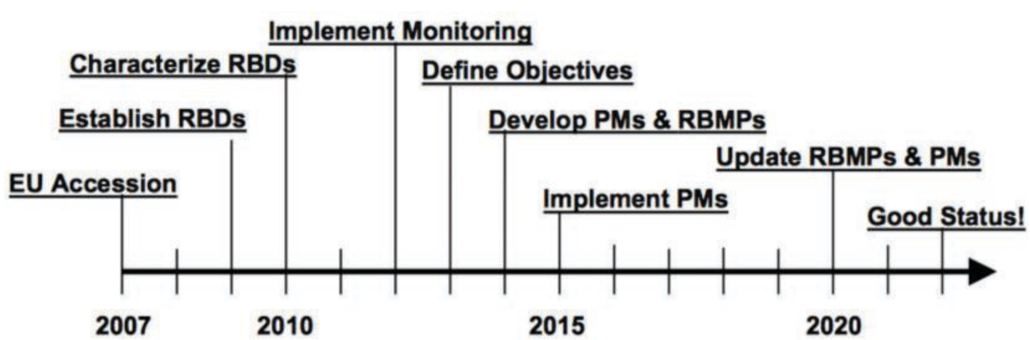
Another key dimension of the implementation of the WFD is to ensure sustainable management of all water resources—including through pricing policies based on cost recovery (Article 11) and promoting the "polluter-pays" principle. While the WFD does not mandate full cost recovery through tariffs for all water services and infrastructure, it does require, however, that member states gradually put in place a financial framework for the various water sub-sectors that will in the long run ensure sustainable financing for both investment and O&M.

Following EU accession in 2007, Romania had an adapted timeline for WFD implementation. The WFD had been adopted in October 2000 and the main steps of the first 6-year cycle were: transposition into national law by December 2003, environmental and economic analysis by December 2004, monitoring programs by December 2006, final RBMPs and associated programs of measures by December 2009, water pricing policies in place by December 2010, measures operational at the latest by December 2012, deadline for achieving environmental Objectives by December 2015. The timetable for these steps was adjusted in the case of Romania, as shown in figure 2.8.

Romania has fully complied with its planning and reporting requirements under the WFD. The WFD has been transposed in the Romanian legislation through the provisions of the Water Law 107/1996, modified and completed by the Law 310/2004, Law 112/2006, Law 146/2010, as well as Government Decision 270/2012, and the more recent Government Decision 1095/2013. The preparation of the first RBMP—in agreement with the International Danube RBMP, coordinated by the ICPDR—and an associated PoMs were finalized in December 2009, and formally approved by the government in January 2011. The policies for water pricing were approved in December 2010. **The updated RBMP for the second six-year implementation cycle 2016–21 was finalized in 2016.** It includes **11 individual sub-basin management plans**, and also outlines of the third cycle 2022-27. These were adopted by Governmental Decision (GD) 859/2016.

Romania has carried out the first round of RBMPs. A gap analysis of the RBMP prepared by the various EU countries (CSWD report, 2015 based on 2012 data), found that Romania fared better than most other EU countries for methods of assessment and monitoring network. It highlighted that despite some gaps, Romania had been identifying supplementary measures comprehensively, with a focus on cost-effectiveness, and that it was amongst the best EU countries for implementing them—clearly standing out from other EU-13 countries. The

FIGURE 2.8. **Romania Timetable for Implementation of WFD**



Source: WB 2015.
Note: RBD = River Basin District; RBMP = River Basin Management Plan; WFD = Water Framework Directive.

review highlighted that Romania's first RBMP made extensive use of the Common Implementation Strategy (CIS) Guidance Documents, was developed under good coordination with EU member states and third countries under the International Commission for the Protection of Danube River (ICPDR), and that significant stakeholder consultation had been carried out. This positive assessment reflects both the commitment of the MWF, and the fact that the country benefits from **almost a century of experience with river basins management**. Romania was ranked amongst the best member states for identifying measures and starting implementation, even better than older member states like Belgium, Germany and Italy.

2.2.6.2. Good Performance for Ecological Status of Surface Water Bodies

About 88 percent of Romania's water resources come from surface bodies. The register of surface water bodies was revised during the implementation of the first cycle of the RBMP, in 2013–15, and the boundaries of the water bodies have been updated. As a result, a total of 3,027 surface water bodies are identified, including 2,737 rivers (1,817 permanent water bodies and 920 non-permanent), 284 lakes, 2 transitional and 4 coastal water bodies. By a different classification system, 2,470 water bodies are natural, 488 are heavily modified water bodies and 69 are artificial water bodies, as shown in table 2.10.

Overall, **the quality of surface waters in Romania is good compared to other European countries—with 66.14 percent of bodies of surface waters already achieving good or high ecological status as of 2016.**[17] Over two-thirds (71 percent) of its rivers already have the good ecological status, while the chemical status is good for over 75 percent of them, and 98.5 percent of rivers have the good and high status for specific pollutants. This is largely due to the fact that a large portion of its territory is made up of rural and scarcely populated areas with little anthropogenic pressures, especially in the Transylvania mountains. Another positive enabling factor has been the closing of polluting industries in the early 1990s. It was identified that point and diffuse pollution and hydro-morphological alterations affect respectively 41 percent and 13 percent of Romanian water bodies—which is much less than in most other EU countries.

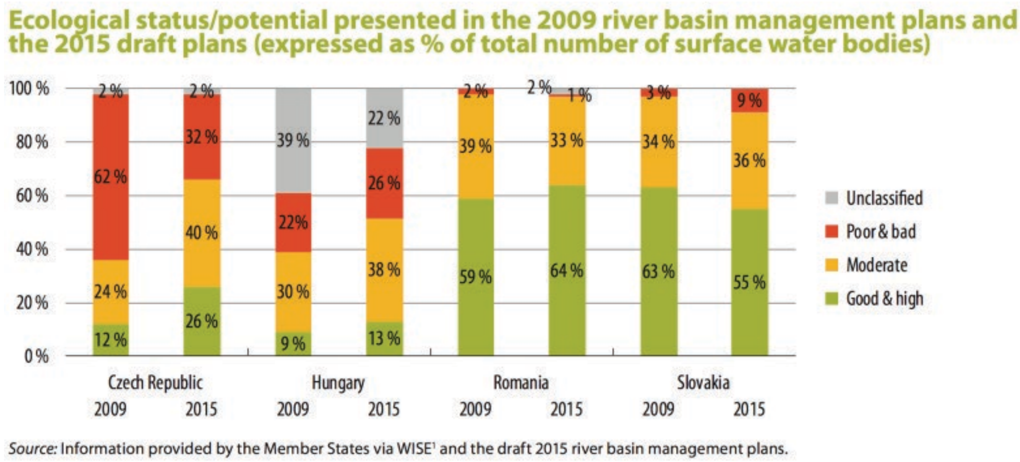
So far, Romania has shown progress towards achieving good ecological status under the WFD since 2009. This was underlined by a 2015 Report by the European Court of Auditors,[18] which reviewed the implementation of the WFD in Romania, as well as Hungary, the Slovak Republic, and the Czech Republic, and found that although little improvement in quality of water bodies had yet been achieved overall, improvement towards good ecological status was noted for Romania—up from 59 percent in 2009 to 64 percent in 2015—with only

TABLE 2.10. Distribution of Surface Water Bodies

Natural water bodies				Water bodies heavily modified				Artificial water bodies		Total water bodies
Rivers	Lakes	Transient	Coastal	Rivers	Lakes	Reservoirs	Coastal	Rivers	Lakes	
2,349	117	2	2	320	12	154	2	68	1	3,027
2,470				488				69		

Source: ANAR 2016.

FIGURE 2.9. **Evolution of the Ecological Status of Surface Waters between 2009 and 2015 in Four EU-13 Countries**



Source: EU Court of Auditors 2015.

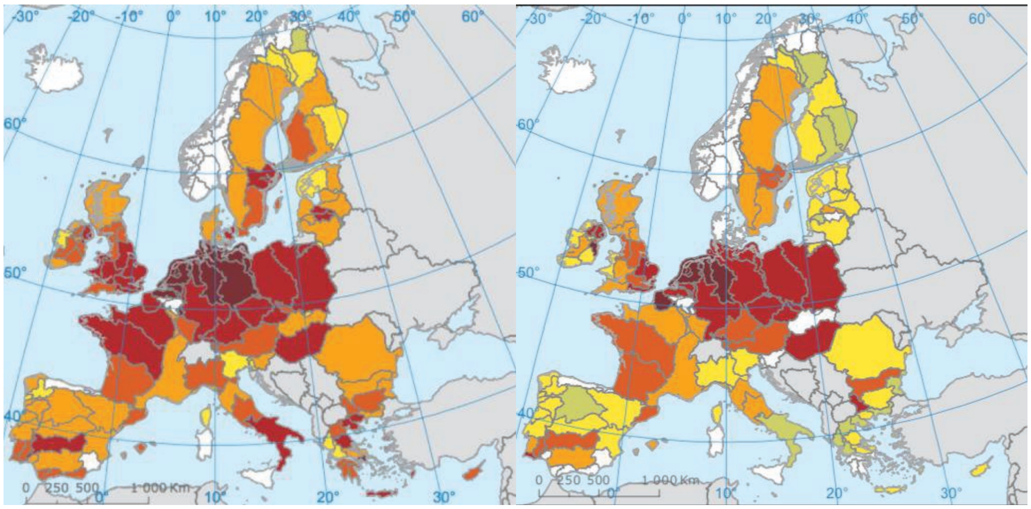
1 percent of rivers being of poor quality (figure 2.9). It must be noted that while the Slovak Republic started in 2008 with a higher proportion of water in good ecological status than Romania, there was a degradation in recent years- down from 63 to 55 percent.

For compliance with the WFD, Romania has already exceeded the EU-wide goal of 60 percent of good and high ecological status of water bodies—and compares very well with other EU countries. Map 2.11 provides a map comparing the situation of Romania with other EU countries in terms of the proportion of rivers and lakes holding less than good ecological status (left map), as well as the proportion of rivers and lakes affected by hydro-morphological pressures (EEA 2012 data). Romania stands out for being the only EU country where the entire territory is reported as being above 50 percent good ecological status, and for having less than 30 percent affected by hydro-morphological alterations. Only the Slovak Republic, portions of the Nordic countries (Sweden, Finland and Baltic countries) as well as Northern Spain achieve a comparable performance of between 50 and 70 percent good or high ecological status of their surface water bodies.

The good performance of Romania for the good ecological status of rivers is further illustrated in figure 2.10. It shows that Romania is among the top three EU member states for achieving the good or high ecological status of rivers, alongside Estonia and the Slovak Republic. Romania has a better performance than all large EU countries: it is followed closely by Spain and France, and is well ahead of Poland and Germany. One cause of concern though is the relatively high proportion (above 40 percent) of rivers affected by diffuse pollution pressures.

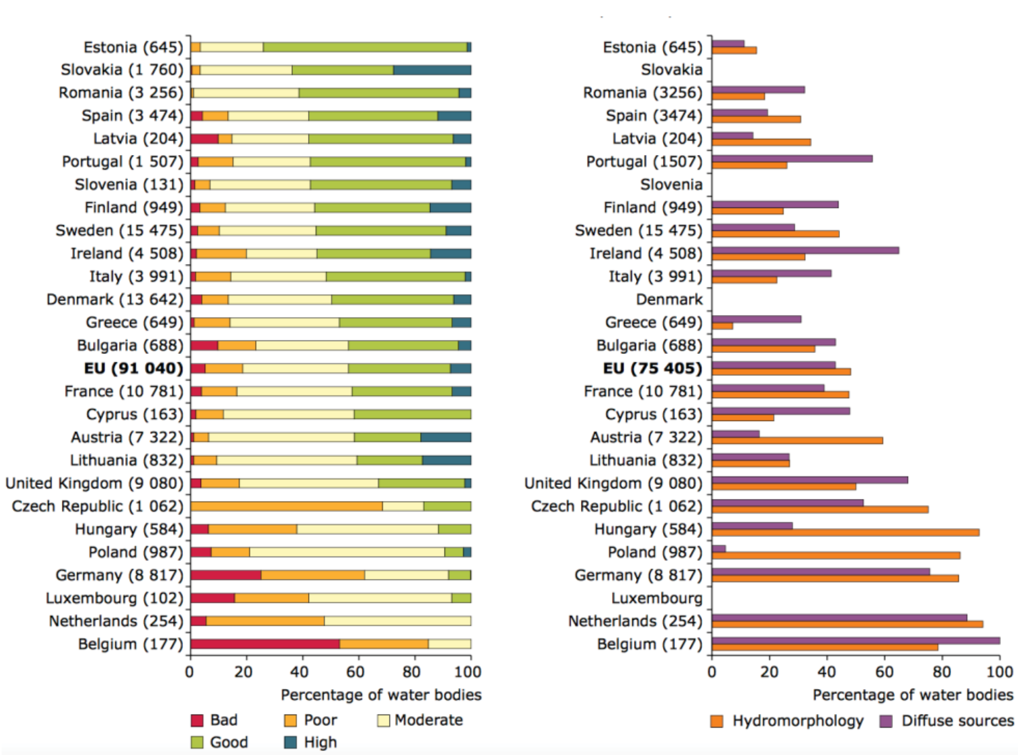
However, **the situation is drastically different for lakes, as Romania stands among the bottom four countries in the EU for achieving good ecological status.** This is illustrated in figure 2.11, with Romania being ahead only of Greece, Belgium and The Netherlands. Only about 15 percent of Romanian lakes have the good or high ecological status. More than 40 percent are affected by

MAP 2.11. Map of Rivers and Lakes Holding Less than Good Ecological Status (Left) and Affected by Hydro-Morphological Alterations (Right)



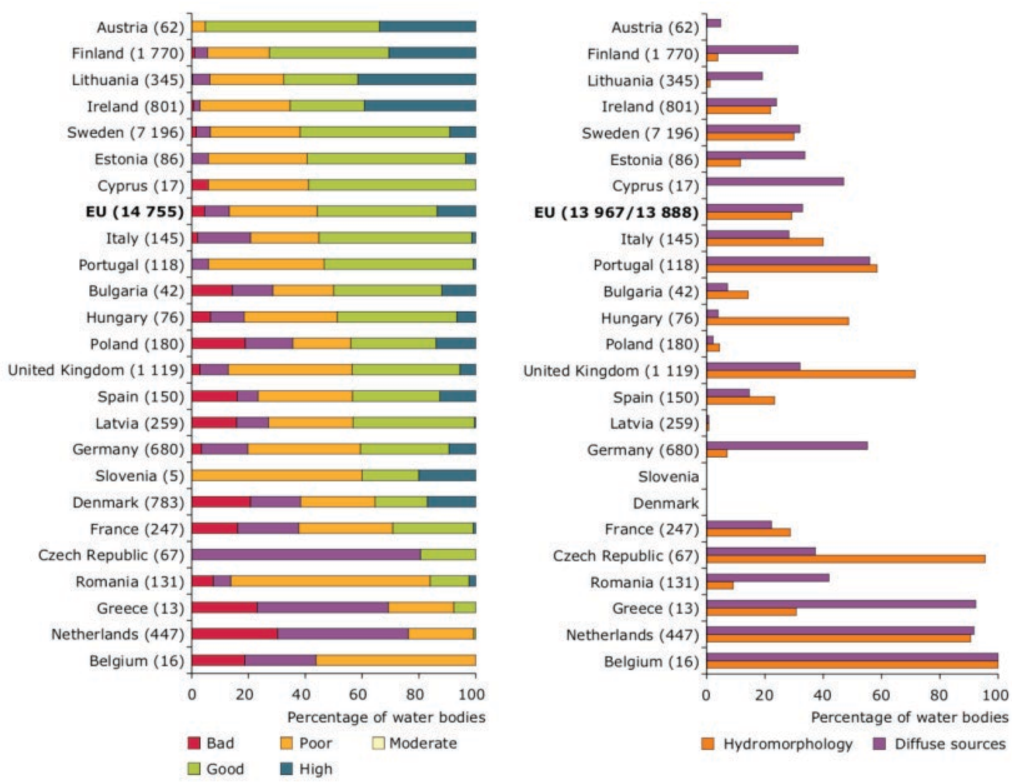
Source: EEA 2012a.

FIGURE 2.10. Ecological Status (Left) and Proportion of Rivers Affected by Hydro-Morphological Alterations and Diffuse Pollution in EU Countries (Right)



Source: EEA 2012a.

FIGURE 2.11. Ecological Status (Left) and Proportion of Lakes affected by Hydro-Morphological Alterations and Diffuse Pollution in EU Countries (Right)



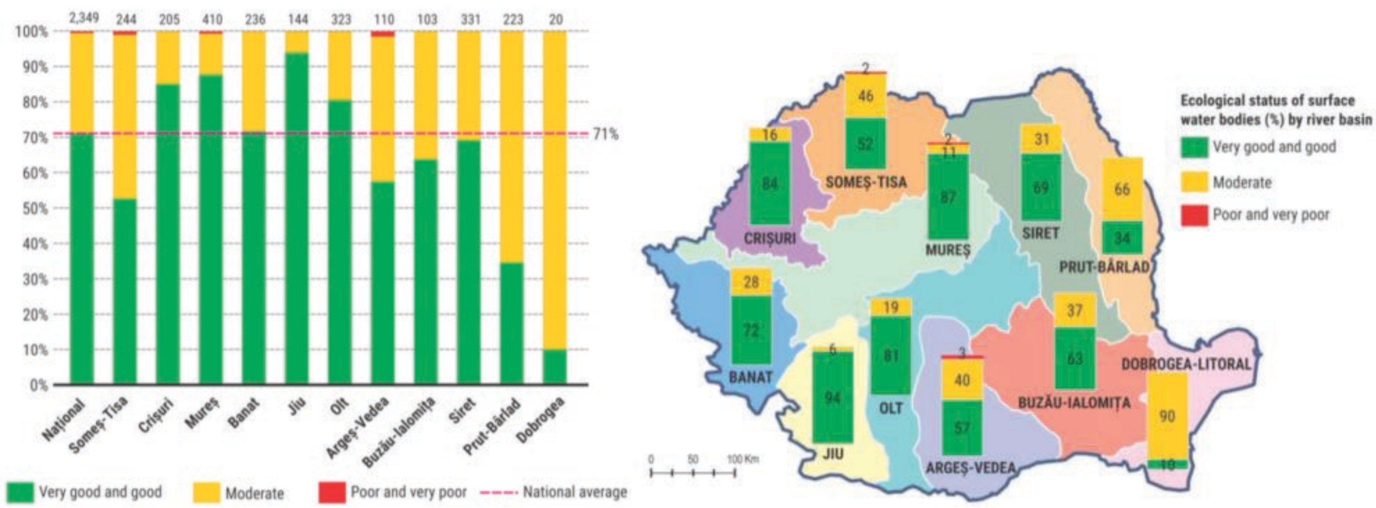
Source: EEA 2012a.

diffuse pollution sources—a figure similar to that for rivers. The fact though that only less than 10 percent of lakes are considered to have the ecological status (much less than in Greece, Belgium and The Netherlands but also France, Denmark, Latvia, Spain, Poland and Bulgaria) gives hope for achieving a tangible improvement over the next decade, once the full implementation of the UWWTD will have brought a significant abatement of domestic sewage pollution.

There are significant variations between Romanian River Basins in terms of ecological status of surface water bodies (rivers). This is illustrated in figure 2.12. The river basins of Jiu, Olt, Crisuri, Mures and Banat have the higher proportion of compliant surface water bodies (rivers)—with a percentage equal or above the national average. The most affected river basins are Dobrogea (Danube delta), Prut-Barlad on the border with Moldova, Somet-Tisa in the North, and Arges-Vedea and Buzau-Ialomita in the lower part of the Danube River.[19] Overall, the river basins with the best ecological status are located in the Western half of the country, while the rivers basin in the Eastern half have a lower than average performance.

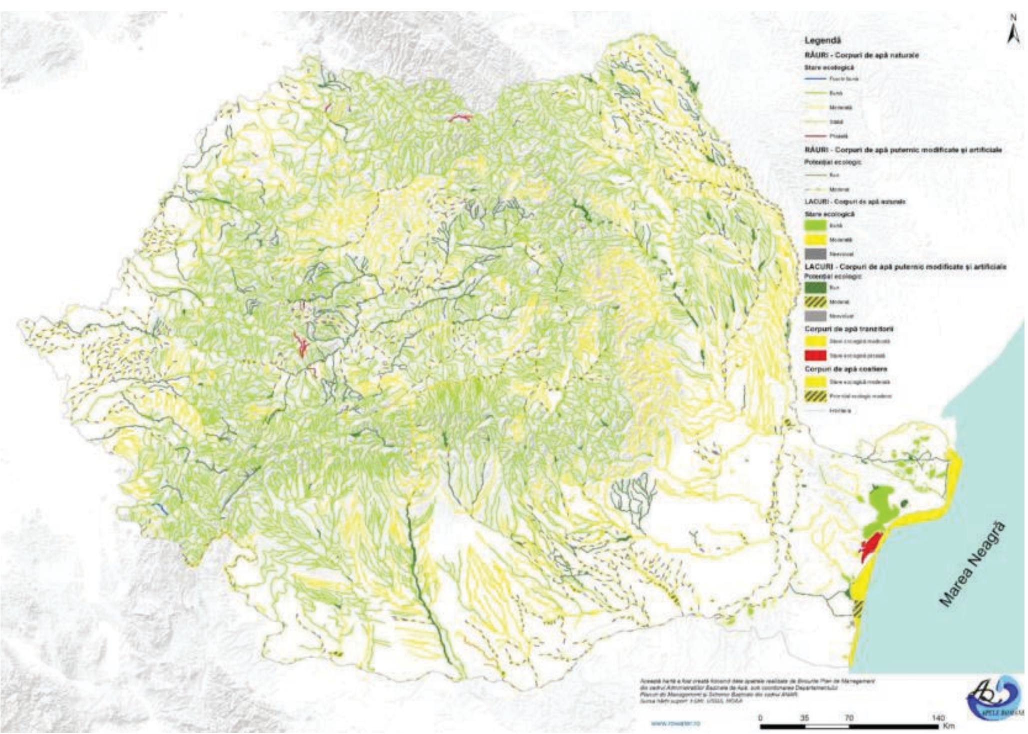
This is illustrated in map 2.12, with a **map showing the location of the permanent river bodies and their current ecological status**. The majority of rivers with the good or high ecological status (marked in green) are located in the Carpathian Mountains of Transylvania—which are

FIGURE 2.12. **Ecological Status of Surface Water Bodies—Rivers**



Source: World Bank's elaboration based on ANAR, 2016.

MAP 2.12. **Map of the Ecological Status of Water Bodies in Romania**



Source: ANAR 2016.

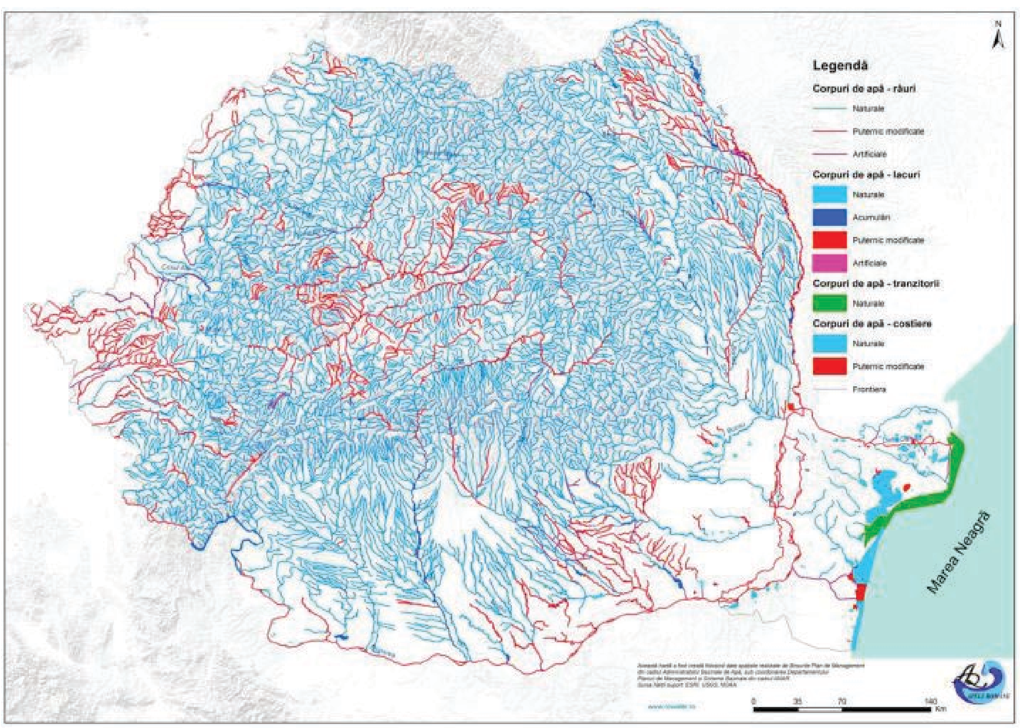
areas with mostly low population density and little anthropomorphic alterations. Rivers with moderate ecological status (marked in yellow) are largely located on the lower Danube plain, the Prut-Barlad basin at the border with Moldova, and the Southern part of the Somes-Tisa basin. It is noteworthy that areas with rivers in less-than-good ecological status largely overlap with the map of the WWTPs to be constructed under the UWWTD, suggesting that compliance with the UWWTD should have a string positive impact for improving the good ecological status performance at national level.

Hydro-morphological alterations of Romanian rivers are geographically concentrated in certain parts of the country. This is shown in map 2.13 below extracted from the national RBMP. These are concentrated on the Western border and its immediate tributaries, in the lower Danube plain, in the center of the country (surrounded by the Carpathians), and in the northeast on the border with Moldova. Only about one-fifth of surface water bodies are affected by hydro-morphological alterations, which is the lower rate among EU countries along with Greece and Estonia.

2.2.6.3. Chemical Status of Surface Water Bodies

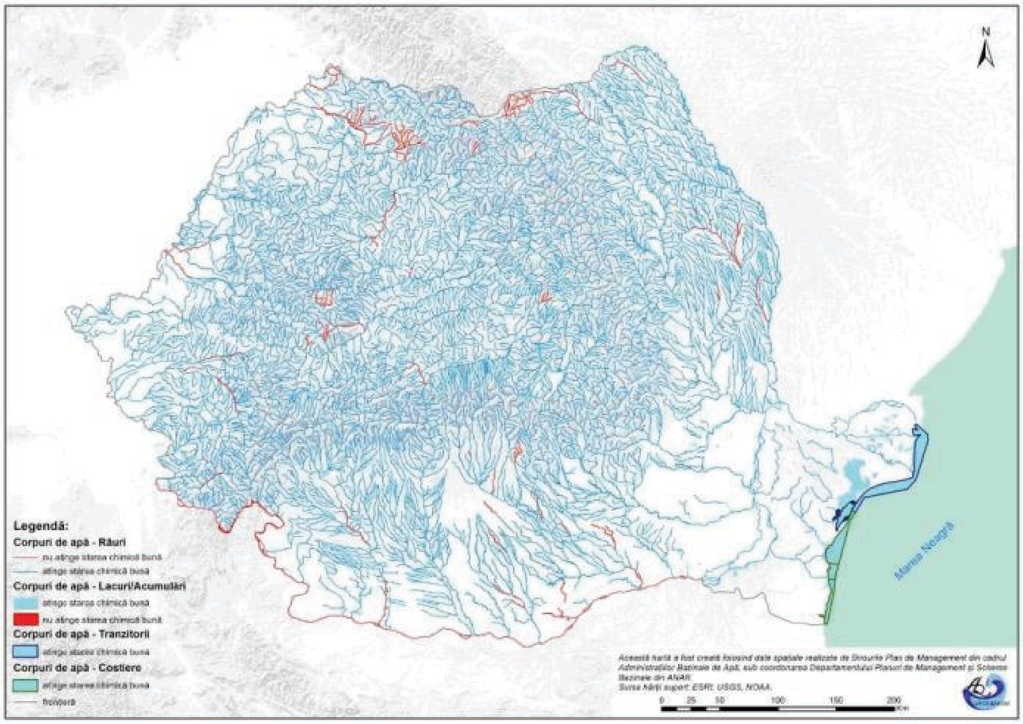
98 percent of Romanian surface water bodies are in good chemical status as of 2015. The Danube river is amongst the remaining 2 percent (69 rivers) that, unsurprisingly, do not reach a good chemical status, but this is due essentially to multiple upstream pollutions outside of the

MAP 2.13. Hydro-Morphological Alterations of Romanian Rivers



Source: ANAR, RBMP 2016.

MAP 2.14. Maps of Chemical Status of Surface Water Bodies in Romania



Source: ANAR 2016.

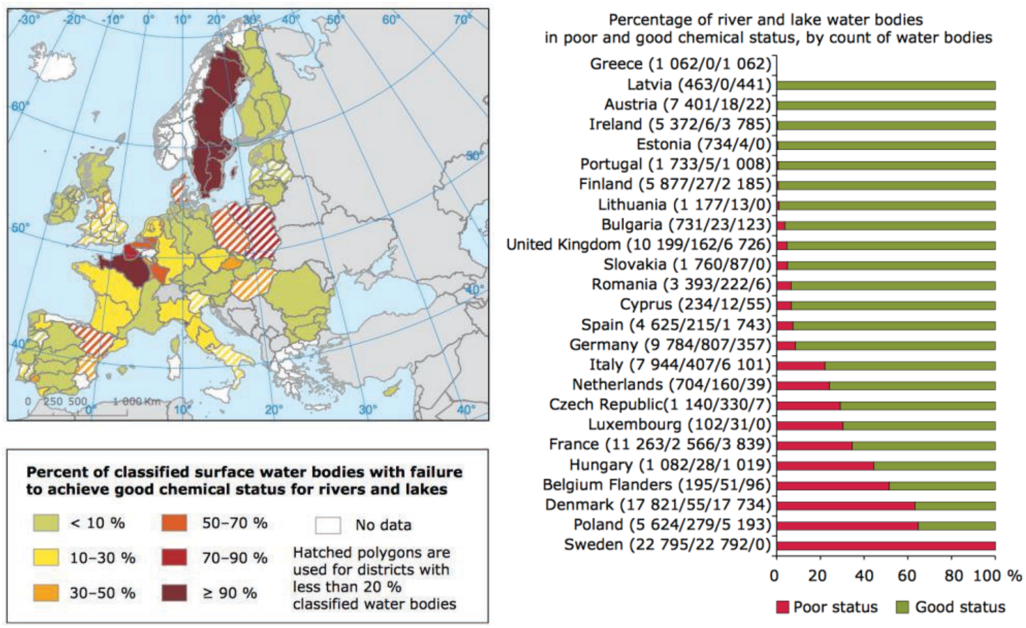
control of Romania. Again, Romania compares well with other EU countries, as illustrated by the map in map 2.14. The results of the assessment, based on the WFD and Environment Quality Standard Directive (EQS) for the concentrations of priority substances, have also been mapped in the same figure. Apart from the Danube, the rivers that still have not achieved good chemical status are spread through the country in a few of "pollution hotspots," as shown in red in the map below, with a higher concentration of these in the north—both in the Somet-Tisa basin and at the border with Ukraine in the Siret basin.

As for achieving good ecological status, **Romania compares well with other EU countries for achieving good chemical status of its surface waters.** The data presented below in map 2.15 does not take into account the progress made under the first round of RBMPs until 2015, but already shows that Romania is amongst EU countries with only a small proportion of surface waters not yet having the good chemical status—in sharp contrast with 10 other EU countries where the proportion of surface waters with a less than good chemical status ranges between 25 percent (Italy, The Netherlands) and 100 percent (Sweden).

2.2.6.4. Groundwater Resources: Quantitative and Qualitative Assessment

Romania has fully complied with the WFD requirements for groundwater resources, with identification of aquifers and regular monitoring of both quantitative and qualitative (chemical) status. A total of 143 groundwater water bodies have been identified under the RBMP.

MAP 2.15. **Chemical Status of Surface Water Bodies amongst EU Member States**



Source: EEA 2012a.

Of these, 115 are at shallow depth and 28 are deep aquifers. Their status is closely monitored for quantitative and chemical condition, since they jointly supply a total of 1,880 drinking piped water systems, and there are about 5 million people in rural areas not connected to piped water networks and depending on private boreholes. Groundwater monitoring is done taking into account all the parameters required by the WFD, including nutrients (nitrogen, nitrogen, ammonium, phosphates) with the frequency of once to twice per year (all drillings and springs) for the surveillance program and twice per year for the monitoring points included in the operational program.

Romania's groundwater monitoring network can be deemed broadly satisfactory—as shown by comparing the network density with other EU countries. While the number and density of groundwater monitoring stations reported by the member states shows high disparities (as shown in table 2.11), Romania, with a total of 2,844 monitoring wells (8 percent of total in EU) and 7.5 sites/1,000 km^2 is close to the EU average (8.0 sites/1,000 km^2 in 2011) for the density of groundwater monitoring stations. The monitoring network has a higher density in the plains area (in inter-fluvial areas), as well as in the valleys of the main water courses, while a lower density can be observed in mountain areas, generally considered natural areas (where the anthropic pressure is lower).

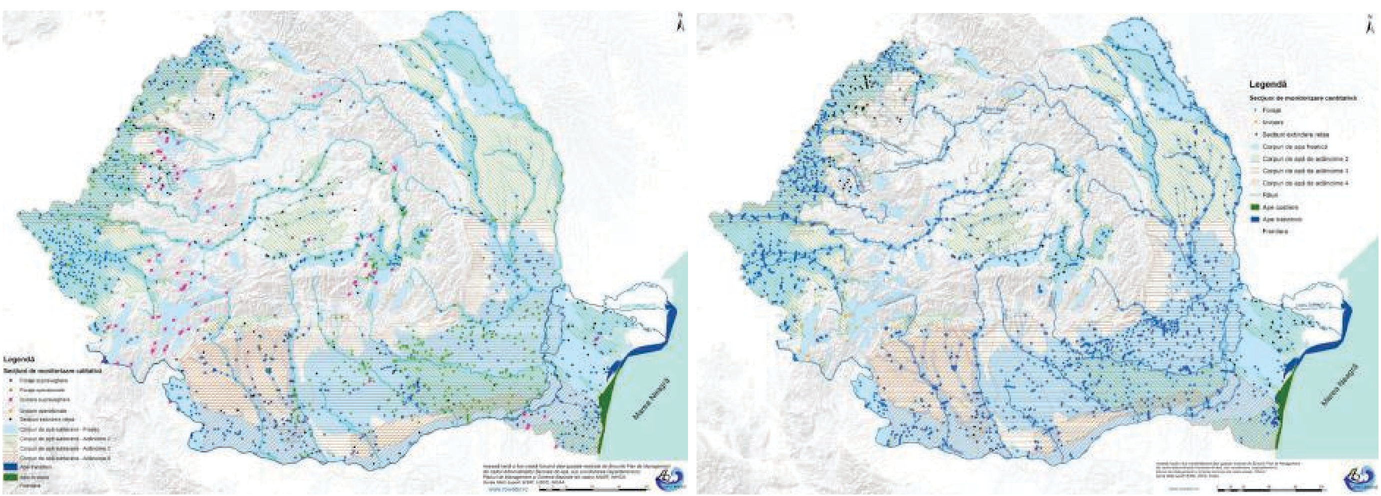
The groundwater monitoring stations are largely concentrated in the lower Danube plain, as well as in the Crisuri and Mures basins, at the border with Hungary and Serbia (as shown in map 2.16).

TABLE 2.11. Groundwater Monitoring in Some EU Countries (2011)

Member state	Groundwater stations with measurements	Groundwater stations density per 1,000 km²
Germany	162	0.5
Denmark	595	14.0
Estonia	299	7.1
Finland	79	0.3
Latvia	174	2.8
Poland	1,258	4.1
Sweden	326	0.8
Austria	n.a.	1.1
Netherland	n.a.	9.3
Spain	n.a.	23
United Kingdom	n.a.	11.9
Romania	**2,844**	**7.5**
EU	**33,493**	**8.0**

Source: World Bank's elaboration based on EEA and other data.
Note: n.a. = not applicable.

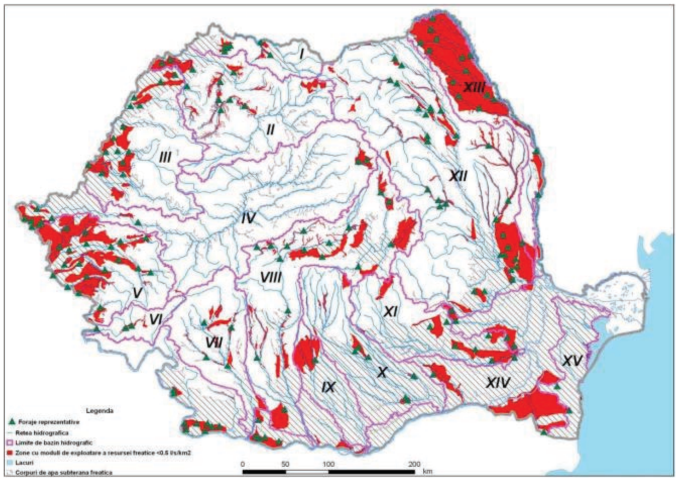
MAP 2.16. Monitoring Network for Chemical (Left) and Quantitative (Right) Status of Underground Waters



Source: ANAR 2016.

Ongoing quantitative assessment shows some gradual deterioration in overall groundwater resources availability, in some parts of the country. The monitoring network has been registering a slight drop of the hydrostatic level in about 75 percent of wells, which is considered not to be a result of anthropic activities but rather an effect of climate change. This change is matching the pattern of the average evolution of the multiannual average and, thus, the quantitative status of subsurface water was assessed to still be good. **The assessment of groundwater resources located in deep aquifers, has identified a number or zones with scarce water availability.**

MAP 2.17. Location of Phreatic Water Bodies with Reduced Resources



Source: ANAR 2016.

Map 2.17 shows the location of the phreatic bodies of water (medium to shallow depth) with identification of the areas with scarce resources and at risk of over-abstraction.

89.5 percent of underground water bodies in Romania have good chemical status as of 2015, and 10.5 percent have a poor chemical quality. There was marginal improvement compared with 2009, up from 86.6 percent, underlining that reverting pollution trends in aquifers can be a long process. Overall again, Romania fares well compared to other EU countries, but significant discrepancies can be found between river basins, as shown in table 2.12 and map 2.18. The largest hotspots for chemical pollution of the aquifers are located in the west (Banat basin) and in the north and south of the Prut-Barlad basin (border with Moldova)—which also happen to be the hotspots for aquifers over-abstraction.

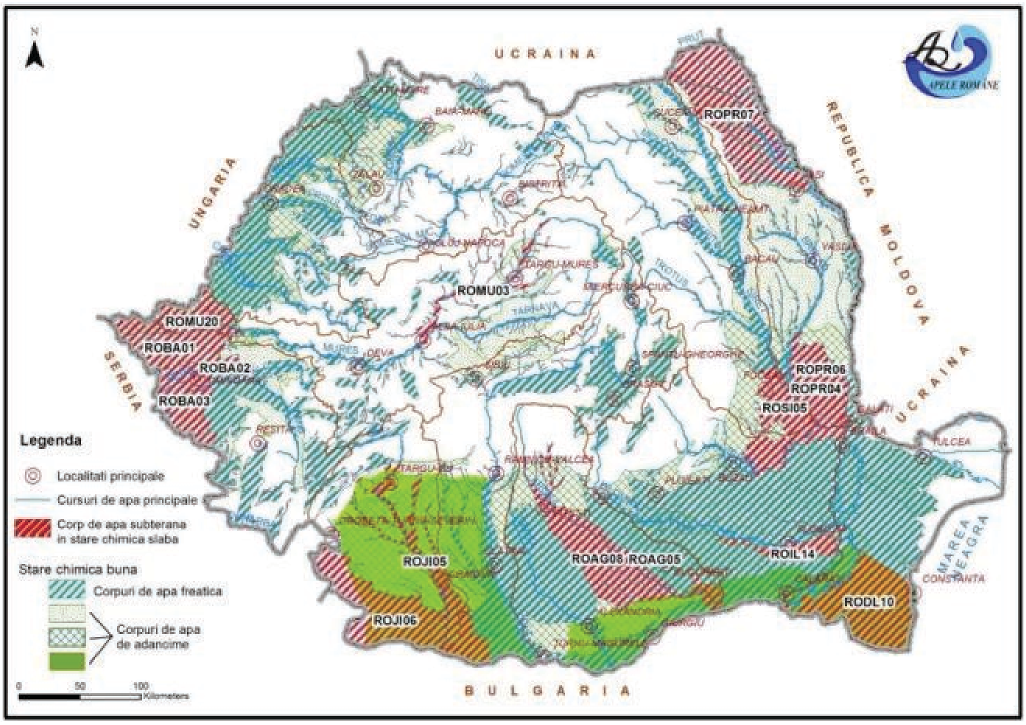
Again, Romania compares reasonably well with other EU countries in terms of achieving good status for its groundwater resources. As illustrated in map 2.19 below, it stands alongside Hungary and the Slovak Republic for having only between 10 and 30 percent poor groundwater chemical status nationwide. This is more than the best performers—namely Sweden, Finland, the Baltic countries, Poland and Austria—but is much better than older EU member states of Western Europe, as well as Bulgaria. Furthermore, this figure was based on older data that did not take into account the progress achieved between 2009 and 2015 with the implementation of the first round of RBMPs in Romania.

TABLE 2.12. Status of Subsurface Water Bodies

River basin	Number of subsurface water bodies	Qualitative status		Quantitative status	
		Good	Poor	Good	Poor
Somes-Tisa	15	15	0	15	0
Crisuri	9	9	0	9	0
Mures	25	23	2	25	0
Banat	20	17	3	20	0
Jiu	8	6	2	8	0
Olt	14	14	0	14	0
Arges-vedea	11	9	2	11	0
Buzau-Ialomita	18	17	1	18	0
Siret	6	5	1	6	0
Prut-Bârlad	7	4	3	7	0
Dobrogea-Litoral	10	9	1	10	0
Total	143	128	15	143	0

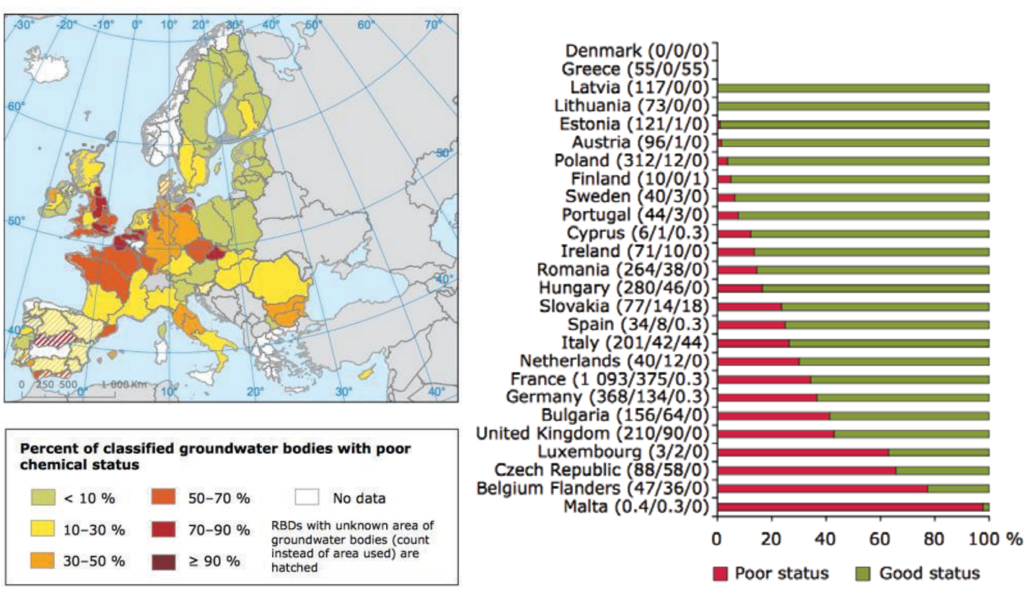
Source: ANAR 2016.

MAP 2.18. Chemical Status of Underground Water Bodies



Source: ANAR 2016.
Note: Aquifers in poor chemical quality appear in red.

MAP 2.19. Chemical Status of Groundwater Bodies in EU Countries



Source: EEA 2012a.

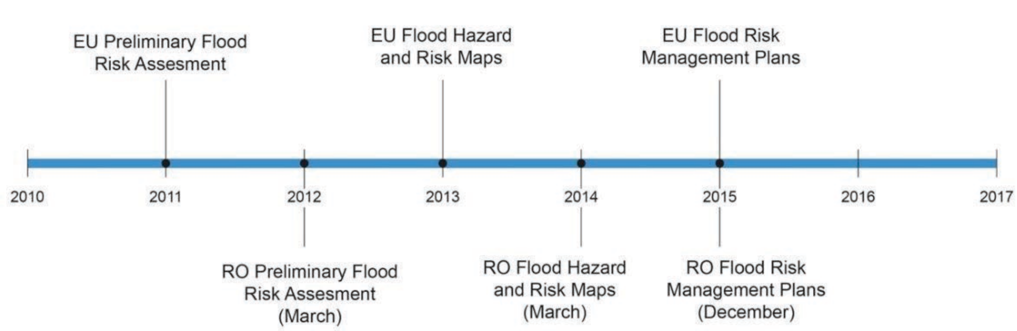
2.2.7. Floods Management Directive: Flood Risks Have Been Duly Identified

As mentioned earlier, flood risk management is regulated by the Romanian Water Law, which fully transposed the EU Flood Management Directive, including all steps required for its full and timely implementation illustrated in figure 2.13. The Water Law also provided the framework for the preparation and adoption of the main country strategy for floods management. The authority responsible for the implementation of the Water Law, including Water Flood Directive, is the Ministry of Waters and Forests (MWF) through the National Agency "Romanian Waters" (ANAR). The MWF is the central public authority which is responsible for the development of water management strategies, including flood risk management, while ANAR is the national authority responsible for the implementation of the national policies on water, including flood risk management, at two levels, strategic and operational.

Romania has fulfilled the requirements of the EU Flood Directive, which focuses on floods risks assessment and mapping. Flood Hazard Maps for different recurrence periods, Flood Risk Maps and FRMPs ("ANAR: The Operational Arm for Water Resources Management" section in chapter 3) were duly prepared and submitted to the EC by the 2015 deadline. All flood risk assessments, maps and plans have been disclosed to the public. Risk maps are available at the ANAR[20] and EU[21] in English and Romanian. It is important to note that while flood risk maps and management plans need to be submitted to the EU for confirmation of completion, they are not subject to approval or checking by the EU, but just accepted as issued by the national authorities. Also, implementation of the various measures proposed in the FRMPs is not subject to monitoring and reporting to the EC.

Romania's approach in the implementation of the Flood Directive was to set up strategic and operational objectives aligned with all Danube River riparian countries. Romania already had extensive experience in mapping the flood risk and undertaking risk prevention actions prior to EU accession. Both types of objectives were set at national level and then

FIGURE 2.13. Timeline of the Implementation of the EU Flood Directive



Source: EC.

TABLE 2.13. Specific Objectives to be Achieved by the FRMP

National strategic objective	Specific objective	Remarks
Economic	Minimization of flood risk to economic activities, with special emphasize on: • Minimize flood risk to transport infrastructure • Minimize flood risk to agriculture lands	**4% of Romania's total population is located in flood prone areas,** equivalent to a total of 0.8 million inhabitants **6% of railroads** at risk of floods
Social	Minimization of flood risk to people with special emphasize on minimization of risks to human health and life	
Environmental	Minimization of flood risk for areas where there is an intake for water supply consumption Minimization of flood risk of places where there is potential for pollution Ensure compliance with WFD for conservation and good environmental status	**About 100 intakes for water supply are in flood risk areas**
Cultural heritage	• Minimization of damage to cultural heritage	

Source: WB elaboration based on FRMP.

evaluated at catchment level. The strategic objective refers to the guiding principles of what should be protected, while the operational objective refers to the minimization of occurrence of potential risks of flooding and their negative impact. The strategic objectives for flood risk management were adopted to be the same as the ones agreed by the International Commission for the Protection of Danube River (ICPDR) countries: *reduce existing risks, avoid new potential risks, increase resilience, advocate for awareness, and collaborate and have a common approach to risk mitigation*. These objectives have been transposed in Romanian national objectives that focus on the reduction of potential socio-economic consequences of floods. The strategic national objectives affect different stakeholders, hence specific objectives depending on the affected stakeholders have been defined, as highlighted in table 2.13.

FRMPs include a set of operational indicators to achieve specific objectives. Each set of indicators is applied to a particular river basin based on the associated FRMP of the basin. A national catalogue of structural and non-structural flood protection measures has been issued, based on a collection of potential measures to be used by each river basin administration in accordance with their specific needs for flood protection. The catalogue is a result of consulting EU guidelines referring to flood management, ICPDR approaches, handbook of good practices for flood protection in different EU member states, Romanian stakeholders, and working discussions within ANAR. The proposed measures address the areas of the flood risk management cycle: prevention, protection, preparedness, public awareness and recovery. Examples of measures for each of the areas, as listed in the list of potential measures, are given in table 2.14.

TABLE 2.14. Catalogue's Example of Potential Protection Measures

No.	Area	Examples of potential measures (listed in the catalog of measures)
1	Prevention	Improvement of the legal framework
		Issuing and continuing updating of Flood Management Plans
2	Protection	Creation of wetlands
		Restauration and maintenance of floodplains
		Implementing land use strategies for soil erosion protection
3	Public awareness	Regularly informing the population of the risk of flooding
		Evacuation exercises
4	Recovery	Repairing of affected infrastructure
		Rehabilitation of affected infrastructure

2.3. Beyond Compliance: Inclusion of the Poor Is a Major Concern

2.3.1. Access to WSS Services: What the EU Water Legislation Fails to Address

The focus on compliance with the EU Water legislation, as part of the obligation to harmonize with the EU Environmental Acquis, created a positive momentum for water reforms in Romania. This includes carrying out extensive assessment and mapping of the status of all water bodies across the country, identifying measures to be carried out in an integrated manner to move towards sustainable management—including for mitigating flood risks—and starting to implement massive infrastructure investment for pollution abatement. In urban areas (agglomerations of more than 10,000 PE) the sewage collection rate now reaches 84 percent, and 78 percent of the urban domestic load is treated before discharge. In spite of the many challenges encountered and delays in implementation, there have been obvious benefits for public health and the protection of water resources in Romania.

In parallel, access to EU grants—which have represented the majority of investment funding for the past two decades—**has enabled major institutional reforms in WSS services**. Access for EU cohesion funds for WSS investments has been limited to localities that have delegated the provision of WSS services to the newly created regional operators, pushing for aggregation of WSS service providers into regional utilities, which both brought economies of scale and allowed to better deal with limited capacity of operators at the local level. This was supported by other key reform measures largely piloted by the EC, such as the establishment of a national regulator, a move to gradually increase WSS tariff levels towards full-cost recovery (by 2017; tariff levels in regional utilities now fully cover all O&M costs, plus some surplus), and access to commercial borrowing for the best regional utilities to cover a portion of their investment financing needs.

Unfortunately, such focus on EU compliance was also bound to result in priority allocation of scarce resources (both financial and execution capacity) to compliance investments. As will be discussed below, there are about 5 million people in Romania (mostly in rural areas) who in 2017 do not have access to piped potable water in their house—a complete oddity for an EU member state. But this is not "dealt with" under the current EU water legislation, which instead focuses on investing in sewerage systems to comply with the UWWTD. The DWD focuses on ensuring the potability of water distributed through piped network serving more than 50 people or 10 m^3/day—it does not require monitoring smaller rural water systems, and does not have any provision for situations where there is no access to piped water systems at all. Similarly, and despite initiatives to promote the recognition of access to water and sanitation as a human right, in line with the July 2010 UN Declaration, the EU water legislation does not address the need to ensure affordable tariffs for the poor.

The core problem though is that the **EU Water legislation was enacted by older EU member states, before new members from Central and Eastern Europe joined in.** The older directives such as the UWWTD, Nitrate Directive, DWD and BWD were all passed in 1991 or earlier, and the WFD was passed in 2000—while the majority of the so-called "EU-13 countries" joined in 2003, and Romania and Bulgaria did so even later, in 2007. It was therefore conceived in view of the needs of these older member states at the time, which is why *inter alia* it tends to focus on pollution abatement and requires major expansion of sewerage infrastructure—which was largely under-developed in Western Europe two decades ago—while not explicitly addressing the issue of access to piped potable water—for which Western European countries had already largely achieved universal access at that time.

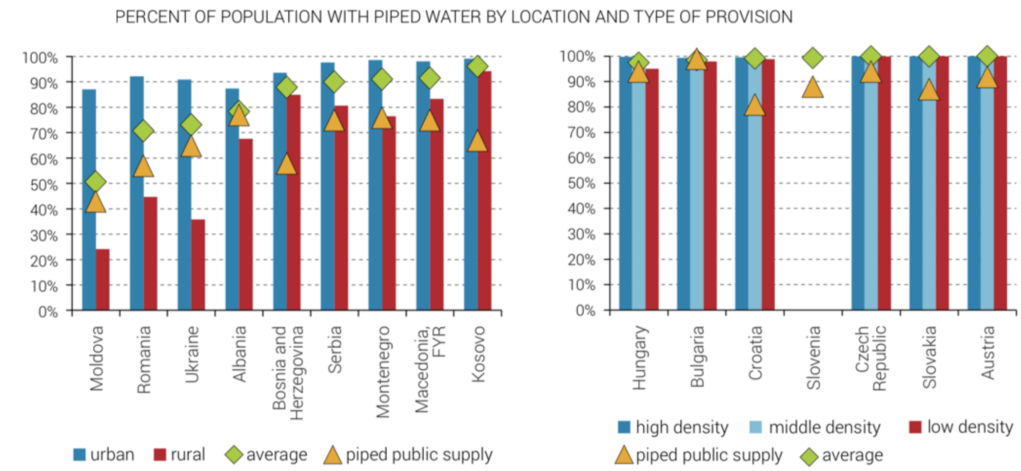
2.3.2. Potable Water Access Gap: Four and a Half Million Romanians without Access to In-House Piped Water

Only about 12.6 million people in Romania have access to piped potable water services through WSS providers—corresponding to an **overall connection rate of 63.7 percent** (ANRSC, 2015).[22] Further, an estimated **2.8 million people have piped water in-house coming from their own private well** (based on 2016 household surveys) raising the overall national access rate to piped potable water to 77.6 percent (up from 72 percent in 2012).

The overall 77.6 percent water access rate means that about four and a half million Romanians do not have access to piped potable water in their house. As shown in figure 2.14 below, such access rate is low not just by EU country standards—Romania being the only EU country without almost universal access for potable water—but even in comparison with other non-EU neighboring countries. In the region, only Moldova has a lower access rate for potable water—at about 50 percent nationwide—while Ukraine (a much poorer country, and not a member of the EU) achieved a similar rate to Romania, based on 2012 household surveys data. All other non-EU countries located in the Danube basin—namely Albania, Bosnia, Serbia, Montenegro and the former Yugoslav Republic of Macedonia—had a higher access rate for piped potable water than Romania, even though they have a lower GDP per capita and the reform of their WSS sector is less advanced than in Romania.

The majority of the Romanian population without access to in-house potable water is concentrated in rural areas, and relies on private wells. While not by itself surprising, the discrepancy is nonetheless considerable. The rural connection rate to piped water networks stands at

FIGURE 2.14. Access Rate to Piped Water in Danube Basin Countries



Source: WB DWP, State of the Sector, 2015.

28.7 percent, against 93.8 percent in urban areas (ANRSC 2015). The proportion of households with access to piped water in house stands at 94.8 percent in urban areas, against only 60.2 percent in rural areas (2016 household surveys). This situation is largely the result of ingrained past practices. Because of the large and dispersed rural population in Romania, and wide access to plentiful shallow underground waters in most of the country, Romanian rural households have traditionally relied on their own private wells. Private wells continue today to be commonplace in rural Romania (photograph 2.1). Contrary to what happened in other Eastern-bloc countries, there was no effort under the communist regime to invest in rural piped water systems. As a result, the nationwide access rate to piped potable water stood at less than 40 percent in the early 1990s. In that regard, the difference with neighboring Bulgaria is striking: the communist regime there invested massively in rural piped water systems, achieving universal access by the late 1980s.

PHOTOGRAPH 2.1. Private Wells in Rural Romania Landscape

Source: Pinterest & all-free-download.

There is a serious concern that the piped water access gap results in significant public health risk for the unconnected population. Most private household wells tap into shallow aquifers which have a high risk of contamination due to anthropogenic influences, as a direct consequence of the absence of sewerage systems in rural agglomerations, as well as poor individual sanitation practices. Despite the risks, most Romanian households relying on wells do not carry out routine testing of the quality of the water from their private well, nor have any disinfection practices. Also, a significant portion of the shallow aquifers in Romania (as elsewhere in the EU) is contaminated with nitrates.

It is estimated that about **12 percent of the Romanian population—or about 2.5 million people—are using unsafe, non-potable water sources for self-supply.** This is based on data from the Joint Monitoring Program (JMP) of WHO-UNICEF, with only 88 percent of Romanians reported to have access to safe water sources in 2015. As already indicated, the EU DWD does not cover populations served through private wells, and also does not have any monitoring requirements for the quality of water distributed through VSWSZs, that is, those serving less than 50 people or with a capacity of less than 10 m^3/day.

There has been an increase in potable water access rate over the past two decades—but starting from a very low base, this has been insufficient for Romania to close the access gap. Back in the early 1990s, the access rate to piped potable water stood at less than 40 percent. By 2008, it had gone up to 53.1 percent for access to piped distribution network (managed by WSS operators), and then up to 63.7 percent in 2015. However, much of this access increase took place in urban areas. And the actual increase in access to in-house piped potable water in the last decade is probably lower, as a portion of those households that became connected to water distribution networks probably had already in-house self-supplied piped water systems.

Under the current trend, Romania would have to wait until at least 2040 to achieve universal access to potable piped water—and align with other EU countries. This can be simply inferred by the fact that over the last eight years, the connection rate to piped water distribution networks has increased by only about 10 percentage points—or about 1.4 percent per year on average. In reality, under a "business as usual" scenario, universal coverage would probably not be achieved until 2050 or beyond, since increasing access will inevitably become more difficult and expensive as coverage gets higher.

Despite the massive amounts of EU funds that went to the Romanian WSS sector, less than one million people have been connected to piped potable water networks since 2007. This fully illustrates the current "hidden agenda" in current EU water legislations and policies, which fail to address the issue of guaranteeing access to potable water for all, while putting most of the focus on building sewerage systems for pollution abatement under the UWWTD. It is also noteworthy that about 2.2 million of the currently unconnected population is located within the current area of service of the public regional utilities (ROCs)—raising questions about whether the regionalization policy initiated a decade ago is fully addressing the potable water access gap.

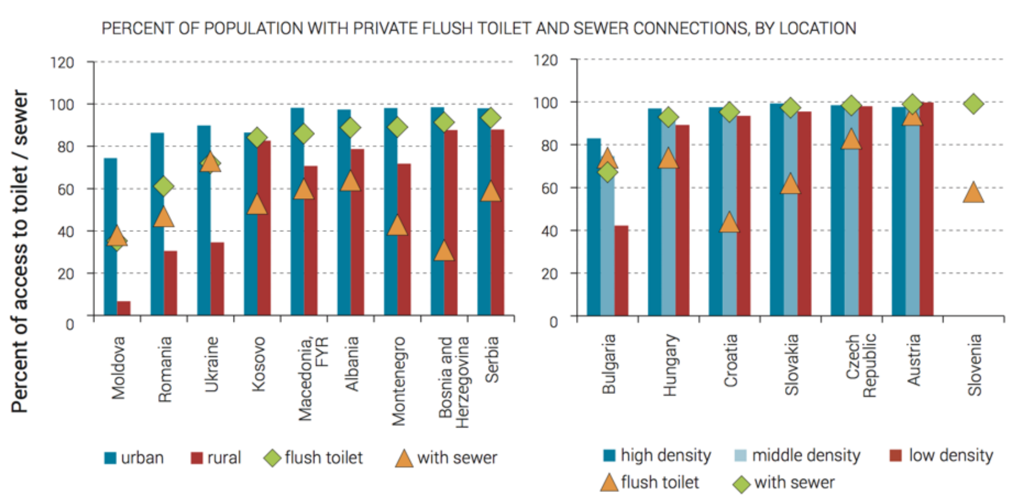
2.3.3. Sanitation Access Gap: More than Six Million Romanians without Flush Toilets

The access gap is even wider for improved sanitation, with access to toilets in house standing at 68.3 percent nationwide, based on the latest 2016 household surveys. This is up from only 61 percent, based on 2012 household survey data. About six million Romanians are without access to flush toilets, mostly in rural areas. The access rate to sewage collection system is much lower, at 48 percent nationwide in 2015 (about 9 million people), and the increase in the sewerage connection rate has been even more modest than for connection to piped water network over the last decade—with an increase of less than 5 percentage points over eight years (it was at 43 percent in 2008). Like for water, the access gap is largely driven by discrepancies between rural and urban areas: only 47.7 percent of the rural population has access to indoor toilets, against 88.7 percent of urban households (2016)—although the access rate in rural areas has increased significantly in recent years (it was at 30 percent in rural areas in 2012 based on previous household surveys, against 86 percent in urban areas).

Romania clearly falls behind other countries in the Danube basin for access to improved sanitation—whether compared to EU and non-EU countries. Even though the access rate in Bulgaria is only slightly above the one in Romania, non-EU countries in the Western Balkans (FYR Macedonia, Serbia, Montenegro, Bosnia and Albania—all above 80 percent) as well as Ukraine (72 percent) all have a higher access rate to flush toilets than Romania (figure 2.15). The only country falling well behind Romania is the neighboring Moldova—which is close to Romania culturally and has similar ingrained water and sanitation practices in rural areas (relying on private wells and pit latrines).

Like for the water access gap, the EU water legislation does not address the issue of access to improved sanitation. First, the UWWTD focuses on agglomerations of more than 2,000 PE.

FIGURE 2.15. Access Rate to Private Flush Toilets and Sewer Connections in the Danube Basin Countries



Source: WB DWP, State of the Sector, 2015.

It therefore does not cover the large portion of the Romanian population living in villages and small rural settlements, which also happens to have the higher poverty rate and lower access to flush toilets. Second, the UWWTD focuses only on reducing discharges of domestic sewage—not on ensuring that all households can have access to improved sanitation. It only requires that households connect to a sewerage collection system or have an IAS, not that they install a flush toilet in their house. This problem will therefore not be solved by Romania merely complying with the UWWTD.

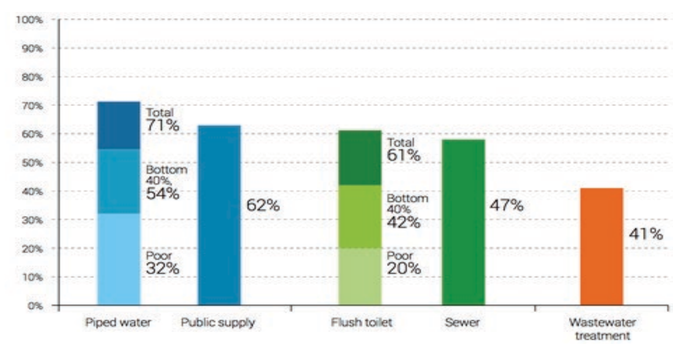
2.3.4. The WSS Access Gap Mostly Affects the Rural Poor and Marginal Groups

The WSS access gap is clearly an inclusion issue, as it is particularly critical for the poorest households, with much lower coverage figures. For the two poorest income quintiles, only 54 percent have access to piped potable water, and 42 percent to flush toilets—against 71 percent and 61 percent respectively on average nationwide (figure 2.16). For the poorest share of the population—those living under the poverty line i.e., on less than US$2.50 a day per capita—the access figure is even lower: only 32 percent have access to piped potable water, and a mere 20 percent to flush toilets.

Lack of access to piped potable water and flush toilets is a major poverty inclusion issue in Romania. The access gap to water and sanitation is largely driven by location, and concentrated in rural areas—which is also the main foyer of poverty across the country—as well as to a lesser extent in marginalized neighborhoods in urban areas. Over the last two decades, **progress has been made to reduce the WSS access gap in rural areas—but starting from a low base.** The rural access rate for piped potable water went up from a mere 16 percent in 1992 to 22 percent in 2001 and 33 percent in 2012. Access to flush toilets has also been improved, especially over the past decade: while in 2008 only one in five households used an indoor toilet, in 2012 this had increased to almost one in every three.

For about half of Romanian rural dwellers, pit latrines are still the norm today. While this may be an acceptable standard for the "older generation" (photograph 2.2), this is unlikely to be the case for the younger ones. Widespread experiences from developing countries all around the world clearly show that access to improved sanitation (especially flush toilet) can be an important factor to foster dignity and self-respect in communities, which is one of the engines for local economic development. In this context, it is hard not to

FIGURE 2.16. Access to WSS: Total Population, Bottom 40 Percent and the Poor



Source: Danube Water Program, State of the Sector 2015.

PHOTOGRAPH 2.2. Pit Latrine in Rural Romania

Source: Susanna Smets, WB.

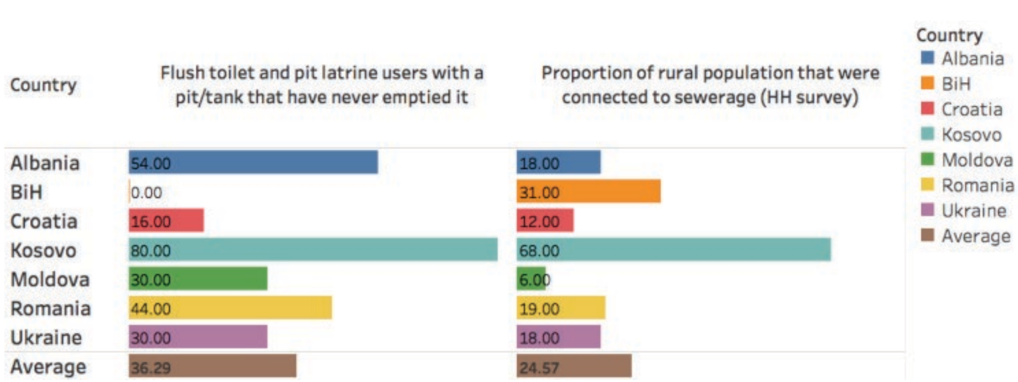
make some connection between the massive outmigration and rural desertification in rural Romania with young people fleeing to big cities or abroad—and the dire sanitation conditions that prevail.

The sewerage access gap in rural Romania is also linked to widespread poor sludge management practices, with negative public health consequences. As will be seen later in this report, sewage collection systems are largely undeveloped in rural Romania (about 15 percent in rural agglomerations, and virtually absent in villages). Figure 2.17 shows the on-site sludge management practices from households in various Danube basin countries, based on the household survey conducted by the WB in 2017. Close to half (44 percent) of rural Romanian households interviewed indicated that they have never emptied their cesspit. This proportion is much higher than the Danube regional average (36 percent), and also higher than in Moldova and Ukraine (only Albania and Kosovo fare worse). Given Romania's high reliance on private wells, this has obvious public health consequences, as many wells are likely to be subject to fecal contamination—whether from a household's own cesspit or from its neighbors'.

In addition to the urban-rural access gap across the country, there appear also to be inequalities in WSS access for the Roma population linked to marginalized urban areas. The difference in potable access rate between Roma and the rest of the population is mostly prevalent in urban areas—where only 14 percent of those living in marginalized urban areas have access to piped water in 2011 (WB, 2015) (figure 2.18). In rural areas, the difference is much less pronounced, with 22 percent of rural Roma having access to potable water access from piped distribution networks in 2011 against an average of about 30 percent. Romania appears to have a much wider gap in access to piped water and improved sanitation for Roma than all other EU countries in the region—even though there are also significant discrepancies on access to improved sanitation between Roma and non-Roma in Bulgaria, the Slovak Republic, and Hungary.

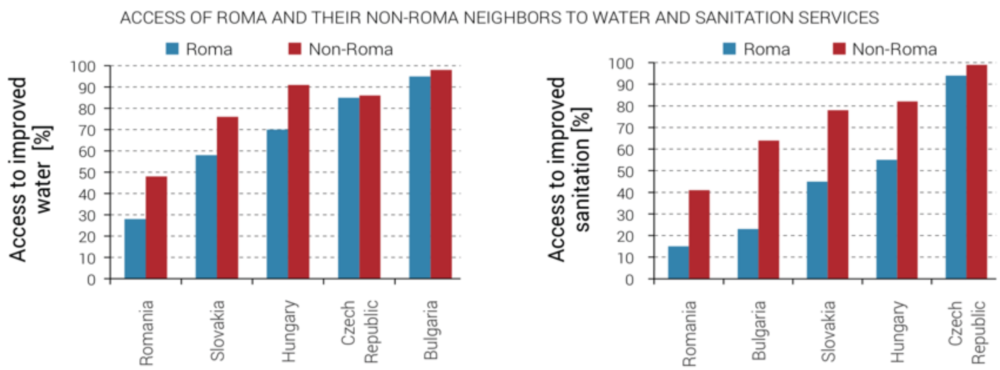
The large urban access gap for Roma appears largely related to the specific challenges of marginal neighborhoods. Marginalized urban areas also have a connection rate to piped water of

FIGURE 2.17. On-Site Sludge Management Practices in Rural Areas in Danube Countries



Source: WB study on WSS access gap in Danube countries, 2017.

FIGURE 2.18. Access of the Roma and their Non-Roma Neighbors to WSS



Source: WB 2015.

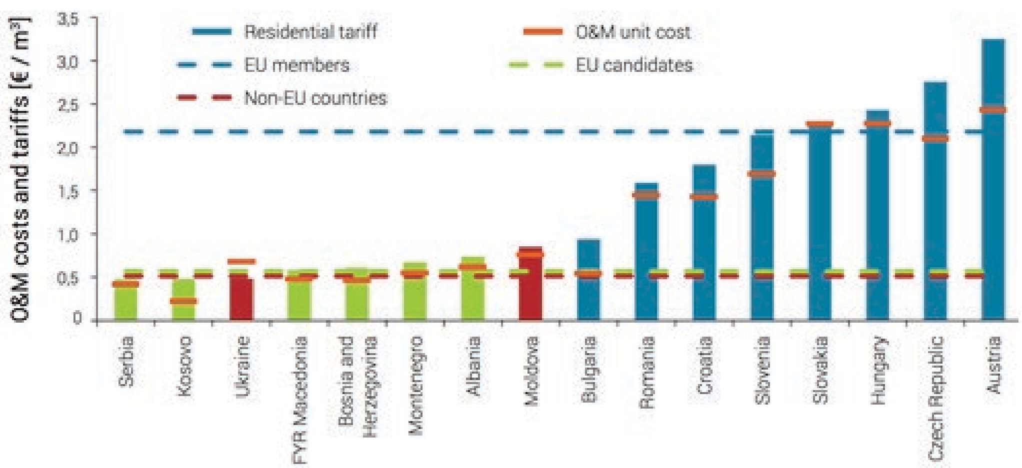
70 percent, much lower than the national urban average (WB, 2014). Based on a new household survey conducted in 2016 by the WB on the WSS access gap in small agglomerations and rural areas, for those Roma families connected to the piped water system, there was no evidence of discrimination in treatment by the respective utilities—whether under regional or municipal administration. This suggests that the problem is largely related to the fact that a large portion of the Roma in urban areas is living in marginal neighborhoods, with issues such as un-legalized land occupation and **lack of property titles which often legally prevent the WSS utility from connecting such households to the WSS network.** In such areas, the actual access figure for piped potable water in urban marginalized areas may be under-estimated, as illegal connections are a prevalent phenomenon.

2.3.5. Affordability of WSS Tariffs: Growing Concern under Current Regulatory Rules

WSS tariffs have increased steeply over the past two decades, slowly approaching WSS tariff levels in other EU-13 countries. Following an increase of about 30 percent over the last 5 years, the average WSS tariff for the public regional utilities stands at about 1.3 euros per m^3.[23] This underlines the major effort made by Romania to push for convergence with the WSS sector in other EU countries. This is illustrated in figure 2.19 below which compares average WSS tariff for both EU and non-EU countries in the Danube basin (based on 2015 data). WSS tariff levels in Romania are now about three times higher than in neighboring non-EU countries such as Serbia, Ukraine, Moldova, Albania and FYR Macedonia—and also much higher than in neighboring Bulgaria (which joined the EU in the same year).

It was estimated that in 2015 the average WSS bill represented about 2.9 percent of the average Romanian household's disposable income—up from about 2 percent back in 2005[24]—**suggesting that affordability is becoming a concern.** Due to significant variations in tariff levels across utilities, there are some regions where the income spent by the average household is even higher—close to or above 3.5 percent. Considering that this threshold is based only on average households' income, this also means that poor households connected to WSS

FIGURE 2.19. O&M Costs and Residential Tariffs (Water and Wastewater) in Danube Countries



Source: WB State of the Sector in Danube Region 2015.
Note: EU = European Union; O&M = operations and maintenance.

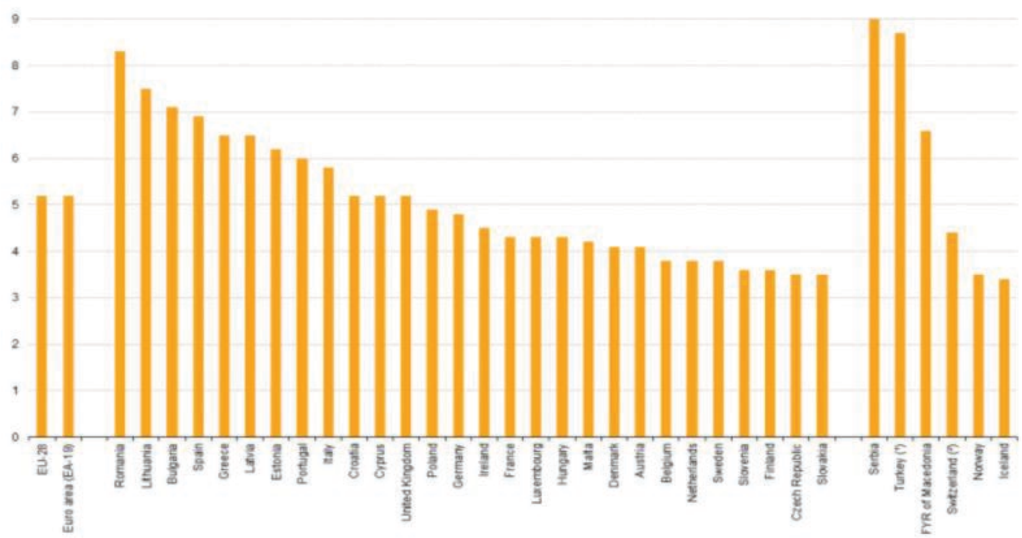
services have to spend more than 5 percent of their disposable income on their WSS bills. The affordability concern is reinforced by the wide tariff discrepancies between regional utilities, which do not follow the local differences in household incomes (the capital city Bucharest, where WSS services are provided by a private concessionaire, has one of the lowest water tariffs but also the highest per capita income in the country).

The current WSS pricing regulation is based on an affordability threshold of 2.5 percent of the disposable income of average households—and it is questionable, whether it actually protects the poor. This rule was established as part of the conditionalities for accessing EU grant cohesion funds by the regional utilities, in an attempt to set a simple pricing threshold mechanism that would still protect affordability for the poor. However, this is conceptually questionable, since the threshold is based on the income level of average households, instead of income of poor households.

Recent data demonstrates that **this approach is not working in a country like Romania, which has the largest income disparity of all EU countries**, as shown in figure 2.20. Research by the WB in neighboring Bulgaria, where the same 2.5 percent threshold pricing rule had been applied, found that there it also failed to protect the poor, since a portion of poor families were paying more than 5 percent of their disposable income for their WSS bill.

It is likely that the WSS bills are now close to or even over 5 percent of their disposable income for poor households connected to WSS services. Analysis presented later in this report (based on 2017 tariff level and 2014 income distribution data) suggests that for the poorest 30 percent of the population that earns about half of national average, the WSS bill represents between 2.6 and 4.6 percent of disposable income. The figure rises to between 3.6 and 6.4 percent for the poorest 10 percent earning about 36 percent of the national average.

FIGURE 2.20. Inequalities in Income Distribution (Quintile Share Ratio) in EU Countries



Source: EC based on Eurostat.

Low connection rates among the poor households explain why this affordability issue has not yet become a major social and political issue. First, only 64 percent of the total population are connected to piped water network, and this rate falls to only 29 percent in rural areas (2015), where 46 percent of the population and the majority of the poor live. This means that in practice, only a small portion of poor households currently receive a water bill. Second, water tariffs in localities not incorporated into the regional utilities and still served by small local operators, tends to be much lower and do not include a sewerage charge—and these are again mostly concentrated in rural areas. Finally, interviews with stakeholders suggest that there is a significant proportion of illegal consumption and unregistered connections in some rural areas, as well as marginalized urban neighborhoods. All in all, it is therefore likely that only a small portion of poor households have to pay more than 5 percent of their disposable income for the WSS bill right now (because they are not connected or do not receive a water bill)—probably not enough to have generated a major popular discontent yet.

Notes

1. The actual total population of Romania is not known precisely, as it is estimated that close to 3 million Romanians have gone to other EU countries in search of employment (either permanent or temporary).
2. In the Romanian language*: “Administrația Națională Apele Române.”*
3. Until mid-2016, ANRSC also had a regulatory role in public heating services, but this responsibility was transferred to the National Regulatory Agency for Energy (ANRE).
4. through the Ministry of Energy, with the rest of the shares owned by a private investment fund (“*Fondul Proprietatea SA*”).
5. The definition of ecological status looks at the abundance of aquatic flora and fish fauna, the availability of nutrients, and aspects like salinity, temperature and pollution by chemical pollutants. Morphological features, such as quantity, water flow, water depths and structures of the river beds, are also taken into account.

6. The DWD concerns the quality of water intended for human consumption and industrial food production (containers and tankers, drinking water in bottles), but is not applicable to mineral waters or medicinal products.

7. If the quality of water has no influence on human health or in the case of individual water supplies delivered to fewer than 50 persons and not as part of a public or commercial activity.

8. Bathing sites are defined as those where bathing is explicitly authorized, or those where it is not prohibited and traditionally practiced by a large number of people. Swimming pools and waters for therapeutic purposes are not covered.

9. CIRCABC—6th UWWTD EG—Presentation of the 9th UWWTD reporting exercise https://circabc.europa.eu/w/browse/946fe0c1-e71d-442e-ba15-2fde9ebd6cec.

10. All surface freshwaters and groundwaters, in particular those used or intended for the abstraction of drinking water, containing or potentially containing (if no action is taken to reverse the trend) a concentration of more than 50 mg/l of nitrates need to be identified.

11. Codes should include: measures limiting the periods when nitrogen fertilizers can be applied on land, measures limiting the conditions for fertilizer application (on steeply sloping ground, frozen or snow covered ground, near water courses), requirement for a minimum storage capacity for livestock manure, as well as crop rotations, soil winter cover, and catch crops to prevent nitrates leaching and run-off during wet seasons.

12. Measures include slurry spreading with trailing shoe system already included in Codes of Good Agricultural Practice, which become mandatory in NVZs, limitation of fertilizer application taking into account crop needs, all nitrogen inputs and soil nitrogen supply, and the maximum amount of livestock manure to be applied (corresponding to 170 kg nitrogen /hectare/year).

13. Monitored parameters include nitrates concentrations in groundwater and surface waters, and eutrophication of surface waters. The impact of action programs on water quality and agricultural practices is assessed; action programs are assessed and trends in water quality are evaluated.

14. Higher concentrations of nitrates were mostly recorded in the sections located on the small non-permanent (low flow) rivers in Dobrogea close to the Black Sea.

15. Much more than in Bulgaria, where the figure for non-compliance with water quality was 124,000 people.

16. of which 3 are “arranged and authorized”, 7 are “arranged-unauthorized”, and 28 are “not arranged” (located in 13 counties).

17. Second 6-year River Basin Management Plan (2016-2021) submitted in 2016.

18. Special Report No 23/2015—Water quality in the Danube river basin: progress in implementing the water framework directive (EC court of auditors).

19. In many basins, such as Prut-Barlad, a large share of rivers and water bodies, up to one third of the total, are ephemeral (non-permanent) reducing their capability to sustain ecosystems.

20. Flood maps available at www.rowater.ro (last accessed on 27 July 2017).

21. Maps from http://ec.europa.eu/environment/water/participation/map_mc/countries/romania_en.htm (last accessed on 27 July 2017).

22. Of these, and about 11 million are served by large operators—either the regional public utilities (ROCs) or the two large private operators, and about 1.5 million are served by local municipal services (not incorporated into ROCs).

23. The average WSS tariffs for ROCs stood at 3.37 RON/m^3 for water and 2.60 RON/m^3 for sewerage as of April 2017.

24. Source: “Impact of regionalization on the financial performances of the operators”, BDO Business Advisory, 2017.

Chapter 3 Water Resources Management under Risks

This chapter presents a detailed analysis of water resources management in Romania. After carrying out a detailed analysis of the water resources balance, water sources and uses, and the expected impact of climate change, it discusses the current institutional and financial status of the national water agency ANAR, and how several shortcomings are preventing efficient and sustainable water resources management. It then analyzes in detail the issue of flood risks (Romania being one of the most floods-prone countries in the EU), reviewing the key actions and investments identified in the Floods Risks Management Plans (FRMPs) under the EU Floods Directive. Finally, it looks the current status of dams' development and management in Romania, discussing the need for rehabilitation to improve safety and the total storage capacity, along with retrofitting of dams to fit new multipurpose uses.

3.1. Water Resources Balance in Romania

3.1.1. Water Availability: Romania Is almost a Water-Stressed Country

Aside from the Danube River which marks most of the southern border with Bulgaria, **the surface water resources in Romania consist of a relatively dense network of rivers and streams** with a total length of 78,905 km with a rather balanced territorial distribution, **all stemming from the Carpathian Mountains and flowing on a radial pattern eventually into the Danube River**, either in Romania, Hungary or Serbia. Some of them also cross international borders, with the Republic of Moldova and Ukraine in the east. The most important Romanian Rivers are the Mures (761 km), the Prut (742 km), the Olt (615 km), and the Siret (559 km).

Romania also has a large number of lakes and ponds with various purposes, of which 129 are natural (except the Danube Delta) and 1,506 artificial, created behind dams. **Romania has a large network of dams**: 246 large and medium dams and 1,260 small dams, most of the latter non-permanent, built in the past 55 years. Most natural lakes, including those located in the Danube Delta, are used for fishing and recreation (tourism) while the artificial lakes have multiple economic purposes: power generation, flood protection, water supply for population, industry, and agriculture.

The total utilizable water resources stand at 38.4 BCM per year—but represent only 29 percent of the total water potential of 135 BCM per year. One major reason is that water abstraction from the Danube River (63 percent of the total water potential) is constrained by agreements with other countries, by topographic conditions that limit the transfer of water from the Danube, and by the need to maintain sufficient flow to protect the ecological conditions of the delta. As for internal rivers, their utilizable potential is constrained by the uneven monthly distribution of flow and limited storage capacity to regulate the annual water stock. Finally, the use of groundwater is limited at 50 percent of potential by

TABLE 3.1. Potential and Utilizable Water Resources in Romania

	Category	Volume (BCM/year)
Interior river basins	Potential natural resource	40.0
	Utilizable resource	13.7
	Demand	3.2
Danube River	Potential natural resource	85.0
	Utilizable resource	20.0
	Demand	2.8
Groundwater	Potential natural resource	9.6
	Utilizable resource	4.7
	Demand	0.6
Total water resources	Potential natural resource	134.6
	Utilizable resource	38.4
	Demand	6.7

Source: ANAR 2016.

the recharging capacity.[1] The distribution of water sources and uses in Romania is presented in table 3.1.

The average water availability in Romania (based on utilizable resources) stands at 1,930 m³ per capita per year—which is below the European average and only slightly above water stress level. This figure is based on a national population of 19.9 million and the total volume of utilizable resources (Danube, internal rivers, groundwater). This is just above the threshold generally defined for water stress of 1,700 m³ per capita per year, and well below the European annual average of about 4,000 m³ per capita.

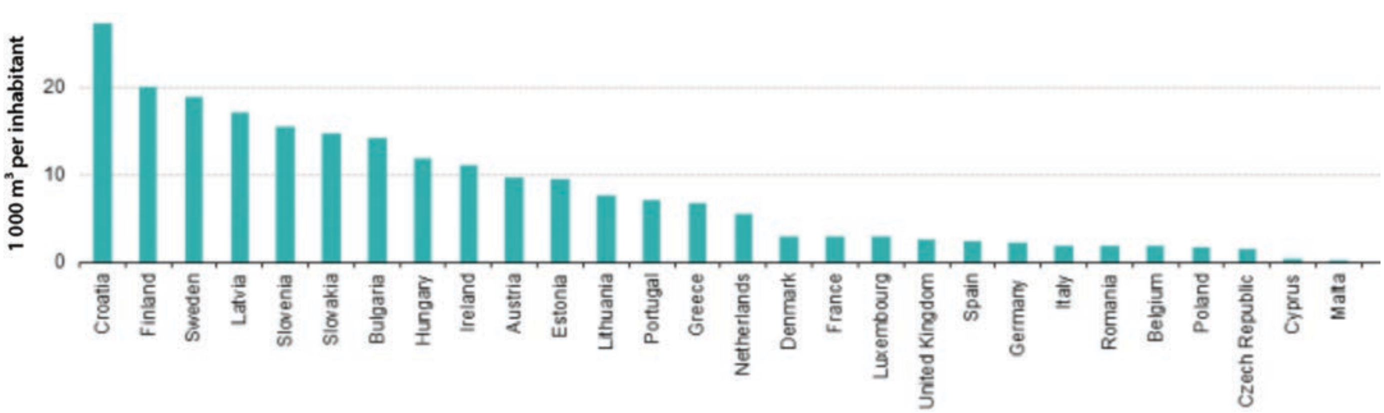
More than half of Romania's utilizable water is dependent on upstream countries (through the Danube), and **when considering only the volume of utilizable water available from internal rivers and groundwater (without the Danube), the average water availability stands at only 924 m³ per capita per year**, below the threshold for water scarcity of 1,000 m³ per capita per year.[2] This is an important figure, because the water from the Danube River can only be used economically (due to pumping cost to higher elevations) only in a small portion of the country, essentially, the southern border with Bulgaria and the delta in the east.

Overall, Romania is one the EU countries with the lowest water availability per capita, as illustrated in figure 3.1 below. In the ranking of water endowment per capita, it is ahead of Malta and Cyprus (water scarce countries) but on a par with Italy, Belgium, Poland and the Czech Republic.

Furthermore, Romania is also vulnerable to rainfall variability, with significant variations between wet and dry years in the total volume of water resources available at the national level. This is illustrated in figure 3.2 below. The volume of the total available utilizable resource can go to as low as 25 BCM in a dry year (such as 1994 and 2012) to more than 60 BCM in a wet year (such as 2006 and 2010).

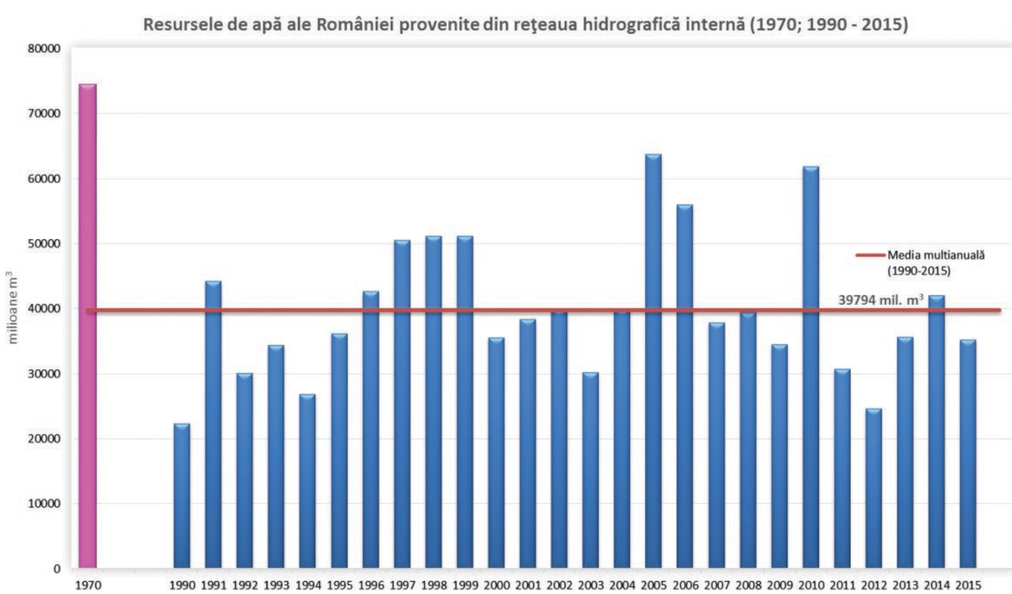
To manage year to year rainfall variability, the country has a long history of development of major storage on its most important rivers. Romania has a total of 1,506 large, medium and small dams with a combined storage capacity of about 12 BCM—or 612 m³ per capita. However, it is still far from having tapped its full potential, with the potential dam storage considered technically feasible for further development estimated in the range of 50-80 BCM, of which 25-28 BCM are considered economically viable under current conditions. This provides a valuable cushion to adapt to the expected effects of climate change in the future. Also, Romania has more than 80 years of hydrological available data on its main rivers (see box 3.1).

FIGURE 3.1. Renewable Water per Capita for EU Countries



Source: Eurostat.
Note: EU = European Union.

FIGURE 3.2. Natural Variability of Utilizable Water Resources of Romania



Source: ANAR 2016.

3.1.2. Major Variations in Water Availability between River Basins

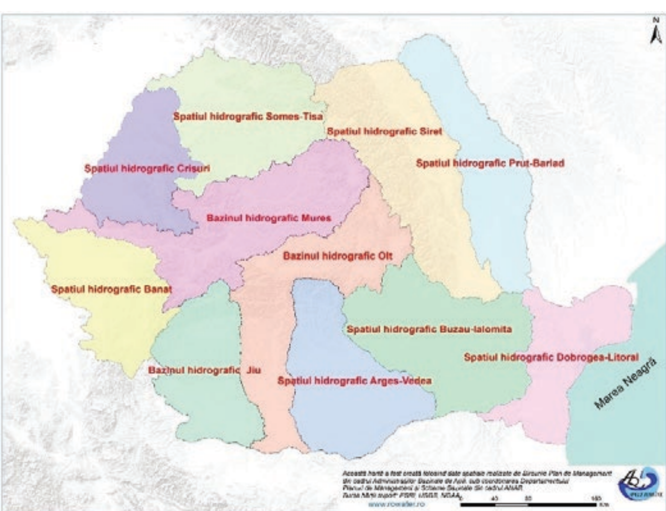
Water management in Romania has been organized around river basins by 11 river basin authorities for almost a century. Romania is one of the few European countries that have decades of experience in managing water resources using an integrated basin-level approach (as will be seen later when discussing institutional players). The 27 major inland rivers are managed through

BOX 3.1. 80 Years of Hydrological Data Available on the Main Rivers of Romania

Romania stands out in the Balkans for having a wealth of historical hydrological data covering almost 80 years. However not all these data have been fully digitized yet, which limits its availability for modeling and water resources planning. Romania's hydro-met network comprises over 880 monitoring stations, out of which about 600 are automated. In addition to this network, the National Meteorological Administration operates 160 stations, 8 radars and 55 agronomic monitoring stations.

While the major gaps in the hydro-met network seem to have been addressed through a series of recent projects (assisted also by the EU), the meteorological network could be strengthened by an up-grading of radar stations, expanding the agronomic stations network, and providing more resources for snowpack studies. The operations of water resources infrastructure are reviewed and approved by the RBAs, as part of the river basin management plan process. The operation rules for the facilities (referred to as "restriction logic") are originally based on the results of optimization analysis conducted for the specific cascades/basins, with priority (in decreasing order) to domestic supplies, energy production, industry and agriculture. Given the recent changes, especially in demand patterns and incidence of floods, many RBAs have conducted reviews and updated of their "restriction logics" for the major facilities in their respective basins, to ensure that the operations respond adequately to the situation on the ground.

MAP 3.1. River Basins in Romania



Source: ANAR 2016.

11 river basin authorities, as shown in map 3.1, with the Siret River Basin having the largest area (42,890 km²) and the greatest water resource. Although the Danube River theoretically could contribute more in term of utilizable resources than the internal rivers to the water resources potential, the constrained access to its utilization—due to its location at the southern border of the country—makes it less important than the contribution of internal rivers in terms of potential actually utilized.

There are considerable spatial discrepancies in water availability from internal rivers (i.e., not accounting for the Danube) **between the 11 river basins—with several basins experiencing serious water shortages during dry years.** The average water availability and utilizable resource of the 11 river basins, as well as the inter-annual variability over the period 2010–15, is presented in table 3.2.

Overall, there are five river basins—out a total of eleven—which are in a situation of water stress (less than 1,700 m³ per capita per year). This is illustrated in figure 3.3 below. These are the river basins of Jiu, Arges-Vedea, Buzau-Ialomita, Prut-Barlad and Dobrogea. In addition, **the two river basins of Arges-Vedea and Dobrogea** (Danube Delta) **fall below the water scarcity threshold** (1,000 m³ per capita per year). This underlines how important it is for Romania to ensure good water management and sustainability not just at the national level, but also with a special focus on the most challenged river basins.

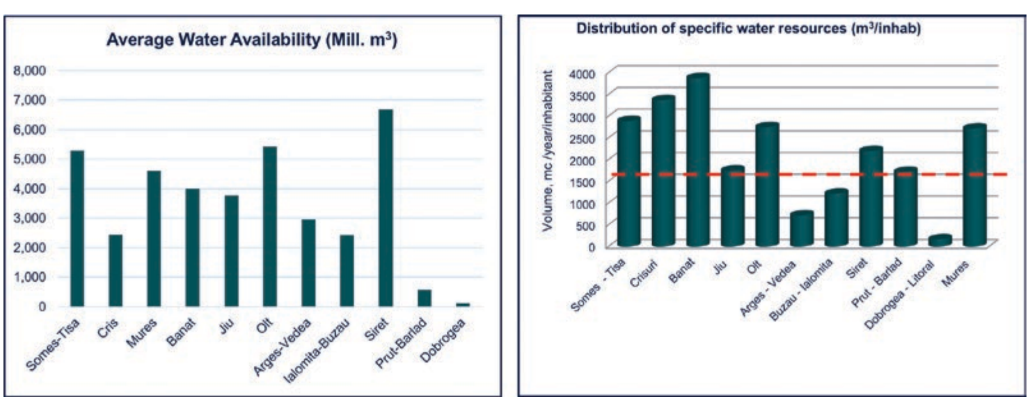
The uneven distribution of water availability across the country is further illustrated in map 3.2.[3] The areas with the lower availability of water appear in light grey, and those with most water in dark blue. It must be noted that, with the exception of Dobrogea area, water stress is not necessary linked with the density of water courses, as rivers' stock is also low

TABLE 3.2. Potential, Utilizable and Variability of Water Resources by River Basin (BCM/Year)

River Basin	Potential resource	Utilizable resource	2010	2011	2012	2013	2014	2015
			Volume of water (mill. m³)					
Somes-Tisa	4.49	0.97	10,225	4,513	3,645	5,385	3,437	4,491
Cris	1.73	0.40	4,923	2,060	1,568	2,723	1,640	1,734
Mures	3.89	1.04	8,426	4,134	3,251	3,954	3,984	3,889
Banat	3.13	0.61	6,753	2,777	2,800	4,530	4,018	3,128
Jiu	4.56	2.11	4,734	2,209	1,830	3,374	5,900	4,560
Olt	5.30	2.01	7,984	4,639	3,447	4,037	7,127	5,298
Arges-Vedea	3.25	1.74	3,724	1,957	1,936	2,647	4,210	3,247
Ialomita-Buzau	2.18	0.73	3,629	1,736	1,652	2,145	3,211	2,182
Siret	5.63	2.66	10,344	6,060	4,098	6,095	7,817	5,626
Prut-Barlad	0.36	0.23	1,019	536	290	608	603	360
Dobrogea	0.24	0.04	117	57	95	73	141	235
Total Internal Rivers	**34.75**	**12.54**	**61,878**	**30,678**	**24,612**	**35,571**	**42,088**	**34,750**

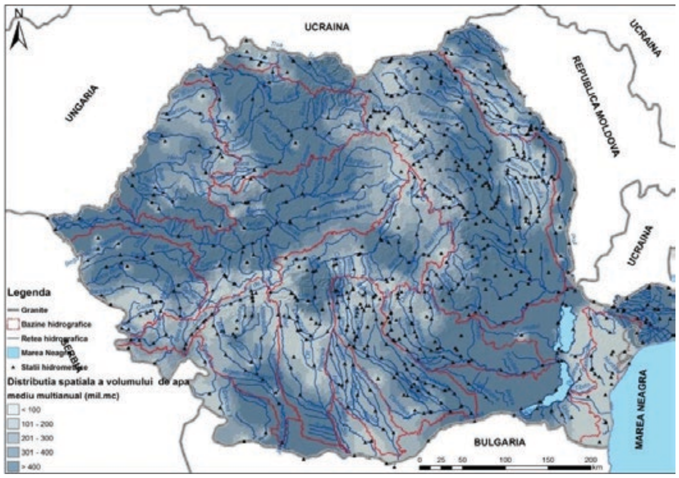
Source: INHGA 2015.

FIGURE 3.3. Per Capita Utilizable Water Resources in Romania's Internal Basins



Source: INHGA 2011.

MAP 3.2. Spatial Distribution of Annual Average Water Resource at National Level for 1991–2013



Source: ANAR 2016.

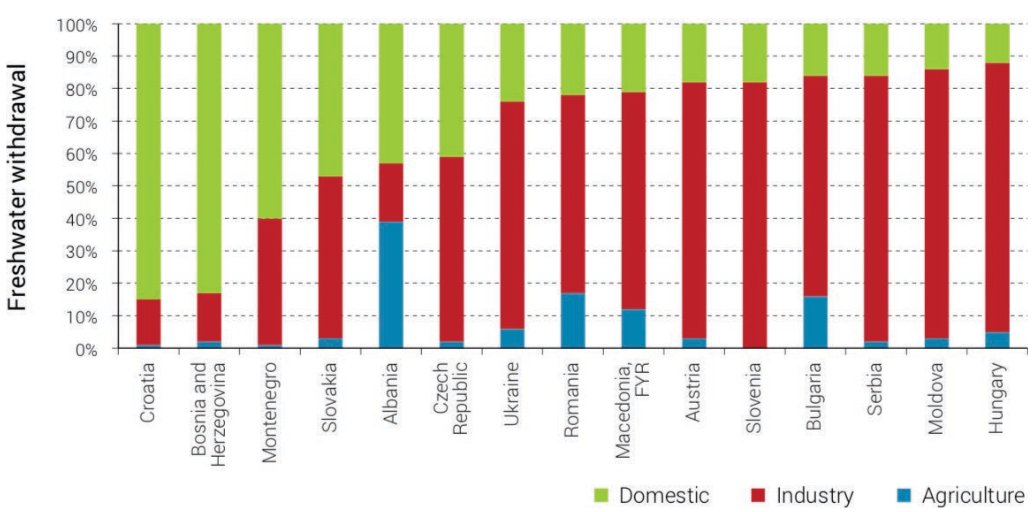
in the Transylvanian mountains during the summer, and several rivers barely meet the minimum environmental flow. Also, most areas with scarce or limited water are important for agricultural production, and depend on irrigation—which is why the Danube River remains the main surface water source for Romania and was preferred for the development of irrigation schemes compared to other internal rivers.

3.1.3. Water Demand Has Fallen Drastically over the Last Two Decades

The repartition of water abstraction between domestic, industrial and agriculture use amongst Danube basin countries is presented in figure 3.4 below. Romania is amongst the countries where industrial usage is the main demand for water withdrawal—though as will be explained later this is mostly for hydropower generation and does not equate, strictly speaking, with water consumption. Also, Romania is among the few countries where irrigation represents a significant proportion of water abstractions—behind only Albania and alongside Bulgaria.

After 1990 and the fall of the communist regime, total water demand went down sharply, due to the drastic structural changes in the Romanian economy. These included: (a) industrial restructuring and closure of many platforms of heavy industry, including for coal and ore mining;

FIGURE 3.4. Repartition of Freshwater Withdrawals between Domestic, Industrial and Agriculture Usage amongst Danube Basin Countries

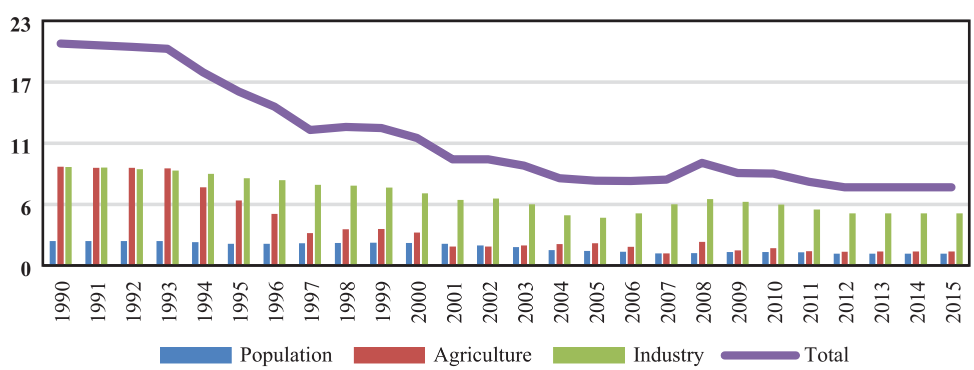


Source: WB DWP, State of the Sector, 2015.

(b) strong reduction of irrigation activity with the closure of many unviable schemes and introduction of water payment for farmers; and (c) reduction in per capita consumptions of potable water supply through tariff increases and the switch from billing based on consumption estimates to actual metering. As a result, the **total water demand fell down from 20.4 BCM (close to full utilization of the country's usable water resources) in 1990 to about 6.5 BCM** currently, as reflected in figure 3.5 where the distribution of water availability per main sectoral users is shown.

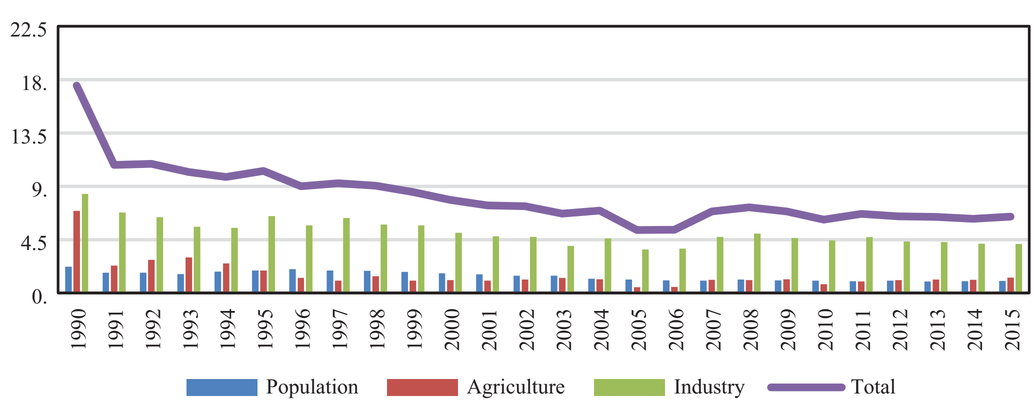
Currently, the actual abstraction levels are smaller than the overall availability, as shown in figure 3.6, indicating a certain degree of flexibility to cover future additional demand, given that the capacity of water management infrastructure was built to meet demand level of over 20 BCM. However, the situation varies widely from basin to basin both in terms of

FIGURE 3.5. Variation of Water Demand, by Users (1990–2015)



source: ANAR 2016.

FIGURE 3.6. Evolution of Water Abstraction by Main Uses (mill. m³)



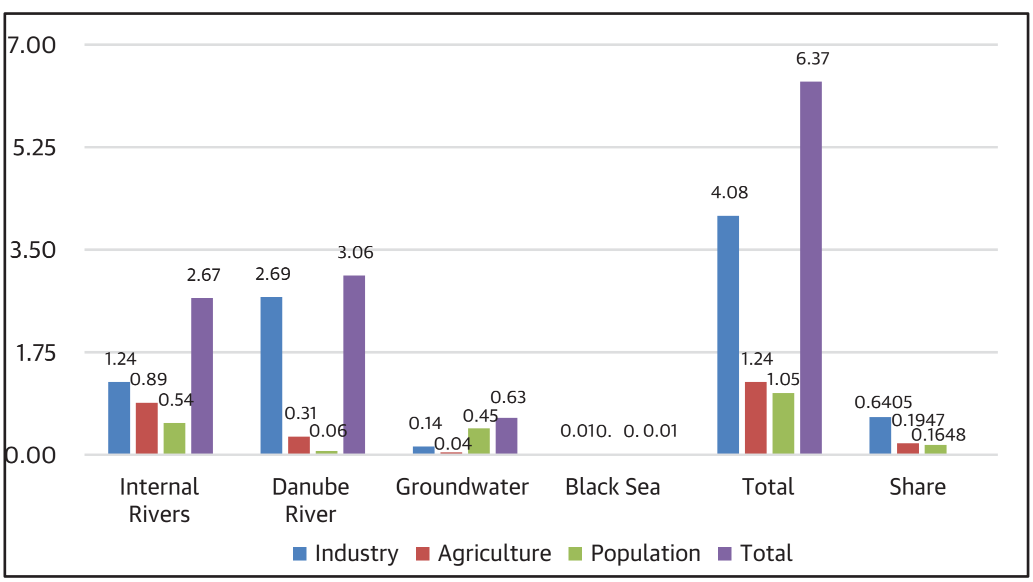
Source: ANAR 2016.

demand and availability—so national average figures can be misleading and fail to reflect the situation of water scarcity or water stress in several river basins of Romania. Furthermore, many elements of water management infrastructure have deteriorated due to years of under-maintenance, and are not functioning at their initial design capacity. This is especially the case for many dams, which are operated well below their design level to ensure safety.

The distribution among the various sources of water demand and supply is shown in figure 3.7. In 2016, the total demand, amounting to 6.41 BCM, was met by abstractions of 2.47 BCM from inland rivers, 3.31 BCM from the Danube River, 0.62 BCM from groundwater, and a small volume (0.01 BCM) from the Black Sea. The sector-wise break-up shows that the largest demand comes from industry (64 percent) which comes mostly from hydropower, followed by agriculture (20 percent) and the population (16 percent).

Domestic water supply is estimated to consume only about 16 percent of total water abstraction. About two-thirds of the water supply for potable domestic use is sourced from surface waters while the rest is pumped from groundwater.[4] In quantitative terms, it appears that most river basins are able to ensure sufficient volume for meeting the domestic demands. However, as mentioned earlier, there is some water stress occurring during summer months in dry years in river basins, locally with highly populated urban settlements and low water reserves—namely in Dobrogea-Litoral, Arges-Vedea, Prut-Barlad, and Buzau-Ialomita. The Dobrogea-Litoral basin is the most severely affected in this regard; almost 95 percent

FIGURE 3.7. Distribution of Water Demand by Source and Sector, 2016 (BCM)



Source: ANAR 2016.

of the supply for the city of Constanta and neighboring seaside resorts has to be sourced from groundwater, and pumped from significant depth (300-700 m) at a high cost. A number of cities in the east and south of Romania also face water scarcity in summer months, but most other urban areas have multiple sources offering significant buffer supplies and a higher degree of reliability.

Over the last two decades, the volume of water abstracted for domestic supply has dropped significantly, even though the size of the population with access to piped water increased steadily both in urban and rural areas.[5] The total annual volume abstracted for water supply went down from as much as 2.25 BCM in 1990, to 1.6 BCM in 2007 and down to just 1.02 BCM in 2015. This has been due to the combination of a **major drop in per capita consumption—due to steep tariff increases and the switch to metered consumption for billing**—and, to a lesser extent, to the rehabilitation of some deteriorated networks. This drop in overall abstraction for domestic uses also explains why most water utilities currently have a comfortable buffer in terms of water resources and production capacity, and water shortages are limited to only a few local hotspots (listed in the previous paragraph).

The largest demand for water comes from the industry, though also with a major drop in abstraction volume, and most of the current demand comes from hydropower generation. With the closing of many heavy industries in the 1990s, the demand for water also dropped by about 50 percent, from 8.36 BCM in 1990 to 4.14 BCM in 2015 (but its share in total water consumption increased from 48 percent in 1990 to 64 percent of total in 2015). Most water for industrial use was and is still supplied from surface sources, either from internal rivers or the Danube River. Access of industries to groundwater is restricted by law, with the exception of the food industry (including beverages) which requires good quality water. As for hydropower, although the largest user, it is in fact not a net consumer of water, but through its operation rules it constrains and is constrained by water uses in other sectors.

By far the largest decrease in water demand has occurred in agriculture, from 8.5 BCM to the current 1.1 BCM per year—i.e. more than a sevenfold reduction. Until 1990, water demand from agriculture was high, with large state farms practicing intensive irrigation (in the lower Danube and southeast of the country) as well as large livestock farms. The radical restructuring of the agriculture sector that occurred in the 1990s, as part of the broader economic and social reforms to switch to a market economy, resulted in a drastic drop in demand. The restitution of the state-managed land to private ownership, with the dismantling of former state and collective farms, produced a myriad of much smaller private farms lacking the financial and mechanical resources for intensive farming practices, and irrigation was abandoned in many of the large perimeters developed during the communist time. Most large livestock farms were closed.

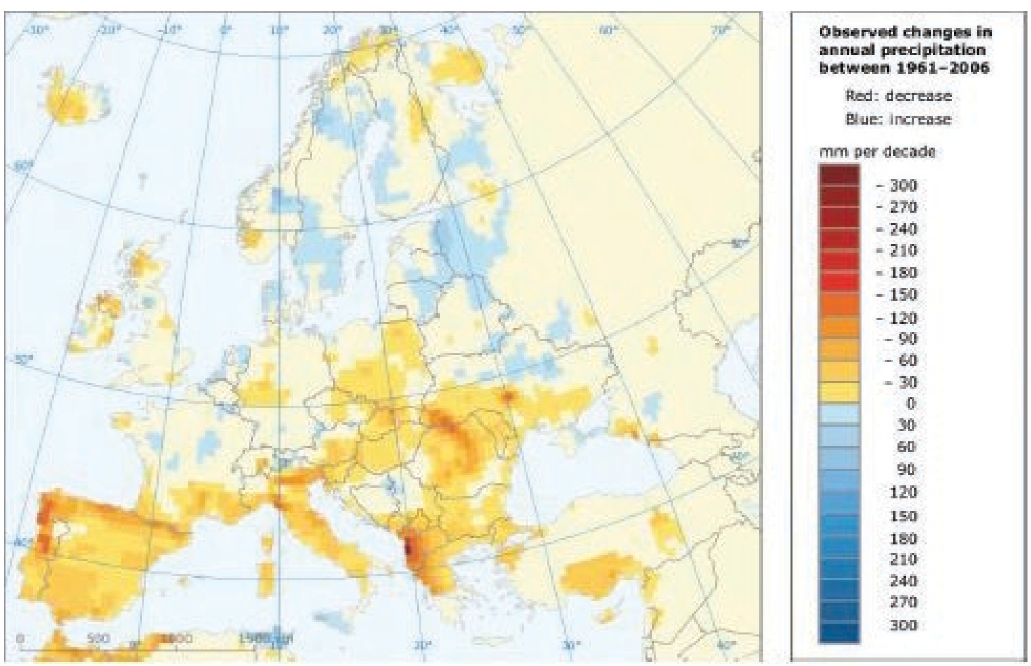
The total surface of irrigated areas nationwide was divided by a factor of twelve—decreasing over the years from the peak of 2.1 million ha in 1990 to an average of just about 0.17 million ha for 2005-16. This is much more than the total reduction in water used for irrigation. With the shrinking of irrigated areas, the water demand decreased correspondingly, down to about 1 BCM per year. Currently, only about 25 percent of the total area of 3.1 million ha that was equipped for irrigation in 1960-90 (most of it requiring high pumping from the source) is considered economically viable and another 20 percent would be marginally viable under a market farming economy, whereas many unviable schemes have ceased operation and were closed down. The still functional infrastructure is usually operated with obsolete hydraulic and electrical equipment, while water losses in the conveyance structures increase continuously. This will be analyzed and discussed in detail in the irrigation chapter.

3.1.4. Romania Water Resources Will Be Seriously Affected by Climate Change

3.1.4.1. Trends for Water Resources Availability and Vulnerability

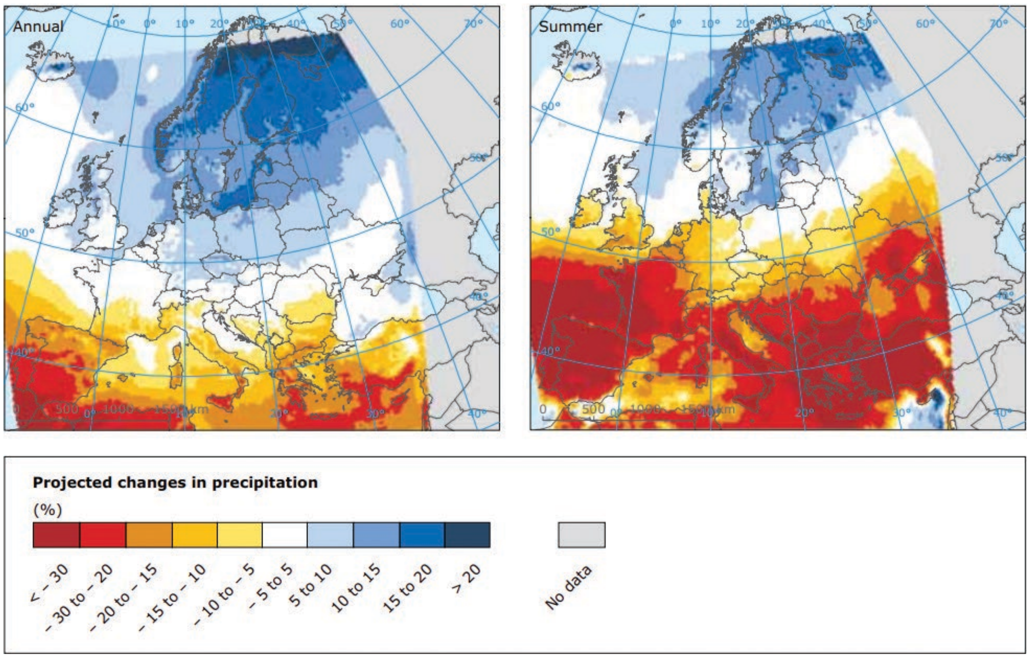
Romania is one of the countries which have already been most affected by climate change over the past decades. This is shown in map 3.3, which presents the observed changes in average annual precipitation in Europe from 1961 until 2006. Romania (alongside the southwest of Ukraine) is one of the hotspots already being affected by a significant reduction in average rainfalls, on a level comparable with those observed for Mediterranean EU countries such as Spain, Southern France, Italy and Greece. The map shows that the larger reduction occurred in Transylvania, which has plentiful water resources, but the impact has been felt during the summer when small rivers are not able to remain at their minimum environmental flow. A significant reduction in rainfalls also took place in the Prut-Barlad basin, at the border with Moldova, which is a water stressed area with major drought risks.

MAP 3.3. Observed Changes in Annual Precipitations in Europe 1961–2006



Source: European Environment Agency.

MAP 3.4. Projected Changes in Annual (Left) and Summer (Right) Precipitation (%) between 1961–90 and 2071–2100

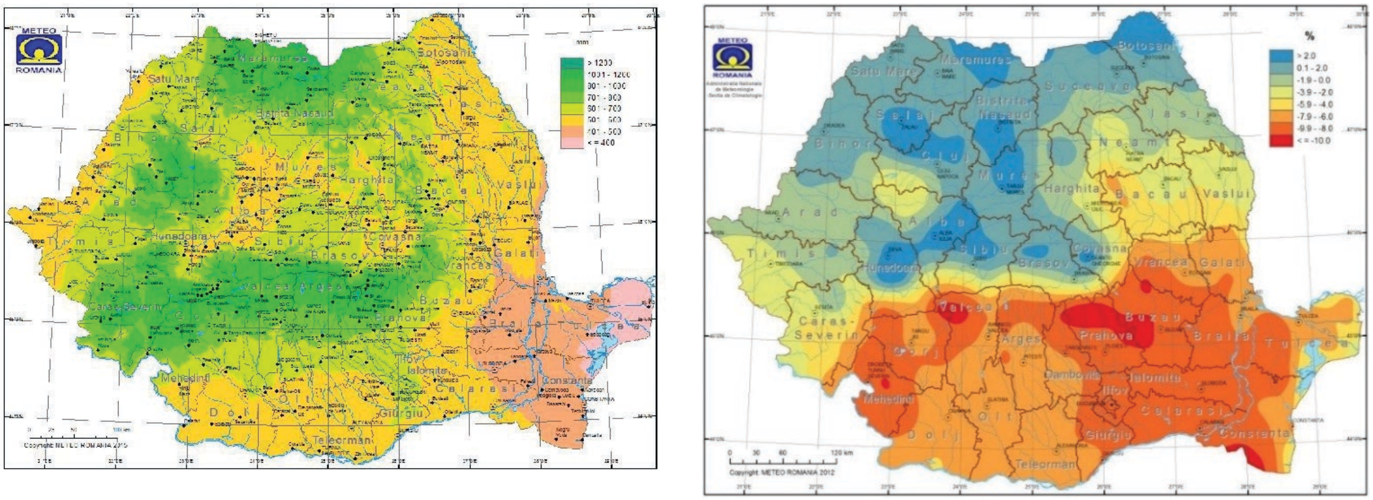


Source: van der Linden and Mitchell 2009.

Southern Europe is a hotspot of climate change impacts. The Mediterranean region is facing decreasing precipitation and increasing temperatures, in particular in summer. Annual river flows are projected to decrease in southern and south-eastern Europe, while intensity and frequency of river floods in winter and spring (in various regions) is projected to increase due to increases in winter precipitation. More frequent and intense droughts are predicted over coming decades. Decreasing water availability will exacerbate water stress, especially in southern Europe. As shown in map 3.4, the southeastern part of Romania—including the Danube plain and delta areas—will experience similar climate change as Mediterranean European countries, on a level comparable with southern France, Italy, Croatia and Bulgaria, with the gradual establishment of a semi-arid climate.

The climate data recorded over the past decades have shown a progressive warming of the atmosphere in Romania, and climate models predict this will continue. Forecasts conducted by National Meteorological Administration (NMA)[6] under IPCC's A1B[7] scenario for Romania predict an average air temperature increase of around 1.3°C in the eastern and southern parts of the country over the period 2011-40. Between 2061 and 2090, the average temperature may increase by 3-4°C in summer months compared to the 1961-90 interval. Projections also indicate that the changes in average temperatures and rainfall occur along with the changes in the variability of extreme phenomena, for example, warmer summers with more frequent and persistent heat waves.

MAP 3.5. Territorial Distribution of Multiannual Average Rainfall Quantities from 1961 to 2014 (Left) and Changes in Multiannual Average Rainfall (mm) in Romania (2011–40 versus 1961–90) (Right)



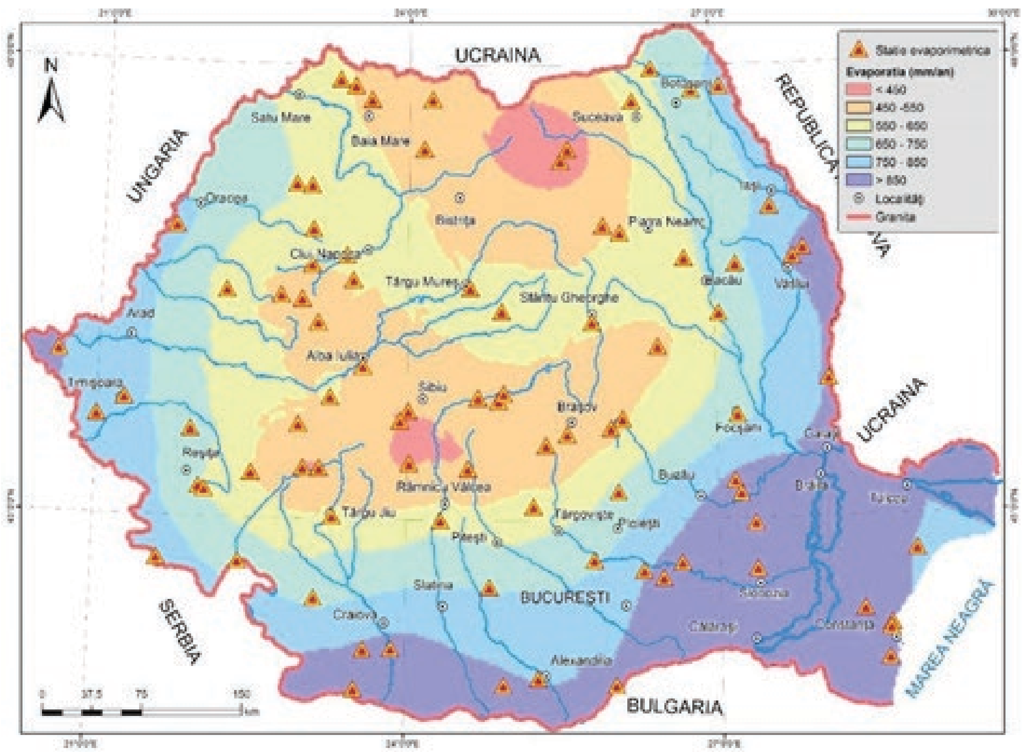
Source: ANAR 2016, based on National Meteorological Administration maps.

In parallel, a decreasing trend in the multiannual average rainfall quantities has been observed in the southern and southeastern parts of the country over the past decades, and **climate models predict that annual, and especially summer, precipitation will continue to decrease there**. The territorial distribution of the multiannual average rainfall quantities on the territory of Romania for 1961–2014 (map 3.5) reveals that large amounts of precipitation, over 900 mm, fall in the central, northern and western parts of the country, while lower rainfall values are common for the south-eastern area (between 401 and 500 mm) and the extreme east (in the Danube Delta—below 400 mm).

Furthermore, the average rainfall will decrease by up to 10 percent in the southern and south-eastern parts of Romania over the period 2011–40 (map 3.5), based on forecasts conducted by NMA under IPCC's A1B scenario. A more drastic reduction of about 24 percent (under A2 scenario) and 20 percent (under A1B scenario) of the average rainfall amounts during the summer season was projected for the 2061–90 period, compared to the reference interval 1961–90.

In several areas of the country, high values of evaporation (above 1000 mm in some cases) **have been recorded, confirming the gradual coming of a semi-arid climate in the southeast of Romania**. An analysis of the spatial distribution of water surface evaporation during 1961–2013 (for March-November period), showcased significant variability of values, between 450 and 1050 mm per year (map 3.6). Within the country, evaporation values grow radially, from north and center to east, west and south amid growing average air temperatures, falling rainfall, and relative humidity. Around 40 percent of the total annual amount of water evaporates during the summer (especially during July and August). Results of various analyses conducted by the National Meteorological Administration have indicated an intensification

MAP 3.6. Spatial Distribution of Water Surface Evaporation in Romania 1961–2013



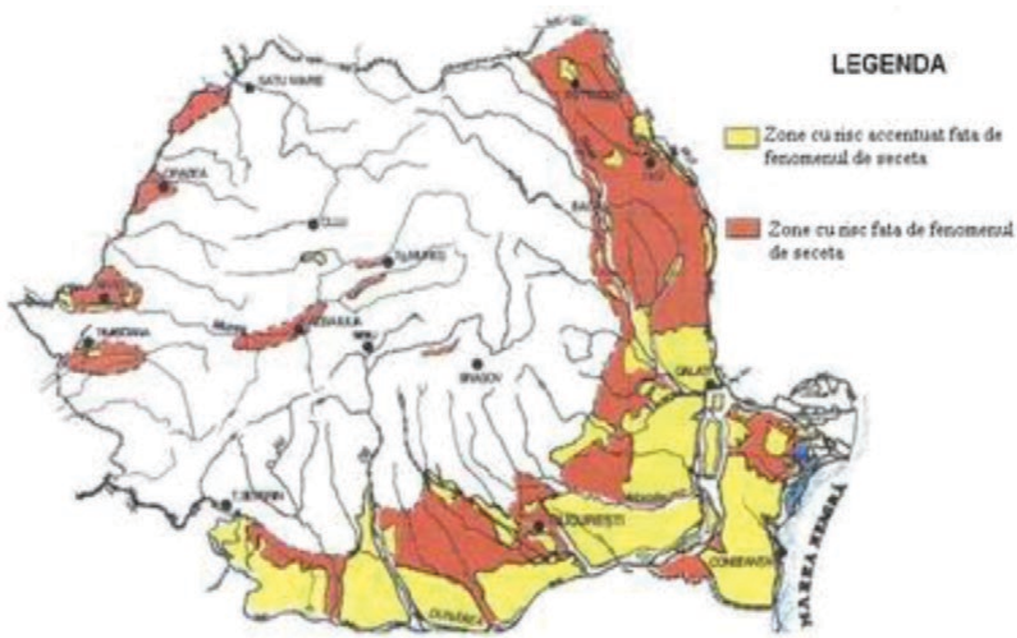
Source: INHGA 2015.

of the evaporation process in the south-eastern part of the country,[8] against a decrease of the evaporation in the West of the country and some sub-Carpathian regions.

The lower part of the Danube plain and delta area, which is already identified in the second RBMP as having the highest risk of drought, will also be the most effected by reduced precipitations under climate change. Map 3.7 below shows the areas of the country that have been most affected by droughts in the past. At the same time, the areas identified as drought-risk in the north of the country—whether the large area in the north of the Prut-Barlad basin on the border with Moldova, or the few pockets along the border with Serbia and in the center of the country—are expected to benefit from an increase in precipitation (albeit probably moderate) which may reduce the drought risk.

Groundwater is also an important factor in the analysis of spatial water stress. As mentioned earlier (Chapter 3.1), Romania's deep aquifers (located at 100-300 m) have sufficient resources of good quality water and good recharge pace. In addition, shallow aquifers exist, located at small to medium depth (5-60 m), with variable water availability and unreliable quality because of the leakage of nutrients and other chemical pollutants from the surface. Although only the deep groundwater is used for water supply to population, there are also abstractions of water from shallow sources for individual human consumption or agriculture.

MAP 3.7. Map of Drought Risks from the 2nd National RBMP



Source: ANAR 2016.
Note: RBMP = River Basin Management Plan.

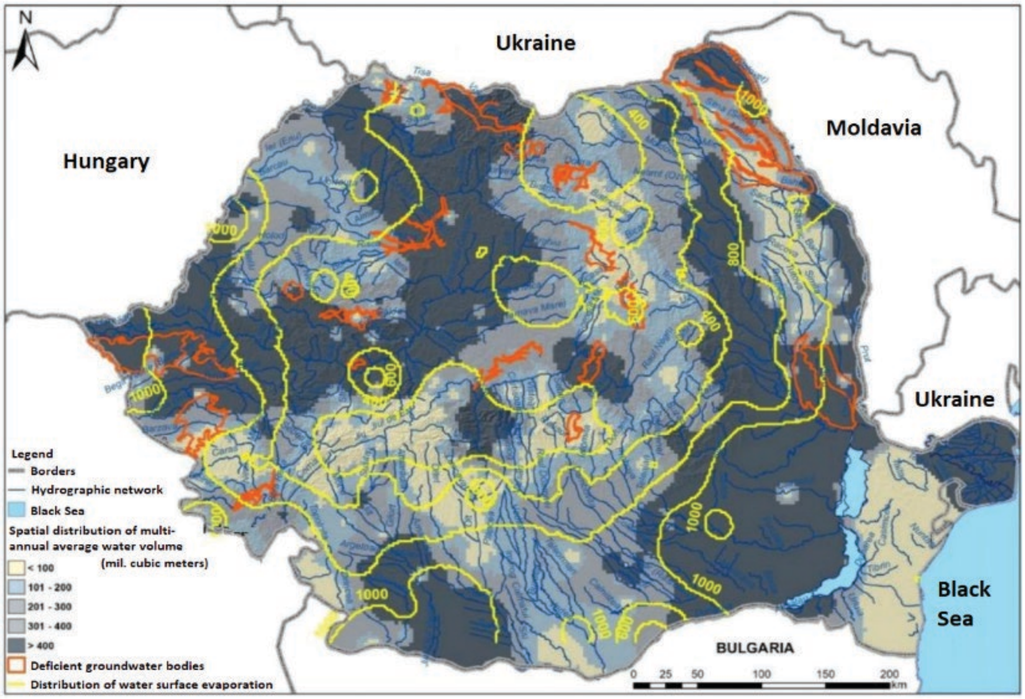
While the stock of deep groundwater seems stable, significant variability was observed in the shallow aquifers, with substantial depletion noted in summer.

A GIS joint representation of renewable water availability, evaporation and deficient groundwater allows to pinpoint potential areas vulnerable to droughts and water scarcity (map 3.8). The map shows some interesting situations resulting from the overlap of surface and subsurface water resources with evaporation (directly connected with temperature variation): in the south-eastern and south-western regions, the significant availability of surface water resources seems to be offset by high evaporation and scarce ground water resources. In mid-south and eastern areas, the combination of scarce surface and subsurface water resources overlaps with very high evaporation (900–1,000 mm/year), creating significant water stress, particularly for agriculture. **The Dobrogea area (extreme south-east) on the Danube Delta appears the most critical region, with very scarce subsurface water resources and high evaporation** (around 1,000 mm/year) and very deeply (250–300 m) located subsurface water resource as the only reliable water source for human supply at risk of depletion. Significant water stress is also present in the northwest in the Prut-Barlad Basin (border with Moldova) and in south Banat and Crisuri Rivers regions in the west (borders with Hungary and Serbia).

3.1.4.2. Water Supply and Demand Forecasts under Climate Change

The average annual flows of Romanian Rivers are projected to decrease. The National Institute of Hydrology and Water Management (INHGA) carried out several national studies to

MAP 3.8. GIS Representation of Three Overlapped Parameters: Spatial Distribution of Multi-Annual Average Water Volumes; Spatial Distribution of Water Surface Evaporation and Spatial Distribution of Deficient Groundwater Bodies



Source: INHGA 2015.
Note: GIS = Geographic Information System.

estimate the impacts of climate change and variability on the hydrological regime in all river basins based on long-term simulation. Calculations were made for 12 rivers, namely: Vişeu, Iza, Tur, Somes, Crasna, Mureş, Jiu, Olt, Vedea, Argeş, Ialomiţa and Siret. The following changes in the regime of the multiannual average flows of these rivers, for the 2021-50 period compared to the reference period 1971-2000, were identified (table 3.3): **a reduction of more than 8 percent of the average flow is expected for 7 rivers** (Crasna, Mures, Jiu, Olt, Vedea, Aerges, Siret), with the largest reduction in flow of about 25 percent expected for the Vedea River in the south.

Water demand is expected to increase in the future, mostly from irrigation due to the increasing frequency and magnitude of droughts. A water demand forecast for the 2020-30 horizon was conducted in 2014 within a study[9] carried out by INHGA. While demand for domestic potable supply is expected to remain stable, irrigated agriculture is expected to have the most significant increase in water demand from 2020 to 2030, but this is conditioned by the implementation of the Investment Program for Rehabilitation of Irrigation Infrastructure to enable improved energy efficiency, resulting in lower tariffs for irrigation water for farmers (table 3.4).

TABLE 3.3. Projected Changes in the Regime of the Multiannual Average Flows of Twelve Romanian Rivers, for the 2021–50 Period, Compared to the Reference Period 1971–2000

River	Projected change
Vișeu	−0.1% decrease
Iza	−1.9% decrease
Tur	−2.5% decrease
Someș	+6.2% increase
Crasna	−9.4% decrease
Mureș	−9.9% decrease
Jiu	−11.0% decrease
Olt	−9.5% decrease
Vedea	−24.6% decrease
Argeș	−8.6% decrease
Ialomița	−5.8% decrease
Siret	−9.6% decrease

Source: ANAR 2016.
Note: Rivers with the largest projected percentage change are in bold.

TABLE 3.4. Summary of the Water Demand Forecast for 2020 and 2030

Water use	Water demand (million cubic meters)					
	2020			2030		
	Minimal scenario	Average scenario	Maximum scenario	Minimal scenario	Average scenario	Maximum scenario
Population	2,041	2,088	2,135	1,986	2,097	2,208
Industry	5,840	6,664	8,221	6,017	7,383	9,944
Irrigation	421	562	702	1,267	1,689	2,112
Livestock	168	172	176	155	164	173
Aquaculture	818	818	818	949	949	949
Total	9,288	10,304	12,052	10,374	12,282	15,386

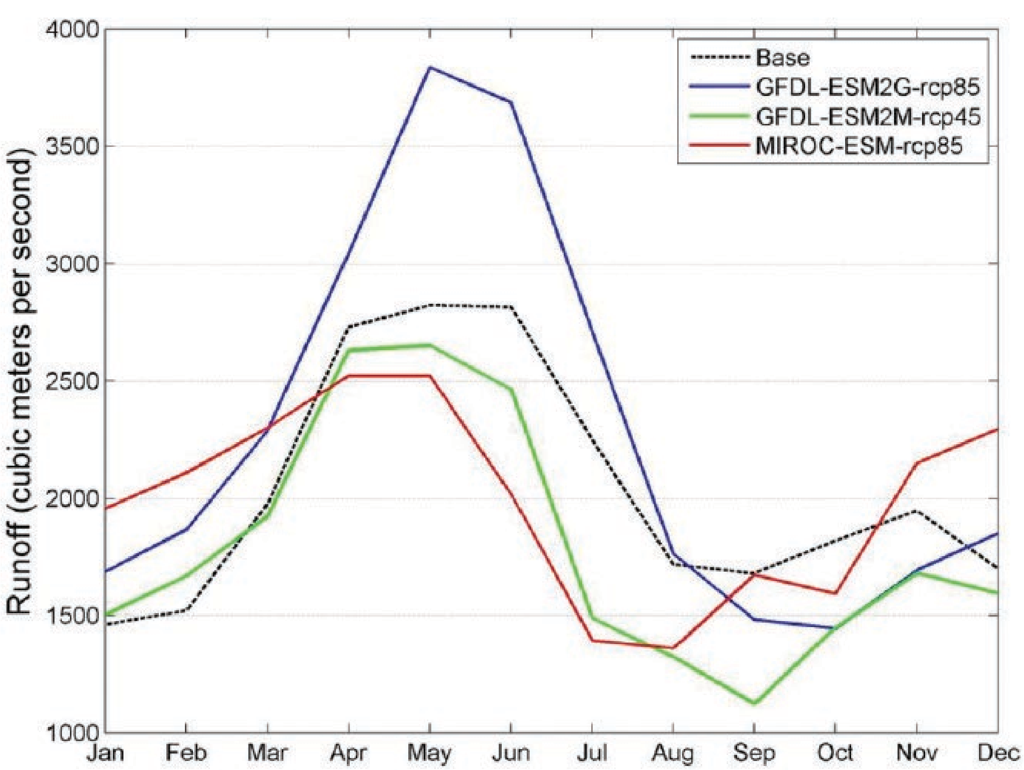
Source: INHGA 2014.

The World Bank Modeling Exercise for climate change in Romania, carried out in 2015, brings additional insights. As part of the RAS project carried out by the World Bank in 2015 for the Government of Romania on "Romania: Climate Change and Low Carbon Green Growth Program," a series of models was used to analyze the impact of climate change on water availability and demand under three climate scenarios, as well as the impact of green policies by comparing two green (adaptation) scenarios with a business as usual (BAU) scenario.[10]

The WB study showed that climate change will lead to a decreased river flow, which in turn will negatively affect the water demand-supply balance. In agriculture, water availability will be threatened during the primary growing months, while demand for irrigation will increase due to rising temperature and evapotranspiration, and decreasing and more variable rainfall.[11] Pressure on domestic potable supply will be modest but industrial users may be locally affected if no adaptation efforts are undertaken. Under the medium-impact climate scenario, rain-fed yields will generally decline but irrigated yields will tend to improve with climate change, provided that enough additional water can be supplied. Climate change is projected to have an overall negative impact, and demand management (including investing in improved efficiency of irrigation and municipal and industrial delivery and use efficiency) provides only a limited solution: increase in basin storage, through the development of new dams, is needed. The greatest green growth investment potential exists for optimizing agronomic inputs, including rehabilitating irrigation infrastructure to restore irrigated production in currently rain-fed areas.

The WB report confirmed that climate change will have a negative impact on water availability (measured as mean annual runoff) under all climate scenarios. Falling runoff during the growing season suggests increase in unmet demand for all types of water users. In the 2020s, the projected changes in annual runoff, as compared with the base year 2014, range from a decrease of 7 percent to an increase of 20 percent. By the 2040s, the changes are dampened somewhat when summarized at the national scale, but universally negative, the reduction ranging from 0.7 percent to 8 percent. Figure 3.8[12] shows total mean monthly runoff across 91 sub-basins under both the 1961-2000 baseline and under the three climate change

FIGURE 3.8. Sum of Mean Monthly Runoff across 91 Sub-Basins, Baseline (1961–2000) versus the Three Climate Projections (2031–50)



Source: WB Water Sector Technical Report—Output C1.1—2015.

scenarios between 2031 and 2050. During the primary growing season months (April to September), runoff changes range from a 30 percent reduction to a 30 percent increase. Importantly, the majority of months under two of the scenarios show falling runoff throughout the growing period, suggesting threats to irrigation water availability.

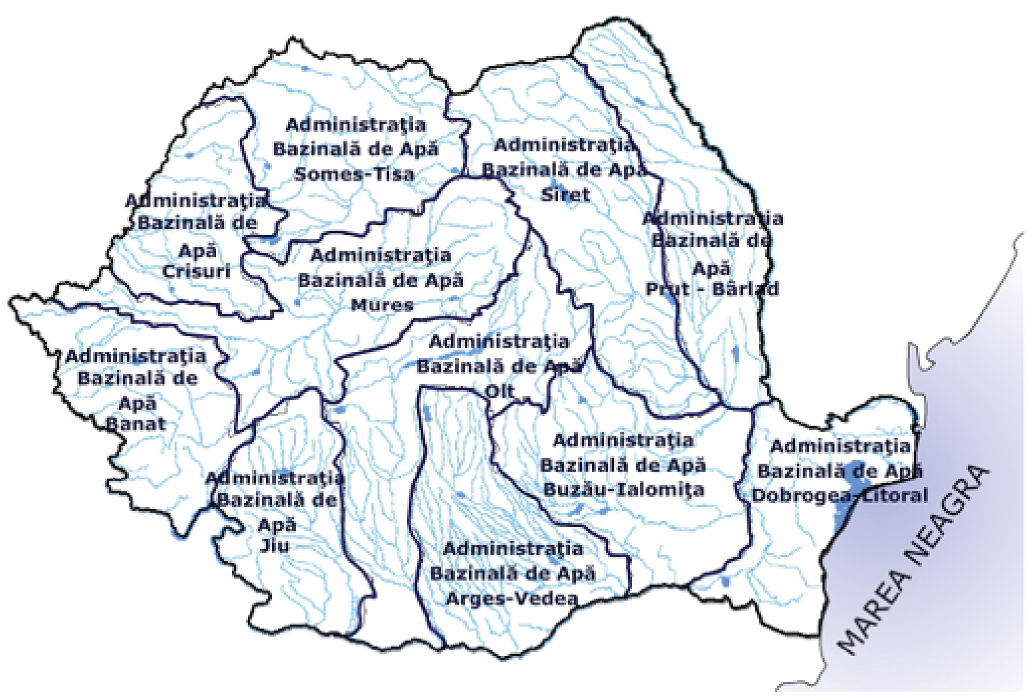
3.2. ANAR: The Operational Arm for Water Resources Management

3.2.1. ANAR Is Organized around 11 River Basin Agencies

National Administration "Romanian Waters" (ANAR) is the national operational arm of the water sector, in charge of managing all large water resources infrastructure (except dams dedicated to hydropower generation). It administrates all public water resources through the national system of water management infrastructure, including dams, reservoirs, flood protection dykes, canals, inter-basin connections, water intakes, as well as the hydrological and ecological monitoring infrastructure for surface and subsurface waters. It is in charge of management, operation and maintenance of over a hundred large dams holding over 4.6 billion m^3 and 7,000 km of dykes.

ANAR is organized around 11 river basin agencies, and its headquarters is based in Bucharest. Map 3.9 shows the areas of the various river basin agencies, based on the corresponding river basins.

MAP 3.9. Romania's 11 Basin Water Administrations



Source: ANAR.

ANAR is also in charge of nationwide quantitative and qualitative monitoring of all water abstraction and restitution of waste water in natural water bodies, through regular flow measurements, and sampling and testing. It is the sole authority in charge of permitting and licensing the activities carried out with impact on water bodies, surface and subsurface, for domestic and economic use, including harvesting of construction materials from rivers (sand, gravel) and restitution of waste waters.

ANAR is responsible for preparing, reporting and supervising the implementation of the River Basin Management Plans (RBMPs), Floods Management Plans (FMPs) as well as other reporting related to EU water directives such as the Urban Wastewater Treatment Directive (including the National Implementation Plan and its regular reporting to the EC). It is also in charge of the management of all interventions following floods and accidental spills of pollutants on surface or subsurface waters and supervision of all works aimed at restoring the quality of the respective water body. ANAR is in charge of the management of the national system of early warning for floods and dam safety operational at river basin level. ANAR monitors permanently, through its water inspection unit, the conformity of all water users with the national regulations, standards, norms on water management, and reports to Ministry of Waters and Forests (MWF) periodically or on demand.

ANAR interacts with the WSS utilities for abstraction of raw water and discharge of treated wastewater. Raw water abstractions for population supply are agreed between each WSS utility and the respective ANAR River Basin administration, and set in the operational license issued by ANAR and regulating the operation of the respective intake. Each utility pays ANAR an abstraction fee based on the metered volumes. ANAR also carries out periodic checks of the water quality in the source at both the raw water abstraction and restitution of wastewater and keeps records of test results.

ANAR has a total staffing of about 9,500 employees, broadly in line with the magnitude of water management infrastructure it operates and its nationwide role in monitoring water resources. This has been relatively constant over the past decade despite new tasks to comply with EU Directives.[13] While an analysis of ANAR staffing level and financing is outside the scope of this diagnostic, it appears from the interviews that the overall staffing level could be broadly appropriate, considering the magnitude of the water infrastructure it has to manage nationwide—including 121 large dams, many of the smaller dams and polders used for flood management, and the 11,655 km of dykes for flood protection—as well as its mandate for monitoring water resources and implementing the WFD.

Key summary data on the 11 river basin agencies (ABAs) is provided in table 3.5 below, where the annual turnover does not include the transfers from the state budget for financing the investment projects for flood protection, completion of construction of new dams, modernization of instrumentation at dams and installation of new water monitoring equipment. It is important to mention that a significant share of annual ANAR revenues (about 25 percent) is spent on maintenance and repair of infrastructure, with no contribution from the state budget.

TABLE 3.5. **Key Data on River Basin Administrations**

River basin agency	Area (km²)	Rivers length Total (km)	Turnover—2015 (million RON)	Capex—2015 (million RON)
Somes-Tisa	12,656	6,085	23.3	21.9
Crisuri	14,860	5,785	2.8	10.8
Mures	24,099	9,428	38.6	15.8
Banat	18,320	6,296	6.3	5.0
Jiu	17,876	5,217	45.7	5.6
Olt	24,868	9,571	58.4	7.4
Arges-Vedea	20,911	7,887	57.4	14.3
Ialomita-Buzau	26,471	6,062	35.1	8.9
Siret	28,878	10,415	40.0	9.7
Prut-Barlad	15,301	7,778	17.7	6.7
Dobrogea	15,501	1,964	40.9	5.1
Central Office	n.a.	n.a.	682.0	154.5
Total	**219,741**	**76,488**	**1,062**	**267**

Source: World Bank's elaboration based on ANAR.
Note: n.a. = not applicable.

3.2.2. Bulk Water Charges Are too Low to Ensure Proper O&M of Hydraulic Assets

Romania has a long tradition of quantitative and qualitative management of its water resources by basin, and of levying a system of payments by the ABAs for all water uses—namely, contributions for using the water resource, contributions for wastewater discharge, pollution charges, water head for hydropower production, gravel harvesting, common water management services tariffs and some other service fees, as shown in Annex 2. **The annual operating budget amounts to about €265 million**, of which about €20 million is the state budget contributions for investment (2016-17). Investments are financed separately through budget allocations from the central government and vary widely between years.

The bulk of ANAR's income is raised from large water resource users, notably large hydropower plants. Most of the fees are collected by the ABAs, but large users (i.e., all *Hidroelectrica* hydropower plants and also the nuclear power plant) pay directly to ANAR HQ. About 50-60 percent of the income of each business unit (ABA and HQ) is spent on salaries and overheads. The remainder of the income at HQ level is redistributed between the ABAs. A sample annual budget for ANAR, for the year 2015, is presented in table 3.6.

The funds for investments, including rehabilitation and modernization, are provided through the national budget, and these are treated as "capital costs," not income—while the funds for regular operation and maintenance (including repairs) are raised from water related contributions and tariffs. In the national accounting, the infrastructure is considered as national patrimony and is not depreciated (though office housing assets are depreciated). In general, ANAR has not yet introduced asset management

TABLE 3.6. ANAR Budget in 2015 (in lei '000)

Indicator	Planned	Result	% of planned
Revenues—Total, of which:	**977,542**	**1,079,739**	**110.45**
- Water services	954,880	1,067,067	111.40
- Financial interests	170	108	63.53
- Fines, penalties	14,460	5,605	38.76
- Other revenues	8,000	6,927	86.58
- Revenues from insured risks	32	32	100
Expenditures—Total, of which:	**1,312,991**	**907,243**	**57,70**
- Staff expenditure	395,700	360,365	91.07
- Goods and services	649,054	276,936	42,67
- Banking interests	35	2	5.71
- Capital expenditures	271,761	266,957	43.04
- Co-financing of foreign non-reimbursable funding	3,559	2,983	83.81
Profit/Loss (+/−)	**−335,449**	**+ 172,496**	

Source: ANAR Annual Report.

techniques to optimize fund utilization and become more pro-active in assets management. Investments are usually co-financed with external agencies on a project basis, such as the European Commission programs (Cohesion funds, Danube Transnational Program), EIB, EDB and the World Bank.

Current bulk water tariff levels are too low to ensure sustainable O&M and lead to insufficient maintenance. This affects assets management (dams), and the implementation of Flood Protection Management Plans and RBMPs. On the basis of interviews with stakeholders, collected revenues are estimated to only cover about a third of what would be needed to cover full O&M cost for sustainable management of Romania's water resources infrastructure. This is, however, a broad estimate since no specific study has been carried out so far by the Romanian Government to analyze the exact financial situation of ANAR. It is clear, however, that a revision and modernization of the financial framework would be needed to ensure that it has sufficient recurrent resources to carry out proper O&M of the water resources infrastructure.

Bulk tariffs are uniform across river basins, and have not been updated since 2010. Tariffs, or "contributions to use water resources," are unified across the national territory and laid down in a government regulation which renders the system transparent and simple but very rigid. The shortcoming of this approach is that it does not allow to introduce price incentives for users that would reflect the actual situation of water resources and floods risks in each basin—a relevant issue considering the wide discrepancies observed between river basins in Romania with regard to *inter alia* water resources availability and rainfall. While the

TABLE 3.7. Comparison of Water Extraction and Wastewater Fees among Danube Countries

Country	Water Extraction Permit Fee	Amount per year collected from extraction fee (Euro	Wastewater discharging permit fee	Amount per year collected from water discharge fee (Euro)	Collected fees paid to	Total fee collected in year (Euro per person)
Albania	Yes, but not charged systematically	230,000	No	N/A	State budget	0.08
Austria	Yes	No charge	Yes	No charge	N.A.	N.A.
Bosnia and Herzegovina	Yes	5,400,000	Yes	15,800,000	State budget	5.58
Bulgaria	Yes, but not charged systematically	9,300,000	Yes	2,000,000	State budget	1.55
Czech Republic	Yes	147,000,000	Yes	7,500,000	Designated water fund	14.71
Croatia	Yes	40,000,000	Yes	29,000,000	Designated water fund	16.05
Hungary	Yes	43,000,000	Yes	10,000,000	State budget	5.35
Kosovo	Yes, but not charged systematically	190,000	Yes, but not charged systematically	190,000	State budget	0.21
FYR Macedonia	Yes, but not charged systematically	1,600,000	Yes, but not charged systematically	16,000	State budget	0.77
Moldova	Yes	Charged together with wastewater	Yes	150,000	Designated water fund	0.04
Montenegro	Yes, but not charged systematically	660,000	Yes, but not charged systematically	210,000	State budget	1.45
Romania	**Yes**	**8,883,000**	**Yes**	**4,550,000**	**State budget**	**1.17**
Serbia	Yes	37,000,000	Yes	No data	State budget	5.21
Slovakia	Yes	37,000,000	Yes	7,000,000	Designated water fund	8.15
Slovenia	Yes, but not charged systematically	No data	Yes	No data	State budget	No data
Ukraine	Yes	No data	Yes	No data	State budget	No data

Source: WB DWP, State of the Sector, 2015.
Note: n.a. = not applicable.

regulation provides for annual adjustment to the consumer price index, no tariff increase has been endorsed since 2010.

A comparison of resource fees charged from WSS service providers in Danube basin countries shows that bulk water tariffs in Romania are in the low range, when compared with other EU-13 countries. This is shown in table 3.7 below. The amounts collected range from mostly symbolic in Albania to relatively significant in Croatia and the Czech Republic. The total amount collected in Romania for water extraction is comparable to Bulgaria but much lower than in the Czech Republic, Croatia, Hungary, the Slovak Republic and even Serbia. As for wastewater discharge fees, the total fees collected on a per capita basis in Romania is comparable again to Bulgaria but extremely low when compared with EU-13 countries, and even Bosnia and Serbia. This is worth reflecting upon given the considerable financial gap for financing compliance with the UWWTD in Romania.

In many other EU countries (including France, Spain and The Netherlands outside of the Danube basin), river basin agencies play a significant role in financing wastewater infrastructure.

A noteworthy institutional issue is that the MWF and ANAR have only limited control over meeting the WFD and UWWTD objectives. The regional ABAs are responsible for drafting the RBMPs and the Programs of Measures, and, thus, are eventually accountable for the quality of the surface and subsurface waters which they duly monitor—but their direct operational control is limited. They issue discharge permits for treated municipal and industrial effluents, but have no power to force the local authorities, utilities or industries to build and duly operate WWTPs. They formulate action plans to regulate the diffuse pollution from agriculture, but have no control over farmers. They also have little or no influence on dam environmental flows for the dams operated by Hidroelectrica (about half of all dams) and the many new micro hydropower stations, and government permits for new dams. The ABAs, thus, depend heavily on the compliance of the municipalities and industry, as well as of the agricultural sector, and dams' operators, to achieve the WFD goals. Furthermore, while the municipalities are bound to treat their sewage to levels specified by the Urban Wastewater Directive, complying with these regulations does not necessarily lead to immediate compliance with the WFD objectives.[14]

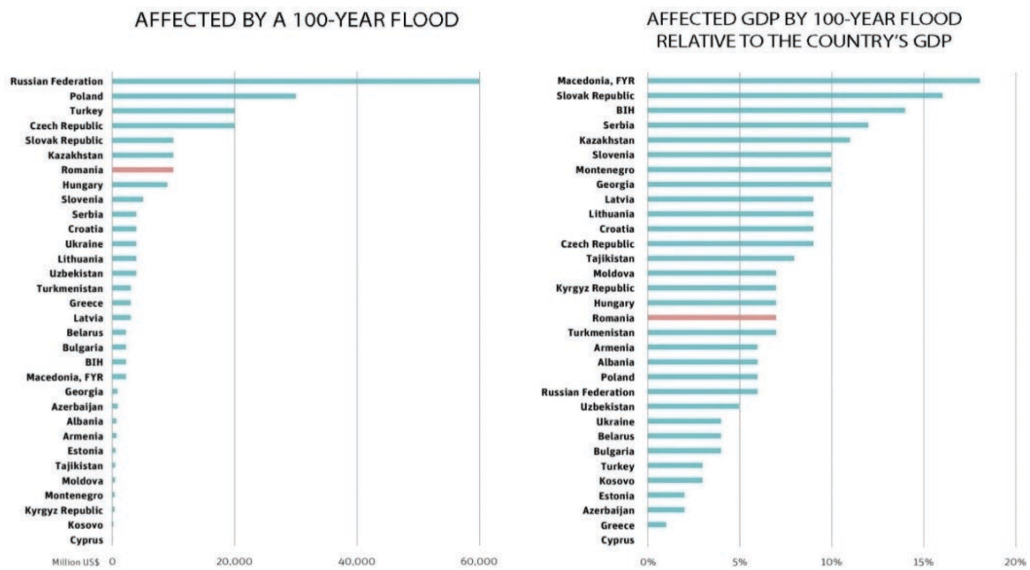
3.3. Floods: Implementing the Flood Risk Management Plans

3.3.1. Romania Is Highly Vulnerable to Floods

Romania is amongst the EU countries most subject to large flooding events—surpassed only by Poland, the Czech Republic and the Slovak Republic for the frequency of 100-year floods. Romania's flood risk is higher than that of all other countries in the Balkans region. However, in terms of proportion of gross domestic product (GDP) affected by floods, Romania does fare better than many other EU countries less prone to floods (e.g., Slovenia, Latvia, Lithuania, Croatia, Hungary)—testimony to the considerable investments that have been made in the past, and the management framework that has been put in place to mitigate the negative impact of floods. In terms of vulnerability to floods, Romania ranks in position 36 out of 162 countries worldwide.[15] Figure 3.9[16] compares the flood risk for the various countries of Eastern & Central Europe and Central Asia for 100-year return period floods—with frequency of floods and proportion of affected GDP.

Floods have been occurring in Romania with growing frequency over the past centuries. This is shown below in table 3.8 with the number of major floods recorded since the 16th century.[17] This increase in frequency could be associated with both the anthropic activities that changed or reduced the space of rivers and climate change effects. The frequency has increased even further in the last 30 years, with floods occurring in all river basins almost every year.

FIGURE 3.9. Countries Vulnerability to Floods Based on Their GDP



Source: World Bank report 2016.

TABLE 3.8. Historical Floods Recorded in Romania

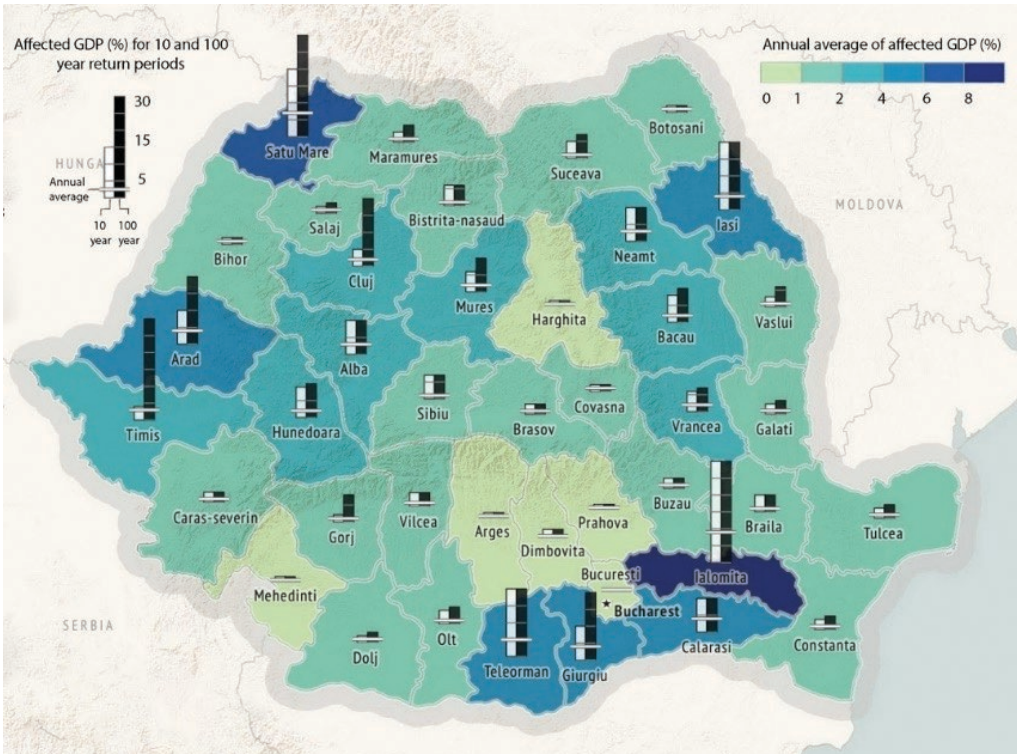
Century	Number of flood occurrences in Romania
XVI	10
XVII	19
XVIII	26
XIX	28
XX	**42**

Source: EM-DAT 2017.

The southeastern, northwestern and western parts of the country have been the most affected, with sometimes considerable impact on the GDP at local level—of more than 4 percent of local GDP on average in the seven most affected counties. This is shown in map 3.10. (based on return periods of both 10 and 100 years). In the counties of Satu Mare (north west) and Ialomita (south east), the average reduction of local GDP due to floods events exceeds 6 percent. It stands between 4 and 6 percent in the counties of Arad (west), Iasi (northwest, border with Moldova) and Calarasi, Giurgiu and Teleorman in the southwest along the Danube.

A recent study commissioned for the EC (DG Env) estimated that the total damages caused by floods during 2002-13 for Romania were 6.3 billion euros,[18] putting the country in the seventh place in the EU. For the same period, Romania has suffered the largest death toll from

MAP 3.10. **Romania's Most Affected Regions by Flood, 10 Years and 100 Years Return Period**



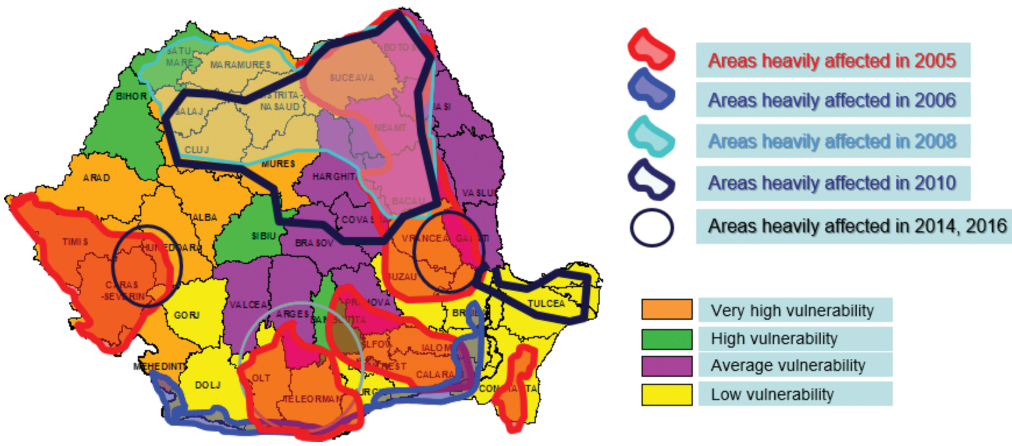
Source: World Bank report 2016.

floods (183 fatalities) and total number of destroyed houses (43,900) across Europe; the country ranked third in EU with regard to the total number of evacuated people (68,000 people). Around 400 important flood events were recorded during 1960-2016, with around 40 of them considered significant historical floods. Map 3.11 highlights the areas with the highest vulnerability to floods, as well as the areas that have been most heavily affected by the recent floods.

Several floods of catastrophic magnitude have been recorded over the past hundred years in Romania, with significant loss of life and socio-economic damages, as reflected in the governmental and international disaster databases (table 3.9). In 1926, more than a thousand peoples lost their lives due to a catastrophic flood. The flood of 1970 stands out due to the combined large number of life loss, value of damages and areas affected. Over the past fifteen years, two catastrophic floods occurred in 2005 and 2010. In both of these more recent cases, in addition to loss of life, the economic damages were considerable, calculated at respectively 1.3 and 1.1 billion USD.

The hydro-meteorological regimes in Romania show regular variations with successions of wet, normal and dry years. This is typical of temperate climate, and an analysis of

MAP 3.11. Floods Vulnerability at County Level during 1992–2004 and Recent Floods



Source: ANAR.

TABLE 3.9. Socio-Economic Damages Inflicted by Floods in Romania

Year	Casualties	Population affected	Damages (US$)
1926	Over 1,000	N.A.	N.A.
1970	215	238,755	500 mill.
1975	60	About a million	50 mill.
2005	75	56,571	1.3 bill.
2010	26	12,237	1.1 bill.

Source: World Bank's elaboration based on various sources.

meteorological and hydrological regime in Romania for a period of 120 years (1881-2001) shows that, on average, **every decade includes two dry years, three wet years and five normal years**. Floods typically occur during wet years, but it must be noted that flash-floods can also occur in dry seasons. Over 100 major past flood records in Romania have been recorded in the international datasets, such as EM-DAT and DFO,[19] and identified based on predefined key-impact indicators, such as human losses, economic damage, and size of flooded areas. Changes in climatic conditions are now generating floods due to the combined effect of snowmelt (due to high temperatures during the day) and heavy rainfall in a short period of time. Each major flooding event is specific and occurs due to a combination of various factors, as illustrated in table 3.10 below for floods in 1970 in 1981, as well as floods waves in 2005 and 2006. It is noteworthy that the 2006 floods, despite their magnitude, caused much less casualties and damages thanks to the existing efficient flood protection, preparedness and mitigation actions that had been put in place.

In the past 15 years, floods have occurred in 9 years, affecting different river basins. Views of recent floods are shown in photograph 3.1 below. The year 2005 was an exception, when

TABLE 3.10. Description of Flooding Events in 1970, 1981, 2005 and 2006

Date	Location of floods, return period	Description of flooding event
May 1970	Floods on Somes, Tarnave, Olt, Siret and Danube Rivers, with a return period of 100-500 years.	Heavy rainfall of the first 4 months of the year infiltrated and saturated the soil. In May, due to saturated soil, snowmelt transformed into runoff with high discharges on the rivers, affected partially 1,528 and totally 83 cities and villages. 256,000 people were evacuated.
March 1981	Floods on Crisul Alb, Crisul Negru, Aries and upstream Olt Rivers, with a 100-year return.	Combined effect of rainfall of 100–150 mm in 48 hours; and snowmelt—due to exceptional coincidence of high spring temperatures and a snowpack of over 1 m deep.
April 2005	Floods on Bârzava and Timis Rivers.	Flooding of over 100,000 ha, 1 town and 6 villages.
July 2005	Floods on Trotus River, flood with a 500-year return.	Over 200 mm/24 hours rainfall, extreme discharge of 2800 m^3/s, flooding 3 towns and many villages.
August 2005	Flood on Siret River.	Flood destroyed almost completely one village and damaged many others, threatening to inundate Galati with its major steel plant.
April–May 2006	Six floods waves hit across the country, the most severe being on the Danube River in the west and south, 100-year return.	Exceptional springtime weather with coincidence of heavy rainfall and fast snowmelt (sudden rise of temperatures in the Alps) resulted in a 100-year flood event on the entire Romanian section of the Danube, which inundated a number of villages and threatened many towns.

Source: World Bank's elaboration based on various sources.

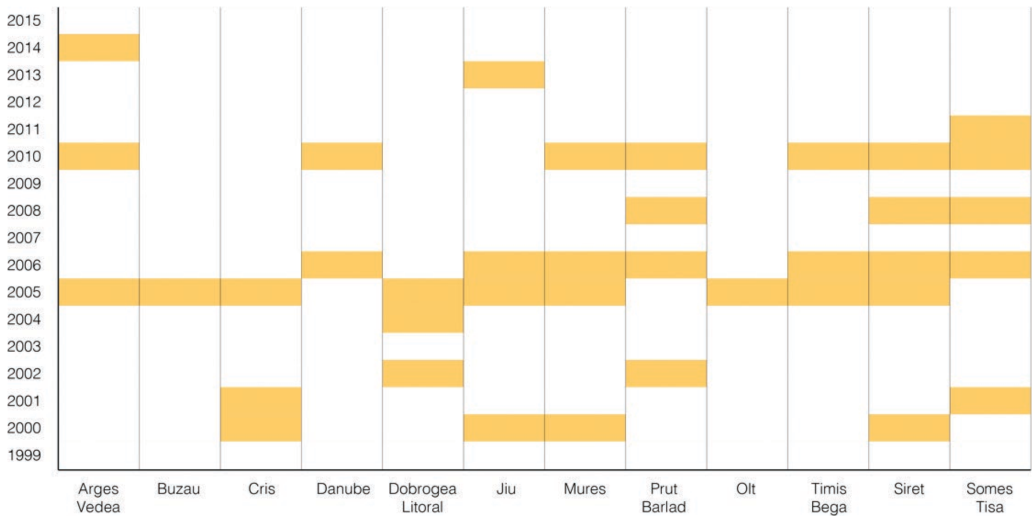
PHOTOGRAPH 3.1. View of Recent Floods in Siret (Left) and Danube Delta (Right)

Source: ANAR website.

floods occurred in almost all river basins, as shown in figure 3.10. This was the unfortunate result of a combination of natural and anthropic factors. The natural factor was the change in rivers' hydrology following the new pattern of rainfalls intensity and distribution, exceeding the past records for 100 years return period or, in very rare cases, 500 years (see for example the case of Trotuș River Basin in 2005); the anthropic factor was the poor maintenance of the river bed and flood management infrastructure. Indeed, the variability of natural factors need to be linked with the effects of climate change, as will be explained further, in "Dams: Ensuring Safety and Retrofitting to Serve New Challenges" section.

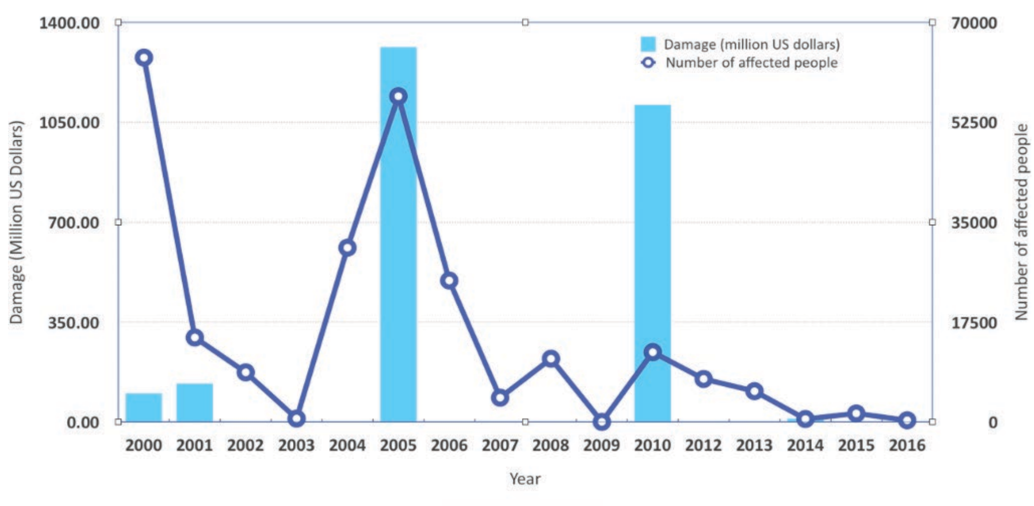
For the period 2000–16, the average costs of flood damages per year have been estimated at over 160 million US Dollars, with an average of 13,650 people being seriously affected annually.

FIGURE 3.10. Occurrence of Floods in Main Romanian River Basins



Source: EM-DAT and ANAR websites 2017.

FIGURE 3.11. Flood Damages and Affected Population



Source: EM-DAT database; flood damages are documented only for major flood events.

The population affected and economic damages (only for large floods) are shown in figure 3.11.

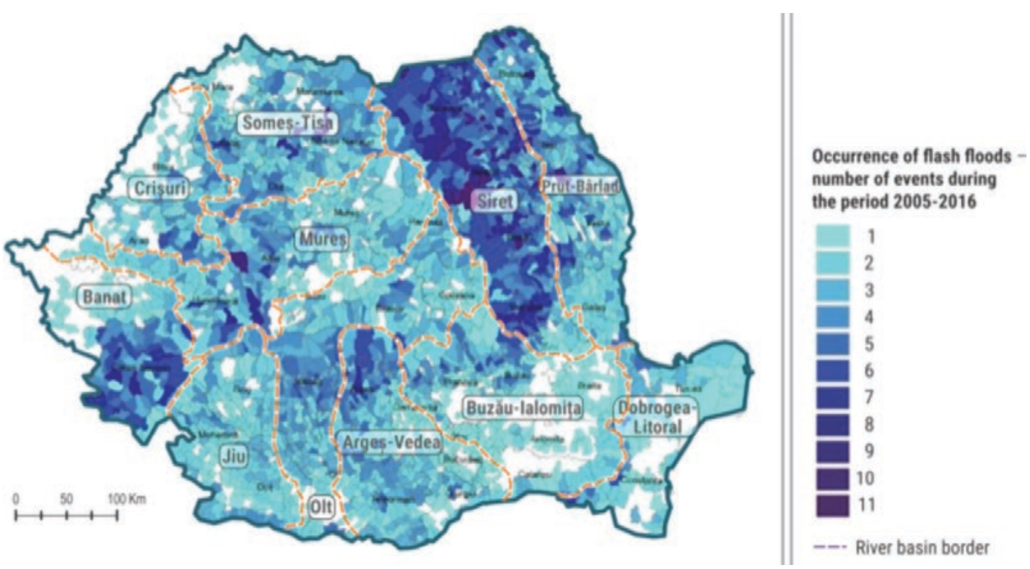
The lower damages floods after 2010 can be attributed to both climatic conditions and the first effects of the implementation of the actions encompassed by the EU Flood Management Directive—especially to improved warning systems. After the Floods Directive was transposed in the national legislation with its implementation norms and regulations, important steps were taken towards improving the short and long term prognosis, improvement of early warning systems, raising public awareness of floods and other natural disasters, improving preparedness and response capability of institutions and population in case of disaster. In addition, the operational rules and regulations were reviewed to enhance the quality and timing of maintenance of flood protection infrastructure.

The improvements in preparedness and response capacity to protect the population in case of major floods were well demonstrated in 2010 when floods with similar size and pattern as in 2005 resulted in significantly lower casualties with a similar size of damages. The improved early warning system allowed for enough time to evacuate population from affected areas. The return period of the floods of 2005 was estimated at 100 years, as it was for the floods in 2010, but in 2010, the flood lasted much longer.

The frequency of flash floods has also been increasing in the past 25 years with an expanding spatial coverage, particularly in the hilly areas of the eastern (Transylvania) and southwestern regions (Dobrogea), as shown in map 3.12. The evolving pattern of flash floods is highly influenced by the change in the intensity and distribution of heavy rainstorms, closely linked, as observed, with the effects of climate change. Another factor that has aggravated the high concentration of run-off on slopes is deforestation. Larger areas of formerly afforested land have been in the recent past aggressively harvested through abusive and, in many cases, illegal logging. This has left the slopes exposed to heavy rains and without the previous soil and vegetation retention capacity for water. Climate change is expected to increase the frequency of extreme flash flood events.

Flash floods are particularly damaging because they are difficult to forecast with enough head time to allow safe sheltering of the potentially affected population. In addition,

MAP 3.12. **Mapping of Locations with High Incidence or Risk of Flash Floods**



Source: WB based on ANAR 2017.

the structural flood protection measures are expensive and difficult to implement in typically affected areas. Flash floods return periods cannot be calculated as they are impossible to predict, and their magnitude can only be associated with the return period of the rainfall likely to produce the runoff.

3.3.2. Romania Has Built a Large Flood Management Infrastructure

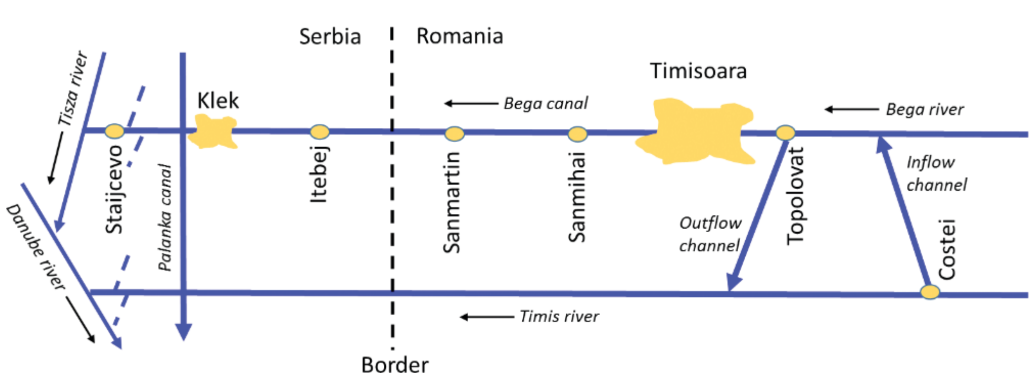
Romania began flood management on a large scale as early as in the 18th century. This was when, in the western part of the country, a complex hydro-technical system was built between the Bega and Timis Rivers to allow diverting water from one river to another, mainly to protect the city of Timisoara against floods. The system, which has been operational ever since its construction more than two centuries ago, allows transferring excess flood water from the Bega River to the Timis River and in the opposite direction.

The Bega-Timis River flood protection scheme is shown in more detail below in photograph 3.2 and figure 3.12. Further, in the late 19th and early 20th centuries, further attention was given to flood protection and management through the embankment of rivers most

PHOTOGRAPH 3.2. Views of Some of the Bega-Timis Floods Protection System

Source: ANAR website.

FIGURE 3.12. Schematic of the Bega—Timiș Rivers Hydro-Technical System



Source: A. Popescu.

PHOTOGRAPH 3.3. Views of Levees and Dykes on Romanian Rivers

Source: ANAR.

prone to flooding and construction of dams to store part of peak flows during floods and, thus, attenuate their downstream effects. The oldest dam still in function was built in 1905. After the large floods of 1970, the construction of more dams was initiated under a new national strategy of flood management. In parallel, embankment works along the Danube River, started in the early 1960s, and were completed by the mid-1980s.

Romania has a reasonably well-developed flood protection infrastructure. It comprises **a network of levees spread along all the rivers** in the country (photograph 3.3), as well as **permanent and non-permanent reservoirs created either behind dams or as riverside flooding pockets (polders)**. In total, there are 11,655 km of dikes located along the Danube River and internal rivers of various size, all managed by the river basin agencies under ANAR.

Since 2012, ANAR has been managing all floods management infrastructure in Romania. Until 2012, the flood protection responsibilities were shared by ANAR and National Agency of Land Reclamation (ANIF), which created overlaps and inefficiencies, leading the government to consolidate all flood management under one single national agency. All flood protection infrastructure previously managed by ANIF was transferred to ANAR that became the sole agency in charge of floods management in Romania. The flood protection infrastructure is subject to regular inspection and improvement.

Dams and reservoirs play an important role in the overall flood protection strategy (photograph 3.4). The second main flood risk protection infrastructure of ANAR are the reservoirs through which peak flows of the flood hydrographs are attenuated. The network of reservoirs dedicated specifically to flood protection includes **324 permanent reservoirs and 129 non-permanent reservoirs and polders**, with a **total storage capacity for floods of 3.7 billion m^3**. For the permanent reservoirs, the flood protection component is included in the reservoir operating rules (i.e., rule curves) and during a flood event the reservoir is fully operated for the purposes of reducing the flood peak.

However, **several reservoirs with flood risk protection role are not fully functional**. They are operated below the envisaged design capacity, to maintain them within safety parameters because of infrastructure deterioration. This happens because the deficiencies observed during their regular inspections and checks require imposing functional restrictions.

PHOTOGRAPH 3.4. **View of Dams for Flood Protection**

Source: ANAR.

TABLE 3.11. **Methodology for Determining Floods Risk Areas**

Step 1	Identification of past historical floods, as preliminary flood risk assessment (PFRA), to identify key areas with potential flood risks.
Step 2	Flood risk maps (FHRM) were produced for areas with potential significant flood risk.
Step 3	Preparation of flood risk management plans (FRMP), for each of the 11 basins, to be completed by December, 2015.
Step 4	All FRMP revised and updated as needed, by 2021, with further revision every 6 years.

Source: ANAR/INHGA (adapted).

These dams would return to their normal functional conditions only after remediation interventions are completed and full safety restored. More information on dams and their current operational and assets status are given in the next sub-chapter. Studies for flood propagation in case of a dam failure are needed. Moreover, these studies would fill the gap of the reevaluation of the flow return periods for which the dam was initially designed, with new design return period of flows to be used to check the spillway capacity of each dam.

3.3.3. Flood Risk Management Plans

As part of implementing the EU Floods Directive, ANAR and INHGA have developed a methodology for determining potential flood risk areas. It allows to do spatial mapping of flood risks, based on flood events scenarios with a return period of respectively 1000, 100 and 10 years. Its development benefited from Romania's active participation in EU research projects related to floods.[20] The methodology followed for flood risk mapping was a stepwise approach, as outlined in table 3.11.

Within step 2, the elaboration of flood risk maps entailed a qualitative approach that combined hazard assessment with risk assessment. Hazard assessment was evaluated based on flood maps, and risk was assessed based on defined hazards and vulnerabilities (see figure 3.13).

The consolidated flood risk map finalized in 2015 (map 3.13) shows that the main risk areas are along the main rivers, specifically: the **Danube, the Mureș, the Crișuri at the border with Hungary, the Timis and the Bârzava at the border with Serbia**, and at the **junction of the Prut, the Siret and the Danube, near Galați**. It is important to mention that these maps were generated on the basis of the return periods of the design flood, and not based on historical floods (as the map shown earlier in this chapter). A historical flood is a flood event that happen in the past, while design floods with a defined return period are possible values of flow, calculated on the basis of a clearly defined methodology. The calculated flow of the design flood is the one corresponding to a certain return period (i.e., 10, 100, 500 years). The methodology of computing possible values of return-flow is based on the frequency analysis of recorded discharges on a river, over long periods. Based on the flood risk maps, disaster planning strategies were prepared and incorporated in the FRMPs issued in December 2015, including the required operation and maintenance of flood infrastructure.

It is important to note that the flood risk maps were prepared based on hydrological data collected for the past 35 years for each river basin, which were used for calculating the design flood return periods. **However, the design parameters are expected to change in the future**, either due to climate change or anthropic interventions in the basin and, as such, would need to be reconsidered in the near future. The current FRMPs finalized in 2015 will be updated every 6 years, starting with 2018. In addition, several adaptation measures need to be developed and implemented by each river basin, in accordance with their needs.

Early warning of the population of potential flood risks are an integral part of all FRMPs. Early warning systems are a requirement by law, and their functioning and the evacuation are the responsibility of the Inspectorate for Emergency Situations (ISU)[21] that is in charge of the protection of civilians. Several periodic evacuation exercises are planned to be carried out in each potentially flood affected area. Three main projects were carried out in order to address floods warning as part of the implementation of the FRMPs: SIMIN, the integrated meteorological system for rainfall prediction (finalized in 2004); WATMAN, the integrated water resources management system; and destructive water abatement and control of water disasters (DESWAT), the hydrological warning and forecasting (box 3.2).[22]

FIGURE 3.13. Qualitative Assessment of Flood Risk

Risk Assessment Qualitative approach

Flood Hazard map delineation

Hazard (10, 100, 1000) years return period		
Flood Depth	Level of magnitude	Index
< 0.5 m	low	H1
0.5m - 1.5m	medium	H2
>1.5 m	high	H3

Flood Risk assessment (R1-low, R2-medium, R3-high)

RISK			Vulnerability		
			low	medium	high
			V1	V2	V3
Hazard	low	H1	R1	R1	R2
	medium	H2	R1	R2	R3
	high	H3	R2	R3	R3

Source: ANAR/INHGA (adapted).

MAP 3.13. Main Flood Risk Areas in Romania under the FMPs (in Red)

Source: INHGA, adapted.
Note: FMP = Flood Management Plan.

BOX 3.2. **Flood Risk Related Warning System**

Early warning of population is one of the main goals of the protection actions encompassed by the flood risk management plans. Three main projects were carried out in order to address the implementation of the FRMPs: (a) SIMIN, the integrated meteorological system for rainfall prediction (finalized in 2004); (b) WATMAN, the integrated water resources management system (2008); and (c) DESWAT, the hydrological warning and forecasting (2010).

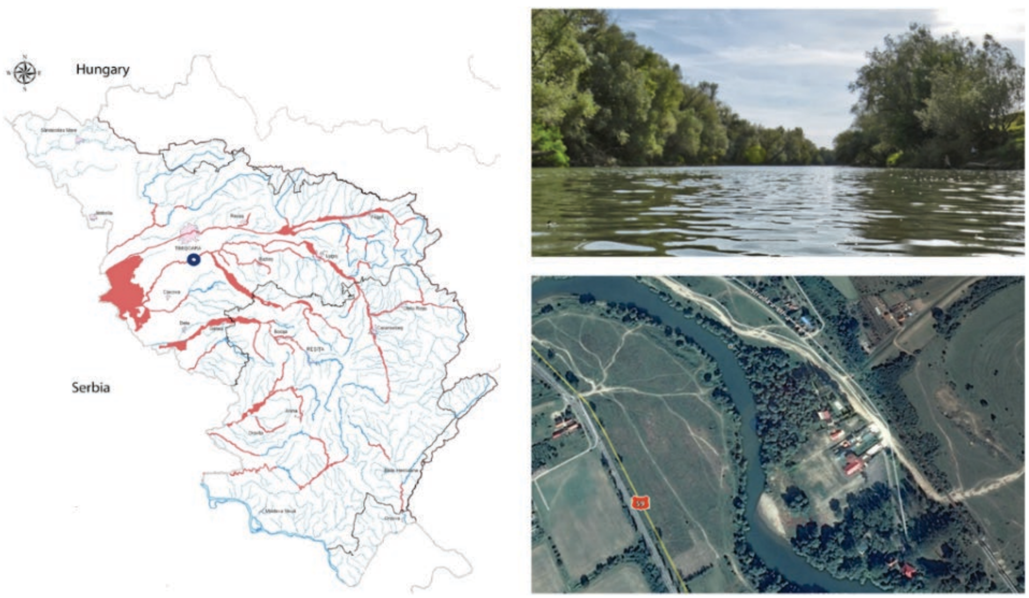
Early warning of potential flood risk is part of all FRMPs and several periodic evacuation exercises are planned to be carried out in each potentially flood affected area. Early warning systems are a requirement by law, and the evacuation and functioning of it is the responsibility of the Inspectorate for Emergency Situations (ISU) that is in charge of the protection of civilians. The ISU issues alarms, organizes periodic exercises and training of both ANAR and civil society. On request of the ISU, ANAR is present at the information sessions that the ISU organizes for the civil society.

WATMAN project comprises 23 quick operational centers, ready to act in case of floods. Their response time, for providing help and support in case a flood event occurs is of 30, 60 and 90 minutes for distances of 22, 45 and 95 km respectively. These 23 centers have 41 units of rapid intervention. Each rapid intervention unit has 11 workers and 2 technical staff members, supported by specialized machinery. It is however not yet clearly stated in the FRMPs how often evacuation exercises with civilians are envisaged to be performed.

The FRMPs do have implementation challenges, often related to the lack of proper maintenance of the floods protection infrastructure. This can be illustrated by the case of Banat ABA. The region is located at the western border with Serbia, and was hit hard by floods in 2005. In the past 26 years, maintenance was not sustainably done, trees have grown in the river bed, changing the flow carrying (conveyance) capacity of the river. Apart from nature taking over the river bed, maintenance work seems to have been done less frequently than required, and as the trees grew in the river bed, the maintenance works have been more difficult to carry out (see maps 3.14 and 3.15).

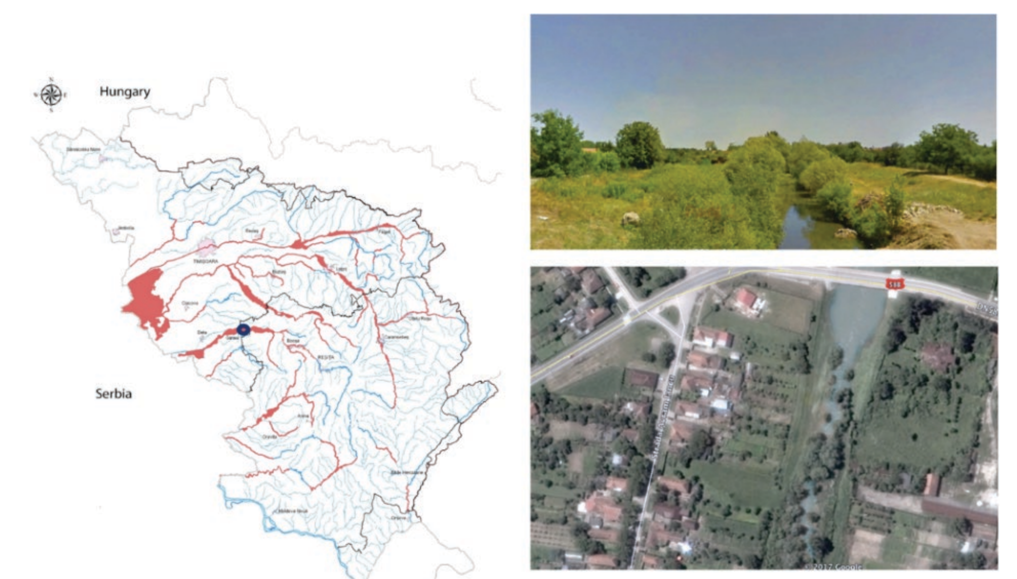
In the case of Timosoara, inadequate maintenance of river bed amplified the impact of the catastrophic floods in 2005. The flood on the Timis River that happened in April 2005 in Banat affected over 100,000 ha at the Romania-Serbia border. Due to high flows on the Timiș right bank levee was overtopped in three sections. As a result of high flows and overtopping of levees in one section the levee failed and generated the above mentioned large flooding area. Though there is an agreement between Serbia and Romania on cooperation in river maintenance and flow rates, there is high vegetation within the river banks not only in Romania but also in Serbia. This high vegetation combined with coincidences of high

MAP 3.14. **Reduced Carrying Capacity of the River due to Trees**



Source: World Bank's elaboration based on ANAR and various sources.
Note: Black dot on the map on the left pane shows where photos on the right pane were taken.

MAP 3.15. **Reduced Carrying Capacity of the River Bârzava due to Trees**



Source: World Bank's elaboration based on ANAR and various sources.
Note: Black dot on the map on the left pane shows where the photos on the right pane were taken.

discharges on the Tisza River in 2005, generated reduced river discharge capacity of the Timiș River in Tisza, hence the formation of a backflow effect on the Romanian side.

3.3.4. Investments of 3.8 Billion Euros Were Identified for Flood Risk Management

Each river basin flood risk management plan includes proposals for improving the condition of infrastructure through rehabilitation of some dikes, including restoration of the designed parameters. **Based on the risks mapping exercise, ANAR has identified the required infrastructure investments for mitigating the flood risks**. The figures presented in table 3.12 represent the costs estimated for implementing the measures proposed in the FRMPs by all river basin administration and the Danube River during 2016-21, both for investment and O&M. The estimated costs may be revised at the time the request for funds is made.

At the national level the floods management investments envisaged in the FMPs comprise 49 integrated projects of approximately 3,7 billion euros. It is worth mentioning that this is broadly equivalent to the value of damages incurred over the period 2000-10. Considering that these are mostly for infrastructure with a long useful life, these investments appear highly justified and should not be delayed. They include: (a) re-naturalization of the river banks (vegetative protection), (b) restoration and maintenance for: increasing river conveyance, increasing attenuation capacity of the flood wave in shorter distances, riverbed stabilization (recalibration of riverbeds, parapets, retaining walls, river bank defenses) and maintenance, obstacles removal from water courses, (c) protection against flooding through: strengthening, raising and/or building new local embankments, dike relocation, creation of new temporary storage areas ("polders," small reservoirs), creation of channels for temporary water diversion, and maintaining designed reservoir volumes (dredging, sediment flushing, etc.), and (d) clearing the backlog for maintenance of existing flood protection infrastructure. Photograph 3.5 shows some views of flood protection maintenance and civil works routinely carried out by ANAR.

TABLE 3.12. Costs of Proposed Measures for FRMPs 2016–21

River Basin Agency (RBA)	Proposed O&M and Investments ('000 Euros)		
	Operation and maintenance	Investments	Total
Someş - Tisa	14,500	433,000	447,500
Crişuri	13,000	495,000	508,000
Mureş	5,500	87,500	93,000
Banat	7,000	652,000	659,000
Jiu	8,000	113,000	121,000
Olt	7,900	385,000	393,000
Argeş - Vedea	4,950	326,000	331,000
Buzău - Ialomiţa	2,000	227,000	229,000
Siret	7,800	972,000	980,000
Prut - Bârlad	550	12,000	12,500
Dobrogea - Litoral	390	33,000	33,000
TOTAL	**72,500**	**3,735,000**	**3,810,000**

Source: ANAR, Danube River Basin Management Plan—2016.
Note: FPMP = Flood Protection Management Plans.

PHOTOGRAPH 3.5. **View of Floods Protection Maintenance and Civil Works by ANAR**

Source: ANAR website.
Note: ANAR = National Administration "Romanian Waters".

A priority list of investment projects for flood risk management representing 246.6 million euros (plus 184.8 million euros to limit coastal erosion on the Black Sea) has been proposed for financing from the Large Infrastructure Operational Program (LIOP) during 2017-20 and there are good prospects that it will receive the required financing. These 19 priority projects are listed in Annex 3. These projects complement the portfolio of 89 investment projects totaling about 500 million euros and already financed with a 298.5 million euros loan (the rest being counterpart financing) from the Council of Europe Development Bank (ECB)—of which 68 projects have been completed and 21 projects are still under implementation. Also, 10 flood protection projects (103 million euros) were implemented with financing from the HRMEP[23] Project during 2005-12.

3.4. Dams: Ensuring Safety and Retrofitting to Serve New Challenges

3.4.1. The Safety of Many Romanian Dams Is a Cause for Concern

3.4.1.1. Romania Has a Large Number of Dams

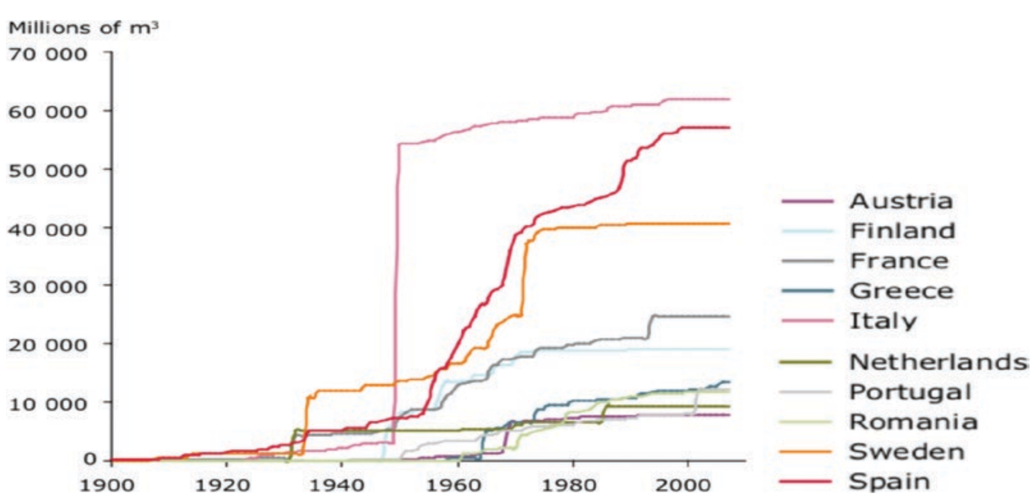
Dams have been constructed in Romania since ancient times, particularly for the gold mining activities carried out during the Roman Empire. These were small dams, but many of them were rehabilitated during the 18th-19th centuries using advanced techniques of the time. Some of such rehabilitated old dams can even be seen nowadays (e.g., the Dognecea Dam near Ocna de Fier, rehabilitated at the beginning of the 18th century). **Construction of dams took off during the 20th century**. At the beginning of the 20th century, the need for energy production led to the building of 38 dams with hydroelectric plants that were producing 21,000 KW in total and had an average installed capacity of 75 GWh/year. The age of building and using thermoelectric plants stalled the construction of dams between 1920 and 1940. Though, construction of dams resumed after 1940: between 1940 and 1970 a series of important dams were built in Romania taking advantage of the growing expertise in dam design and construction using new techniques. With its experience and interest in dams, Romania contributed to the establishment, in 1928, of the International Commission on Large Dams (ICOLD) as one of its six founders. Investment in dams continued at a faster pace during 1970–89 due to the combined need to provide hydroelectric power and to create a strategy for the protection against floods, so that 75 percent of all dams were built during that period.

In total, 2,617 dams have been built in Romania for various purposes. The majority of them (2,087, or 80 percent) have been built to serve one main purpose (e.g., water supply, hydropower production) or serving multiple purposes (including irrigation). In all cases, the reservoirs of retention dams have been provided with a tranche of volume to be used for flood control (attenuation of flood peaks). In addition, a large number of small, run-on-river dams, have been built for small hydropower systems, small irrigation schemes or fish farms. Dams have also been built to create storage facilities for tailings resulted from the mining industry (mostly non-ferrous ores). Since Romania used to have a well-developed non-ferrous mining industry, a large number of tailings dams have been built, particularly in the central and north-western parts of the country.

While dam construction in Romania during the 1960–90 period was large-scale, it fell short of the massive dam development that took place in some other European countries. Figure 3.14 below shows the increase in total storage over the last hundred years for Romania and other nine European countries. It must be noted that other countries of the similarly large size, such as Spain, Italy, France and Sweden have witness a much sharper increase of the total water storage capacity that Romania.

Water retention dams can be classified using different criteria recommended by two main international expert bodies: ICOLD and World Commission of Dams (WCD). According to **ICOLD**, all dams with a height over ***15 m*** are considered ***large dams*** and all dams with the height over ***150 m*** are considered ***major dams***; the rest are ***small dams***. According to WCD, the large dam

FIGURE 3.14. Growth in Total Reservoir Storage over the Last Hundred Year for 10 European Countries



Source: EEA.

category should be extended to dams with the height of ***5–15 m*** provided that their reservoir capacity is greater than ***3 million m³***, the dams with the height of *10–15 m* can be considered *medium size dams* and those *below 10 m, smaller dams*. No decision to harmonize the two views has been reached so far, and different combinations of criteria are used by countries and international organizations.

By ICOLD criteria, Romania has 183 large dams and 1,350 small dams. **By WCD criteria, Romania has 246 large dams** and 1260 small dams. Romania decided to include all dams classified as large dams by both ICOLD and WCD criteria in the National Register of Romanian Large Dams (RRMB, *Registrul Român al Marilor Baraje*), which includes, thus, **246 large dams**. Interestingly, construction activities for 31 of the 246 large dams are still underway (some of them for over 20 years) because of insufficient budgetary funds allocated for their finalization, postponing the expected benefits until their final commissioning.

The majority of large and medium dams serve multiple purposes, including hydropower production, water supply and flood protection. The 1,260 small dams serve mainly for flood protection (attenuation of peak flow) but could have other secondary functions. Therefore, they can be used for permanent or non-permanent water storage, i.e. they retain water permanently for other use or retain water just during floods.

The Romanian legislation introduced an additional classification in four classes according to dam importance associated with risk factors. A classification of large dams using the above criteria made on the basis of the information found in a presentation made by the Ministry of Environment in 2009 is shown in table 3.13. This was the only source of information found related to dam classification by risk level. One can note that the classification leads to **276 dams**, 30 more than those listed in RRMB. It appears, thus, that a revision of the classification of dams included in RRMB by their risk level is required, to make it consistent with other sources and publicly available.

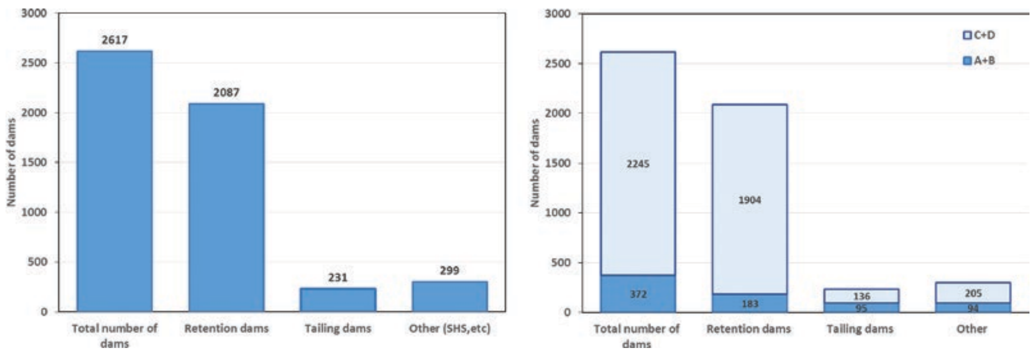
In figure 3.15 the classification of dams according to their function and risk factors is shown. **This report will further refer only to large dams of classes A and B. It shows that a total**

TABLE 3.13. Classification of Large Dams by Risk Factors

Number of dams			Risk level classification of dams				Total
			Exceptionally important	Very important	Important	Reduced importance	
			A	B	C	D	
Dam Height (m)	Small	H < 10 m Vol>3 mill. m³	0	5	46	27	78
	Medium	H = 10–15 m V>3 mill. m³	0	19	12	6	37
	Great	H > 15 m	27	116	14	4	161
Total			27	140	72	37	276

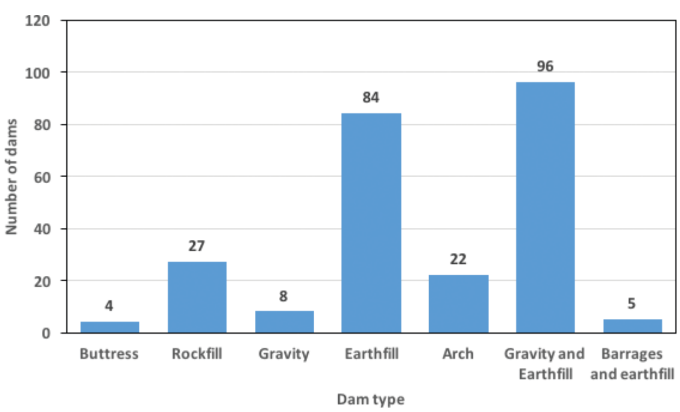
Source: World Bank's elaboration based on the Ministry of Environment, 2009.

FIGURE 3.15. **Classification of Romanian Dams Based on Importance**



Source: Romanian Ministry of Environment presentation of 24.11.2009, www.mmediu.ro.

FIGURE 3.16. **Type of Construction and Materials for Dams**



Source: World Bank, based on RRMB database on www.baraje.ro, 2017.

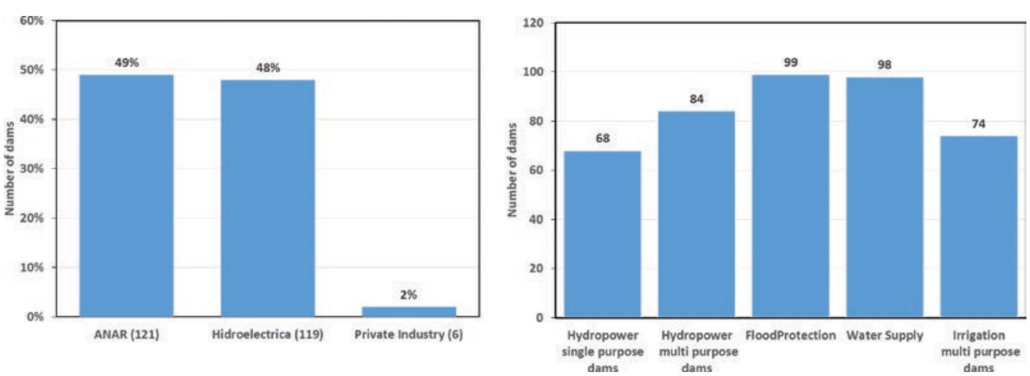
of 372 dams are in the two high-risk categories, of which 183 are retention dams and 95 tailing dams. This underlines the importance of ensuring their safety for the population downstream.

By type of construction and material, the majority of large and medium size dams in Romania are earth-fill dams and concrete gravity dams, but a significant number of rock-fill dams and arch dams have also been built, while the number of buttress dams is very small, as shown in figure 3.16.

Most dams were built during the 1950–80 period, and are usually multi-purpose, with one main function and few secondary ones, for example, hydropower with flood protection and irrigation; or water supply with hydropower and irrigation; etc. However, about 39 percent of all large and medium size retention dams serve a single purpose. In general, all large and medium dams are designed to include the flood protection purpose, and flood management responsibility lies with the dam owner or manager. The ownership of these dams is split between ANAR and Hidroelectrica; each of which owns and operates about half of the dams in Romania and is fully responsible for safety and proper management, operation and maintenance of their respective dams. An overview of main purpose and ownership is presented in figure 3.17.

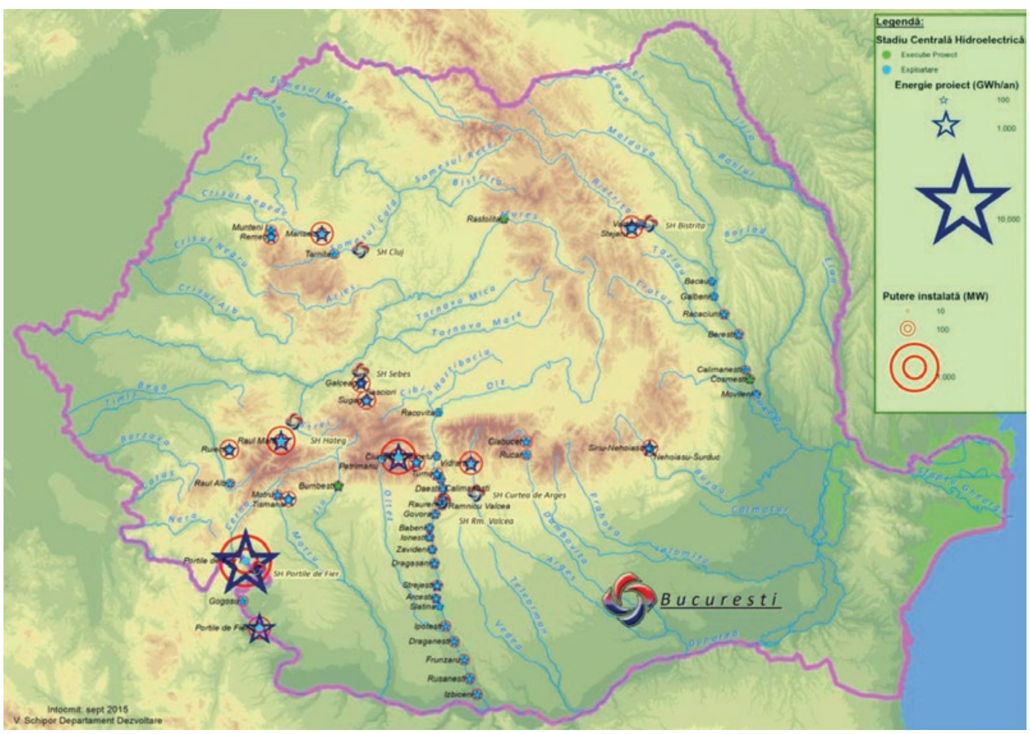
Most of the hydropower capacity operated by Hidroelectrica is concentrated in a series of large dams. The total installed capacity amounted to 6.43 MW in 2016 and has not changed significantly in recent years. In 2015, the few hydropower plants of more than 25 MW accounted for 85 percent of the total hydropower generation. Hydroelectrica produces on average about 25-30 percent of the total power generated in Romania, though in practice there are considerable variations between dry years (12 percent) and wet years (35 percent in 2005 and 2010). Hydroelectricity is the second largest source of power generation after fossil

FIGURE 3.17. Dam Owners and Purposes



Source: World Bank team, based on RRMB database on www.baraje.ro, 2017.

MAP 3.16. Location of Large Hydropower Dams Operated by Hidroelectrica



Source: Hidroelectrica 2016a.

fuels, with annual production oscillating between 12 and 20 TWh over the past decade. Map 3.16 below shows the location of the main dams and hydropower plants operated by Hidroelectrica.

The framework that would apply to the construction of new dams changed when Romania joined the EU—since several EU Directives (WFD, Flood Management) impose strict requirements with respect to environment protection (including flora and fauna, under the Habitat Directive), impact on surface and subsurface water bodies, etc., entailing stricter quality control of designs. It means that any project for a new dam or rehabilitation of an existing one needs to observe such requirements and include provisions for updated environmental flow, fish ladders, analysis of the eutrophication of reservoir, effects of reservoir flushing on the downstream environment balance, dam sustainability, etc. In case of a new dam for hydropower purposes, sustainability can be checked using the Hydropower Sustainability Assessment Protocol, a tool that promotes and guides realization of sustainable hydropower projects, by making an evaluation across more than 20 topics. It provides a common language that allows governments, civil society, financial institutions and the hydropower sector to talk about hydropower and sustainability issues.

3.4.1.2. Several Romanian Dams Have Operation and Maintenance Issues

Regular operation and maintenance as well as thorough inspection are mandatory for all the dams in Romania. Operations and Maintenance (O&M) Program is imposed by law; it is elaborated by the dam owner and it is approved by the water authority. An O&M Plan is a guidance document developed to ensure that a dam is performing safely and according to its design and purpose. As the name suggests, this type of program contains details pertaining to two main administrative matters: operation and maintenance. Standard practices for both preventive and extraordinary maintenance are established. Preventative maintenance is performed routinely and includes the servicing of the dam and its appurtenances with the intention of avoiding over-vegetation, animal impacts, equipment deterioration, mechanical malfunction, flooding, or failure. Extraordinary maintenance is comprised of the repairs required to correct these damages if they do occur.

The current O&M issues are mainly related to personnel and funds—notably in the case of hydropower dams. *Hidroelectrica* used to be an exemplary company in terms of dam maintenance, but the company was declared insolvent in 2012 following financial troubles. As a result, *Hidroelectrica* management has started a program of retirement of experienced personnel without replacements. The funds allocated to dam maintenance were also severely cut. Consequently, the present condition of existing dams is far from the requirements and incidents are solved by imposing operational constrains instead of a consistent rehabilitation program.

ANAR is also starting to face some staffing issues with lack of experienced personnel for the dams it manages, but the cause is different. The water management service at each river basin administration (ABA) is in charge of both infrastructure operation and maintenance of hydraulic structures, including dams. The number of qualified employees is insufficient, most of them are directed towards water quality monitoring and the salary is far for being attractive for experienced dam engineers. Since even the day by day maintenance activity has been outsourced and the procedure of hiring a qualified contractor is tedious and in most of the cases not beneficial (the procurement procedure is based on the minimum price offered and not upon the qualifications), proper dam maintenance is becoming problematic and needs remedial actions.

3.4.1.3. Dams Safety: Legal Framework and Functional Requirements

Dams and reservoirs are a potential hazard to downstream areas of the reservoir, hence design, construction, operation, and regulation of dams all over the world need to be done so as to ensure that dam's safety. The need for safety evaluation comes from the fact that a failure of a large dam is considered to be the worst possible accident; many Romanian dams had been constructed relatively long time ago, before the time when the applicable regulations were enacted and updated (1996 and 2004) and harmonized with the EU regulations on environment, water and floods risk management.

Dam safety has two main goals: minimization of all risks; and dealing with the remaining parts of the risk in the best possible way. Moreover, increasing the safety of dams aims not only at avoiding all possible risks of failure, but also at ensuring continuity in the services for which they had been designed: steady supply of water to different stakeholders (population, industry, agriculture); flood protection; and energy production, through sustainable management of the stored water in the reservoir.

The Water Law sets the roles of the central government and of the dam owner with respect to dam safety (box 3.3). At the central government level, the main responsibility for dam safety is assigned to the Ministry of Waters and Forests which, in implementing its obligations, gets support from Romanian Commission for Safety of Dams and other Hydraulic Works (CONSIB),[24] the special commission for dam safety acting at the national level. CONSIB approves the process of checking and permitting the operation of dams, advises upon commissioning of dams after construction completion, advises upon dam operational rules, reviews technical inspection reports, etc.

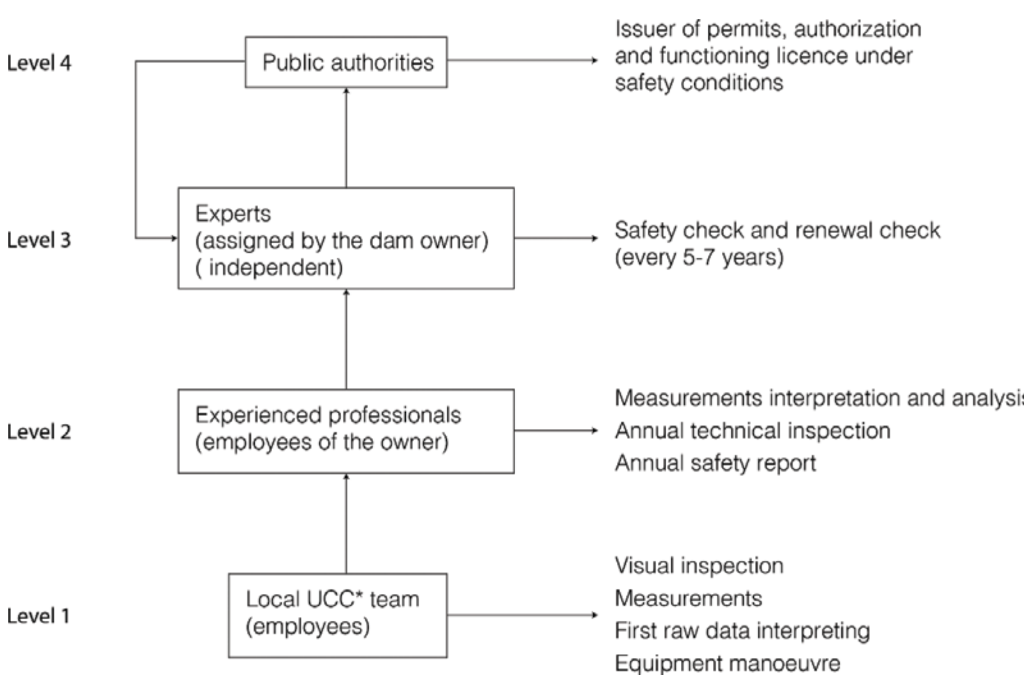
BOX 3.3. Legal Framework for Dam Safety

The Water Law #107/1996 provides the guidelines for management procedures to ensure dam safety, assigning to all dam owners the obligation to maintain, repair and operate under safe conditions the structures in their ownership. Specific provisions regarding the dam safety policy, classification of dams, dam safety obligations, rules for dams' operation and maintenance, responsibilities for periodic inspections have been enacted through the **Law of Dam Safety #466/2001** (which approved the Government Ordinance 244/2000). In addition, 14 technical norms specific to dam safety have been further approved, creating a comprehensive legal and regulatory framework for sustainable dam safety. The latest set of regulations regarding the assessment and evaluation of dam risk, transposing the international practice on risk assessment (recommendations issued by the ICOLD) was enacted in 2012. The **Law on Safety of Dykes #259/2010** also complemented the Water Law providing more specific rules and regulations for construction, management, maintenance and monitoring of dykes to ensure their safety and resilience in case of floods, in order to properly protect population and socio-economic life in their associated area.

In practice, the role of CONSIB is to ensure that dam owners fulfill the legal requirements on dam safety, by approval of plans for operation, construction and rehabilitation of dams, reassessment reports, qualifications of consultants and dam owners; audits of dam owner internal control systems, inspections of dams and other hydraulic structures (at scheduled times, randomly or on request, or when a safety alert is raised); review of inspection reports; development/revision of regulations and guidelines, carrying out expert analysis of the dam state and approving the constraints within which a dam may function. CONSIB includes up to 30 specialists, staff representatives of 50 institutions of central public authorities from the water sector, public works, land and water development, infrastructure and transport, administration and internal affairs, dam owners, consultancy and research institutions, hydraulic construction companies, and relevant academia. Representatives in CONSIB are reputed specialists in hydrology, hydraulics, geotechnics, concrete technology and other subjects relevant for dam safety. (Some additional information can also be found in section 2.4)

Ultimately the main agent responsible for safety is the dam owner that must ensure that dams and other hydraulic structures (penstocks, spillways, etc.) are operated and maintained so that they are not posing a threat to life, property or the environment. Dam safety is institutionally managed at four levels, as shown in figure 3.18 (where UCC stands for Construction Behavior Monitoring). The flow of information within the institution that owns the dam is highlighted by the direction of the arrows.

FIGURE 3.18. The Romanian Approach to Dam Safety



Source: World Bank Team, based on dam safety regulations, 2017.
Note: UCC* = Construction Behavior Monitoring.

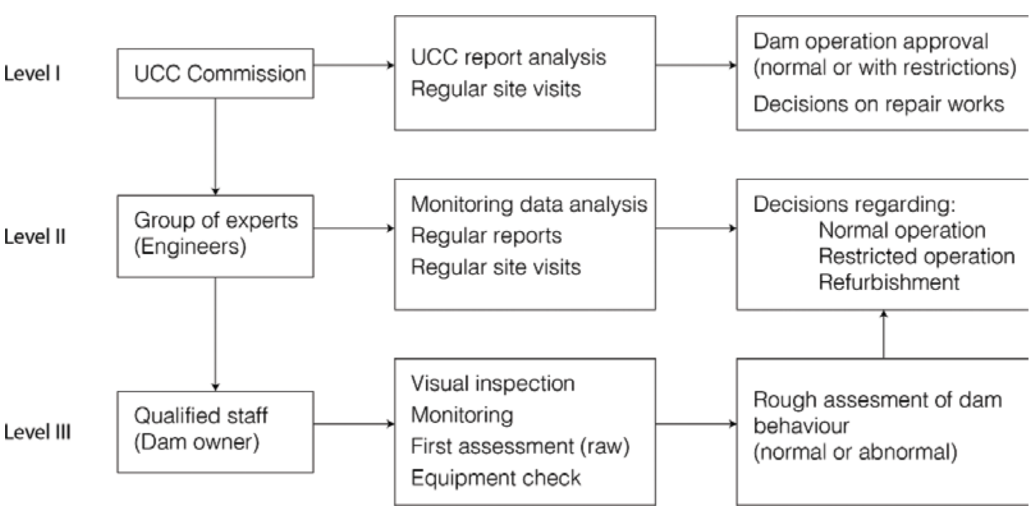
For large and medium dams, ANAR has an internal protocol for carrying out periodic inspections by a Construction Behavior Monitoring team, measurements, and interpretations of the collected monitoring data by their own employed experienced professionals. ANAR internal process is schematically presented in figure 3.19. Dam operation permits are issued every 5-7 years, when an external expert assesses the dam status, together with the dam owner and CONSIB, and a new permit for dam operation is issued by CONSIB, provided that all requirements are fulfilled. In case some requirements are not fulfilled a permit with restrictions ensuring a safe operation of the dam is issued.

The owner of a dam is required by law to constantly monitor and evaluate the functioning of the dam for safety. In case that an event affecting the safe functioning of a dam occurs, the owner has the obligation to suspend the operation of the dam and to inform CONSIB about the status. The owner of the dam has 2 months to work with an expert, who carries out an inspection and evaluation of the dam and issues a technical report. Based on the expert report a decision is taken by CONSIB's permitting committee regarding the functioning of the dam. The decision of the committee can be: restart operating the dam as is; restart operating the dam with restrictions and carry out some rehabilitation works; discontinue the operation of the dam and carry out appropriate conservation. Based on the expert analysis of the dam status, decisions are taken regarding refurbishment, and restrictions in daily or normal operations.

3.4.2. Many Dams Have to Be Operated below Their Capacity to Ensure Safety

The Water Law stipulates that dams can be operated only if they fulfill the safety conditions specified in the applicable regulations; therefore, all dams are functioning following the

FIGURE 3.19. ANAR Internal Process of Monitoring Dams for Safety



Source: World Bank Team, based on dam safety regulations, 2017.
Note: ANAR = National Administration "Romanian Waters".

prescribed protocols that ensure their safety. The safety conditions imposed on each dam stem from the conclusions and recommendations of the periodic inspection and could include operational restrictions for the dam and reservoir at parameters lower than the design parameters. The operational restrictions are meant to keep the potential risks under control and avoid accidents or incidents at the dam. However, operating the dam in safety conditions but below the design parameters entails restrictions for some or all downstream water users, thus reducing the intended benefits of the dam and leading to economic losses for the users. The potential impacts on environment need also to be considered.

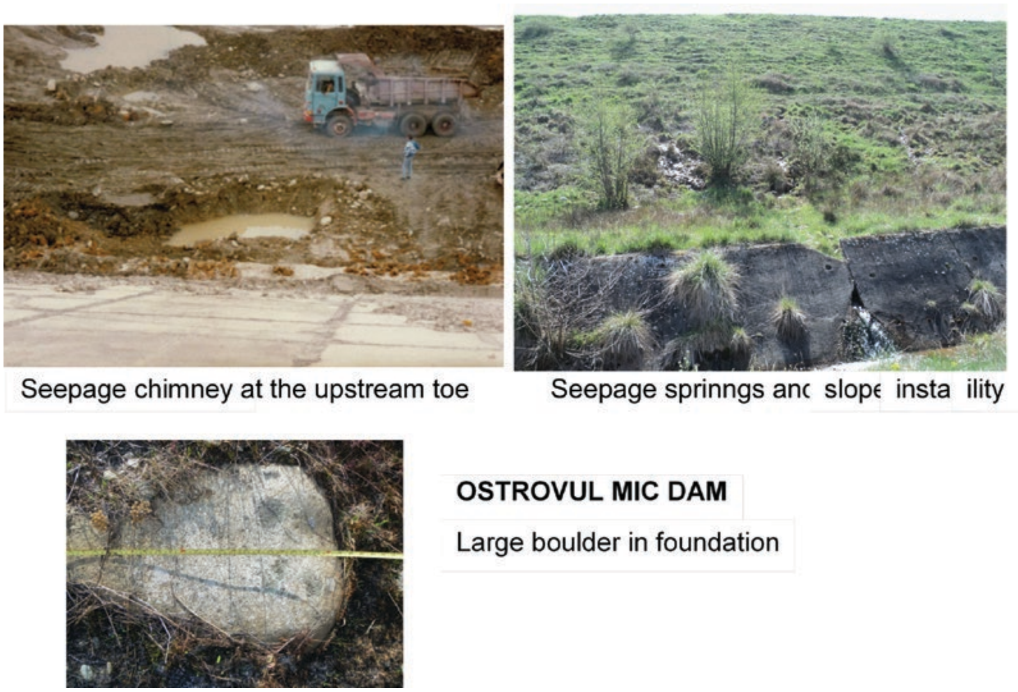
Safety is not an absolute condition, but a tolerated situation, with various levels of residual risk, which implies trade-offs between costs and benefits. The technical norms enacted in 2012 regarding the analysis and evaluation of the dam associated risk specify the levels of accepted risk within which a dam could operate. However, as previously mentioned, there is a constant requirement that risks are identified, assessed, kept under observation and properly controlled; hence operation permits must be reissued every 5–7 years. A permit for operating a dam is issued based on the evaluation of the status of the dam, the plans for alarms in case of accidents prepared by the dam's owner, the action plans in case of floods or action plans in case of accidental pollution (in case of dams for water supply).

To date, all Romanian dams are operated in safety conditions, but only because many of them are operated at a lower level than their initial design, so as to guarantee their structural integrity. The level of service of a dam refers to the purpose for which the dam was designed, such as supply a certain volume of water to users or enable production of a certain amount of energy, etc. The design parameters of a dam are related to conditions of the intended level of service (e.g., infiltration rate into the drainage, type and functionality of equipment installed, etc.), and they are checked during safety evaluation, and operating conditions are imposed accordingly. The operating conditions imposed may affect the level of service. Sometimes, though all design parameters are at their initial value, service can be disrupted due to external causes, such as a dry hydrological year, while in other cases, due to new service levels imposed for dam safety, changes in design parameters are required. Thus, the Gura Apelor Dam on the Raul Mare River, for safety reasons, operated with a low water level in the reservoir. Under such conditions the turbines installed initially in the power plant used to work inefficiently and had to be replaced.

Three main concerns regarding the operation and safety of Romanian dams closely related to construction faults or hydraulic activity on the river and not related to geologic events (like earthquakes) can be summarized as follows: (1) large or dangerous seepage through the dam foundation; (2) fast reservoir sedimentation; and (3) significant drop of the river bed elevation. Their likely effects on dams are briefly presented below.

Concern 1: *Large and dangerous seepage*. The majority of the seepage incidents are encountered at medium height dams where the reservoir is created by long lateral dams (dikes). The dikes are founded on pervious alluvium and the foundation water tightening is provided by cut-off walls. The particular geological conditions given by the variable depth of the

PHOTOGRAPH 3.6. Examples of Seepage in Romanian Dams



Source: Prof. Stematiu, with authorization.

impervious base rock or more frequently by the large boulders disseminated in the alluvial ground lead to significant deficiencies of the water tightening system—floating cut-off walls, large windows in the cut-off wall, opened connection between the face concrete slab and the cut-off wall. In all of the cases the seepage itself is not the main issue but the internal erosion induced by the large gradients. A cavern is created and the stability of the dike body is endangered. In order to reduce the seepage gradient and the seepage flow the reservoir level has to be decreased. The constraint in the storage operation is imposed. The restricted operation may become the new operation rule if the rehabilitation of the water tightening system is very expensive. Sometimes the duration of the reservoir emptying that construction works would require would lead to loss of income from the energy output that exceed the loss caused by operating at the lower head. Photograph 3.6 showcases examples of see page effects.

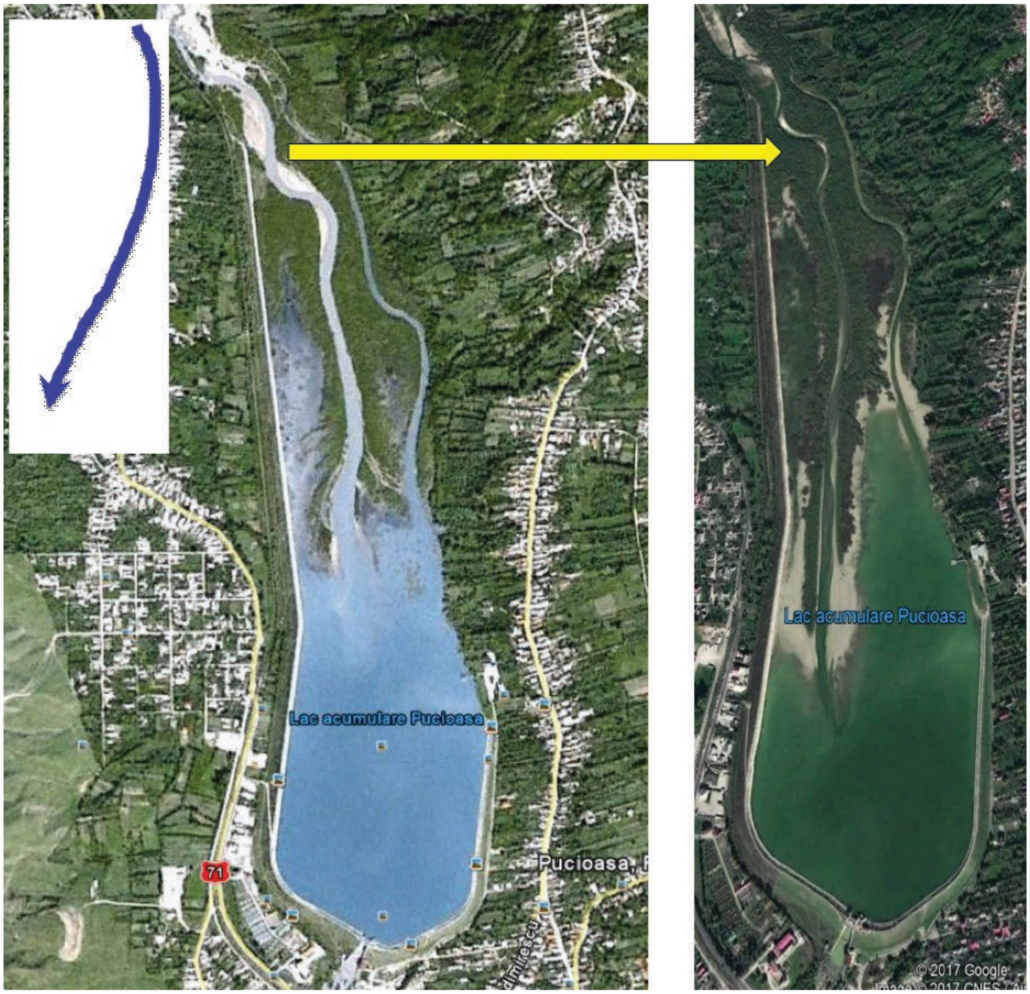
At some large dams, the seepage problem is associated with the rock mass foundation. The grout curtain that provides the water tightening of the foundation was not efficient or not enough extended, and during the first reservoir filling the seepage flow collected by the drainage system was very large or concentrated in a specific zone. Consequently, the reservoir level was severely restricted for long periods. The remediation of the grout curtain was achieved by extending or doubling the existing one. The measure was usually beneficial and the reservoir started to be operated with no constrains.

Concern 2: *Reservoir sedimentation*. Siltation is a common process that reservoirs undergo once they are placed in a river system. The total erosion rate from Romania's territory is, on the average, 125 million tons/year out of which 45-50 million tons/year are transferred by rivers. Large reservoirs in the mountain regions have a low rate of siltation (0.03-0.04 percent of reservoir capacity) and the reservoir operation would not be affected for centuries. A totally different situation is encountered at the smaller reservoirs from the sub-Carpathian area with easily erodible rocks (Arges, Siret, Ialomita and Jiu River Basins). The most notorious examples are the Bascov and Pitesti reservoirs which were entirely silted in 2 years. There are two kinds of issues created by reservoir siltation: operational and safety. If the reservoir has flood control as the main objective, the available storage for the large inflow attenuation is lost and the downstream area is no longer protected. For the hydro power output, the effect is not so important since the turbine discharge is provided by the reservoir in the upper end of the cascade. A more serious issue is that of dam safety. The siltation process is more active in the upstream end of the reservoir. If the intake in the reservoir is blocked by sediments there is a major risk that the water will bypass the reservoir in the case of a significant flood eroding or overtopping the side dike and flooding the all downstream area. The most evident case is Pucioasa reservoir (see map 3.17), where the sediments are consolidated by vegetation and Pucioasa town (with more than 14,000 inhabitants) is endangered.

Concern 3: *Drop of the river bed*. The process is due to the cumulative effects of in stream aggregate mining and lack or decrease of sediment supply from upstream when the natural passage of sediment through the system is interrupted by upstream dam. In terms of dam safety, the lowering of the riverbed downstream of dam inherently leads to the increase of the hydraulic gradient, to the seepage expansion and has a negative impact on the hydraulic jump associated with energy dissipation. The most dangerous effect on safety is the regressive erosion affecting the foundations of the rear aprons and stilling basins and sometimes even the dam foundation itself. Some recent accidents caused to Romanian dams by downstream river bed lowering are briefly presented in photograph 3.7.

The capacity for dam monitoring and population warning in case of accidents has been gradually increasing through the implementation of the WATMAN Project (Phase 1) financed with EU funds from the OP Environment (2011-15) with €77.5 million. The main objective of WATMAN is to contribute to the sustainable management of water resources through structural and non-structural measures and reduce the incidence of natural disasters affecting Romania. The specific objectives of WATMAN included strengthening the response capacity of ANAR in case of floods as well as improvement of the early warning and alarm system of the population in areas affected by floods. So far, equipment for enhancing safety of large dams and measuring the river flow and snow thickness has been procured and installed; also, programs and equipment to enhance control and coordination of the operation of hydraulic structures have been implemented. The expected benefits include: continuous monitoring of 95 large dams managed by ANAR to prevent floods and minimize the flood risk associated with them; automated collection of data relevant

MAP 3.17. Examples of Sedimentation in Romanian Dams



Source: Prof. Stematiu, with authorization.

for flood protection through 48 automated hydrometric stations on main rivers, 43 hydrometric stations on tributaries, and 149 rainfall stations; enhanced real time data processing and transmission capacity to decision makers at central level in order to prevent floods and reduce risks.

WATMAN Project Phase 2, envisaged to be carried out in 2018–21, is expected to further improve dam safety. It would have three objectives: (a) incorporation of population warning systems; (b) rehabilitation of the ICT system for data collection and transmission; and (c) implementation of the integrated decision support system for water management, with an investment need estimated at approximately €64 million. WATMAN project also uses results of SIMIN and DESWAT projects, creating the possibility of realizing, in the end, the Integrated Decision-Information System in case of disasters (the SIMIN and DESWAT projects are briefly described in the Flood Risk Management section).

PHOTOGRAPH 3.7. **Examples of River Bed Drops in Romanian Dams**

Source: Prof. Stematiu, with authorization.

Dams safety management for reservoirs operated directly by *Hidroelectrica* may pose special challenges, particularly with regard to flood protection. While hydropower is not a consumptive user of water, operational rules for hydropower facilities constrain and are constrained by water uses in other sectors. Therefore, the hydropower facilities are operated taking into account the existing and anticipated future water uses in all sectors. The main issue up to now has been the contribution of the Hidroelectrica reservoirs to flood management in a basin well equipped with dams. Hydropower plants are actually used to control and prevent floods. Making room for accumulation of large volumes of water in the water power plant reservoirs is mandatory for rational flood management. There are basin management plans, and during floods the actual control of the reservoirs, disregarding the owner, is made by ANAR. Except some singular events, when the reservoir emptying was done with a delay by the hydro-electricity company, the rules have been observed. In the basins affected in summers of dry years, hydropower production will be adversely affected for a short duration, as it was in the dry year of 1990. These constraints can be alleviated to a large extent by careful optimization of systems' planning and operations, and by accounting for the anticipated climate change impacts in the operation of existing facilities as well as in planning for new ones.

3.4.3. Major Investments Are Needed for Dam Rehabilitation and Completion

3.4.3.1. Rehabilitation and Completion Costs Have Been Estimated only for a Few Dams

A number of Romanian dams that have been under construction for two decades by ANAR, have not been commissioned due to lack of funds, although they are close to finalization. The lacking investment in order to finalize a dam is approximately 15-20 percent of the total investment. The longer these dams are in a waiting status, the more they will deteriorate due to lack of maintenance and monitoring; their safety is being put at risk. The same situation is valid for many dams in need of rehabilitation.

In 2004, a study carried out by the World Bank and the Romanian Government identified nine large dams requiring various interventions to enhance their safety in operation and restore their full capacity to provide the initially intended services. These 9 dams, Berdu (Maramures), Vârșolț (Sălaj), Mâneciu (Prahova), Dridu (Ialomița), Siriu (Buzău), Poiana Uzului (Bacău), Leșu (Bihor), Valea de Pești (Hunedoara), Pucioasa (Dâmbovița), are located in populated areas and therefore pose significant risks in case of failure. Population at direct risk in these areas is 338,000 people, and population potentially affected in case of failure is 820,00 people. In addition, a disruption of social and economic activities for a varied duration, with substantial economic losses, would occur.

The total costs estimated at appraisal for all nine large dams were of US$53.3 million, while the revised cost estimate based on the updated feasibility studies and engineering designs prepared and financed under the HRMEP project amounted to US$100.3 million. Hence, **works could be contracted only for four large dams with a total cost of US$ 52.8 million**. However, by financing the preparation of feasibility studies and engineering designs for all dams included in the program, the HRMEP project contributed to their readiness for further works financing.

Two of the five remaining large dams have been included in the list of priority flood protection projects to be financed from the Large Infrastructure Operational Program: the Lesu Dam (on the Cris River) and Valea de Pesti (on the Jiu River). **The other dams, listed in table 3.14, still need to be rehabilitated with costs estimated at €30 million**. Indeed, the feasibility studies would need be updated to reconfirm the required interventions and revise the cost estimates.

TABLE 3.14. Estimated Costs for the Rehabilitation of Selected Dams

Name	River basin	Storage volume (Mm3)	Purpose	Population at risk/benefiting	Works to be financed	Estimated costs (Mill. Euro)
Poiana Uzului	Siret	90	Water supply, hydropower, flood	30,000/80,000	Consolidation of bottom rock, injections at joints, instrumentation improvement, increase spillway capacity.	3.4
Siriu	Buzău	155	Water supply, irrigation, hydropower, flood	85,000/100,000	Repair drainage galleries, grouting, repair dam crest, drainage downstream dam, rehabilitate Hydro-mechanical equipment, monitoring system.	15.2
Pucioasa	Ialomita	8	Water supply, hydropower, flood	2,900/45,000	Rehabilitate downstream stilling basin, rehabilitate hydromechanical and electrical equipment, monitoring system.	8.7
Dridu (reservoir)	Ialomița	45	Irrigation, flood, water supply	0/10,000	Increase of dyke crest level, enhance the drainage system, rehabilitation of pump stations, rehabilitate upstream face of dykes.	12.6

Source: World Bank, HRMEP Project, 2012.

MAP 3.18. Location of the Four Examples of Dams in This Report

Source: World Bank's elaboration based on ANAR and various sources.

An updated inventory of safety issues associated with the operational and unfinished dams would be required, given the large number of unfinished dams as well as the changes that may have occurred since the last inventory was done (2004), to define the scope of the intervention program to enhance the safety and functional parameters of dams. The inventory should also include the assessment of seismic risks for dam body stability and loads that may be induced by a major earthquake (exceeding 7.0 degrees on Richter scale). Such a check is even more urgent given the alerts issued by the earthquake specialists regarding an increasing likelihood that Romania may be exposed to a major earthquake. The proposed national inventory would estimate the capital expenses required and rank the urgency of interventions in close connection with the population exposed and socio-economic effects of any incident or accident that may result in human or economic losses.

3.4.3.2. Selected Examples of Issues for ANAR Managed Dams

The present subchapter describes the state of maintenance and related key issues for some selected examples of Romanian dams, as they have been identified during discussions with ANAR. Each example has been associated with a specific situation: stalled works, stopped investments, un-commissioned dams, and dams out of use due to accidents. The locations of the four examples are shown in map 3.18.

PHOTOGRAPH 3.8. **View of the Sanmihaiu Român Dam**

Source: A. Popescu.

Stalled construction: the Sânmihaiu Român Dam. This dam managed by ABA Banat is a historical landmark in the area. Sanmihaiu Român dam is located on the Bega Canal and its main original purpose was to maintain specific water levels on the canal for navigation of vessels weighting up to 600 tones. A view of the Sanmihaiu Român dam, that is currently not in use, is shown in photograph 3.8.

The Bega Canal is a component of the complex river and canal network system built for navigation and flood protection since 1760. The Timis and the Bega are the two main rivers in the area that are connected through the network of canals. The rivers are discharging their waters in the Tisza and the Danube. Upstream of Timisoara, diverted from the Timis to the Bega and back, protecting the city of Timisoara against flooding, or giving water to the city in times of drought.

The Bega Canal links the city of Timisoara (in Romania) and the city of Klek (in Serbia). It has a length of 114,5 km, out of which 44,5 km are on Romanian territory. In order to ensure the required navigability depth, several locks and barrages were built, two of which, Sanmihaiul Roman and Sanmartinul Maghiar, on Romanian territory. In 1958, due to political developments in the region, navigation on the Bega Canal, on Romanian side, was stopped and has never been restored since then. In absence of navigation on the canal maintenance on the Romanian side was deferred, which resulted in serious deterioration of the environmental situation and water quality downstream.

Except for navigability, all the other functions of the two dams were kept: to maintain specific water levels upstream to ensure the drinking and industrial water supply needs for the city of Timisoara; to reduce flood peaks; to maintain water levels such that aquatic life and a good ecological status are preserved; to provide minimum amount of flow at the border between Serbia and Romania in accordance with the agreement between the two countries.

In 1989, because of the structure age and safety requirements at the time, capital rehabilitation of Sanmihaiu dam was considered, particular attention was being given to the main gate. The total flow was diverted through the lock and the dam was prepared for rehabilitation. Unfortunately, when the new steel gate manufactured in Resita was delivered to the dam, it fell from the trailer, got damaged and could not be installed. No further action had been taken until the year 2004, when the rehabilitation of the dam was included in the Hazard Risk Mitigation and Emergency Preparedness (HRMEP) Project financed from a World Bank loan. However, without an updated inspection of the main gate and dam structure and without a legal and financial solution to discharge the expenses made for the damaged gate, no significant action could be taken. However, to enable the inspection of the dam structure and equipment and evaluation of interventions needed, in 2011, the flow on Bega River was diverted through the lock and the dam site dried out. Currently, the dam is in the same status as in 2012 (not in use)—as no funds have been allocated for further rehabilitation—and water levels on Bega Canal are maintained through the operation of the dams and storage capacity upstream of Timisoara.

A decision to resume the rehabilitation of this structure and restore its safe operation is urgently needed, because otherwise, in case of extreme flood events, severe social and economic damages are expected (about 20 km of roads, 4,000 ha of agricultural area and 1,000 houses are at risk). There is also an increasing local interest to restore navigation on the Bega for recreation as well as for environment enhancement purpose. The main focus should be on repairing and enhancing the stability and reliability of both the construction and the hydro-mechanical equipment, as well as the replacement of damaged items or the ones in advanced degradation.

Un-commissioned/unfinished dams: the Mihaileni Dam is managed by ABA Crisuri, is located on the Crisul Alb River and was designed as a multi-purpose dam to manage a sustainable flow on the Crisul Alb, supply drinking water for Brad town and Crisor village, and ensure flood protection and power production. Construction work started in 1987 and continued fast until 1990. Then, due to new political developments and economic needs, funds were no longer made available, the works were halted, and the dam has not yet been commissioned. The only funds that were allocated for the dam after 1990 were targeted to construction conservation so as to avoid risks for the surrounding area. So far, there is no equipment in place and some small access works, like a 1.5 km road, are missing. Photograph 3.9 shows a view of the Mihaileni Dam spillway area.

In its current condition, the dam is used as a non-permanent reservoir and will accumulate water in case of a heavy rainfall or floods. The spillway is designed to discharge water from the river for the protection from floods with a return period of 10 years only. In case a heavy rainfall produces a flow rate of a higher return period (or close to the design one) the dam

PHOTOGRAPH 3.9. **View of the Mihăileni Dam**

Source: A. Popescu.

will start storing water behind it and put at risk the population living in the reservoir area. Because the dam was not finalized and commissioned, resettlement of the population from the reservoir location did not take place.

The water supply purpose was considered during dam design because the water availability for population is insufficient in natural conditions. Currently, the drinking water is supplied from groundwater and surface water sources, at a rate of maximum 100 l/s, while the needs are 130-140 l/s. Moreover, taking into account the industrial needs, a discharge of 190 l/s would be required to fulfill all needs. The serious water scarcity in the area provides a strong argument for resuming and continuing the construction works until the full completion and commissioning. The information available in the RRBM database shows that 31 other unfinished dams are in similar situations.

Dam working below design parameters: the Gura Apelor Dam is the tallest rock-fill dam in Romania. It is located on the Râul Mare River and owned by Hydroelectric. It was designed and built as a multi-purpose dam, with hydropower production as primary purpose, and water supply and flood protection as secondary purposes. The power plant has 335 MW capacity and it is located 18 km underground. The whole hydro-system has a hydraulic head of 582.5 m (i.e., the difference between the elevations of the water level in the reservoir and the power station). Water is conveyed from the reservoir to the power station through a long pipe. Construction of the dam started in 1975 and, although not finalized, it was commissioned in 1986, when the power station started to operate.

Structural leakage was discovered when the dam was being commissioned, and was never solved. In order to reach the full level of service of the power station the reservoir started to be filled to its maximum capacity and, at some point, it was noticed that there was a significant water loss from the reservoir. A quick water balance of the inflows, reservoir volumes and outflow confirmed the losses, but the location(s) of leakages could not be found. Since leakage can create structural instability of the side slopes or the dam and affect its safety, the decision to stop filling the reservoir was taken. Except for 1999, the reservoir has never been filled to its maximum capacity. Nowadays, the dam is operated below its intended level of service. A view of the dam, with the lower water level is shown in photograph 3.10.

Despite not having been repaired, the dam saved the city of Hunedoara from catastrophic flooding in 1999. In July 1999, the low water levels maintained in the reservoir saved the city of Hunedoara from severe floods. Heavy rainfall on July 11 and 12 in the upstream catchment produced a flood peak of 1,345 m^3/s, with high velocity torrents carrying woods and masonry from the side slopes. At the dam site the workers' settlement was swept away killing 14 people. Due to debris brought by the torrents, access roads to the dam were blocked and people could be saved only after two days. However, the reservoir filled up, kept the flood wave and saved the whole city of Hunedoara from a disaster and high economic damages.

Several attempts to eliminate the leakage of the reservoir have failed. The attempts to fix the leakage in 2005-07 (grouting on the right side) and 2012 (with emptying the reservoir) did not bring the expected results. This created the problem of the inefficient operation of the originally installed turbines, which led to their replacement with others that fit the operating conditions, as described earlier.

Damaged dams that need reconstruction or rehabilitation: the Belci dam is located on the Tazlau River, under the authority of ABA Siret. The dam was mainly built for water supply of

PHOTOGRAPH 3.10. **View of the Gura Apelor Dam**

Source: A. Popescu.

Onesti city and hydropower production. This was the only Romanian dam failure in the last 50 years. The failure of the dam took place in 1991 due to heavy floods which overtopped the crest. The dam had been partially damaged by floods in 1970 but remained in use. After 1991, the dam remained out of use and in the same condition of disrepair, as can be seen in photograph 3.11.

The Belci dam was built in 1962 as an earthfill structure with clay core, the height of 18.5 m, and a storage capacity of 12.7 million m^3. The central longitudinal section of the dam is made of concrete and contains the spillway, with four flood gates and two gated bottom outlets. The design of the dam took into consideration the hydrological records from a gauge station located 10 km upstream of the dam site. Design flood was estimated based on 10-year records from 1950 to 1960, resulting in a design capacity of the spillway of 850 m^3/s at 100 years return period. Since 1950, recorded flood peaks on the Tazlau River exceeded the assumed design value on several occasions. In 1970, a peak inflow of 980 m^3/s caused overtopping of the dam which led to a partial erosion of its left wing. Floods in May 1971 and in August 1979 had peak values of 890 m^3/sec and 855 m^3/sec, respectively. These three consecutive flood events triggered new hydrological calculations, which estimated a significantly higher design peak inflow of 1,515 m^3/s. However, the spillway capacity was never changed because the dam was classified to be of a medium risk.

On July 28, 1991, a heavy rainfall occurred in the upstream catchment of the dam, where four monitoring stations were installed. Meanwhile there was no rain at the dam site. The telephone lines in the upper catchment failed and it was not possible to send flood warnings to the dam site. Rain at the dam started later on, but the dam officer could not open the bottom outlet wide enough (more than 40 cm) because of a failure of the electric power system, nor could he open the bottom outlet manually, because logs had blocked it. Backup power generator was not available. This unfortunate sequence of events led to dam crest overtopping by 50 cm. After 4 hours of overtopping the water level in the reservoir started to fall, presumably, because of the beginning of the dam erosion process. One hour later, the reservoir was practically empty, and the flood downstream had killed more than 20 people and destroyed 119 houses.

PHOTOGRAPH 3.11. View of the Belci Dam

Source: A. Popescu.

The dam has not been in use since the breach, nor have any maintenance works been done around it. Taking into account the flood peaks that have been recorded in the past 30 years at the dam site, ABA Siret proposed that the Belci Dam could be repurposed from water supply and hydropower into flood protection, as a non-permanent reservoir. This would require significant reconstruction and rehabilitation works at the dam to restore its safe functionality. This proposal was included in the 2015 FRM plans.

Notes

1. An even smaller fraction of the natural potential, amounting to about 6.4 BCM/year (5.7 percent), was actually consumed, on average, during 2007–15.

2. Based on the World Business Council for Sustainable Development (2005): a country should have at least 1,700 m^3/capita/year to be water-sufficient. Between 1,000 and 1,700 m^3/capita/year a country experiences water stress. Water scarcity starts below 1,000 m^3/capita/year with less than 500 m^3/capita/year characterizing extreme water scarcity.

3. Map based on an analysis of water resources vulnerability conducted in 2014 by NMA and INHGA, based on the spatial distribution of multi-annual average water resources covering the period 1991–2013.

4. The actual abstraction volumes from groundwater are not well known and may be under-estimated, since about 6.8 million Romanians rely on private wells for their water supply and are not connected to a piped water distribution network (of these, an estimated 1.8 million have in-house plumbing connected to their well).

5. The number of rural communes with access more than doubled, from 1,060 in 1990 to 2,157 communes in 2015. In the same period, the number of urban settlements connected to water supply increased from 260 to 317.

6. Climatic scenarios for the 2011–40 and 2021–50 periods and the quantifiable effects on the multiannual average temperature and the multiannual average rainfall in Romania have been conducted by the National Meteorological Administration, within the ADER project (2011–14): *Geo-referential indicators system at different spatial and temporal scales to assess the vulnerability and adaptation of agro-ecosystems to global changes*.

7. IPCC's A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on any one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end-use technologies).

8. Extreme high values, of over 1,000 mm/year, have been recorded in the Eastern Romanian Plain (Jirlau) and Danube flood plain (Bistret), in the drought-vulnerable areas.

9. "Updating the background studies of River Basin Management Plans—Assessment of water demand (reference year 2011) at river basin level for the 2020 and 2030 time horizons"—INHGA, 2014.

10. The following models were used for the analysis: General Circulation Models (GCMs), the Water Evaluation and Planning (WEAP) model, a water run-off model (CLIRUN) and an agricultural yield model (AquaCrop).

11. Climate change affects crop yields through changes in soil moisture, direct temperature effects on crop growth, and changes in the evapotranspiration requirements of the crop, among other effects.

12. Climate Scenarios Used to Develop Future Climate for Romania: GFDL-ESM2G-rcp85 (low impact climate scenario, based on the Geophysical Fluid Dynamics Laboratory ESM2G, under the RCP 8.5 IPCC emissions scenario); GFDL-ESM2M-rcp45 (medium impact climate scenario, based on the Geophysical Fluid Dynamics Laboratory ESM2M, under the RCP 4.5 IPCC emissions scenario); MIROC-ESM-rcp85 (Model for Interdisciplinary Research on Climate ESM, under the RCP 8.5 IPCC emissions scenario).

13. For comparison, The Netherlands' Water Boards have a total staff complement of about 11,000. However, as mentioned, these Boards spend about half of their efforts in the treatment of all domestic wastewaters of the country. To compare

better with ANAR's tasks, it can be estimated that roughly 60-70 percent of this staff is dedicated to water quantity management tasks, or 6,600-7,600. At the same time, in The Netherlands also the national Ministry of Environment and Infrastructure has a significant budget for investments in, and O&M of hydraulic infrastructure that is considered of national and strategic significance, such as parts of large seaport facilities and locks, barrages and dikes along the coast and main rivers such as Rhine and Meuse.

14. As an example, The Netherlands has been achieving 99 percent compliance on stringent urban and industrial effluent quality regulations for over two decades, yet the number of water bodies with good or high ecological status (2015) varied between 70 and 85 percent, depending on the indicator organism, with only slow improvements over the past decade.

15. According to www.preventionweb.net.

16. World Bank and GFDRR, 2016, Europe and Central Asia Country risk profiles for flood and earthquakes.

17. As aggregated in EM-DAT database.

18. Final Report prepared for DG Environment (February 2014) Study on Economic and Social Benefits of Environmental Protection and Resource Efficiency Related to the European Semester; ENV.D.2/ETU/2013/0048r.

19. DFO—Dartmouth Flood Observatory, available at www.dartmouth.edu/ ~floods/Archives/ (last accessed on August 2017).

20. Such as Freeman, EnviroGRIDS, and DanubeFloodrisk.

21. ISU—Inspectorate for Emergency Situations (*Inspectorat pentru Situatii de Urgenta*).

22. The WATMAN project comprises 23 quick operational centers, ready to act in case of floods. Their response time, for providing help and support in case a flood event occurs is of 30, 60 and 90 minutes for distances of 22, 45 and 95 km respectively. These 23 centers have 41 units of rapid intervention, with 11 workers and 2 technicians.

23. HRMEP—Hazard Risk Mitigation and Emergency Preparedness Project.

24. CONSB—National Council for Dam Safety ("Consiliul National pentru Siguranta Barajelor").

Chapter 4 Water Supply and Sanitation: Taking Stock of Two Decades of Utilities Reforms

This chapter looks at the situation in water supply and sanitation services in Romania, taking stock of two decades of reforms. It reviews the key elements of the reform that has been largely driven by a regionalization process together with regulation and tariff increases. It analyzes in detail the various achievements in terms of performance and financing of investments—with many Romanian WSS utilities having been able to access commercial loans for the co-financing of EU funds over the past decades—as well as remaining areas of under-performance, such as high water losses and slow absorption of EU funds. It also analyzes in detail the issue of access—with five million Romanians lacking access to piped water and eight million Romanians lacking access to flush toilets—for which Romania is a complete outlier when compared with all other EU countries. Finally, it identifies and discusses what could be the priorities for further steps in the WSS reform, with special emphasis on how to remove the various roadblocks for compliance with the UWWTD.

4.1. Organization of WSS Services Provision

4.1.1. Establishing Viable Regional Public Utilities has been the Backbone of WSS Reform

Back in the early 1990s, the Romanian Water Supply and Sanitation (WSS) sector was in a poor shape and heavily fragmented. WSS services providers were organized mainly as departments within municipal authorities (with more than 800 local operators), and less than half of the population had access to piped water. Customers were billed based on estimated consumption (not metered) and service quality was poor with often intermittent supply. The water production and distribution infrastructure was in a poor shape, and the quality of potable water was poorly monitored. Wastewater collection and treatment was very limited. The difficult structural adjustment of the Romanian economy following the fall of the Communist regime in 1989 further affected the sector. Investment in WSS infrastructure became severely curtailed and was limited to large cities—which made matters even worse for several years.

Investment in WSS infrastructure slowly restarted in 1996 with EC programs (Municipal Utilities Development Program [MUDP], followed by Instrument for Structural Policies for Pre-Accession [ISPA] and Small and Medium Town Infrastructure Development [SAMTID] programs) in the context of the EU accession preparation process. Yet, only 32 major municipalities (more than 100,000 inhabitants) benefited from this funding for the rehabilitation of their water and wastewater infrastructure between 1990 and 2007. At the same time, the general condition of the majority of the systems not covered by these programs continued to deteriorate, with poor maintenance, high water losses, and poor bills collection from customers.

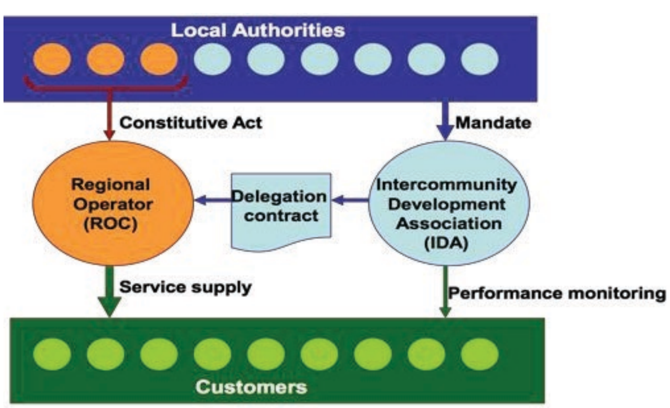
Starting with 2007, the regionalization process became a precondition for access to EU funds for water and wastewater infrastructure, as part of a strategy actively promoted by the EC under the Sectoral Operational Program (SOP) Environment. The objectives of the regionalization were twofold. First, it aimed to promote a more integrated water resources management and the application of the solidarity principle between urban and rural areas in each region. Second, it sought to overcome excessive sector fragmentation and lack of local capacity, and to achieve economies of scale by concentrating the operation of the WSS services provided by various municipalities within a geographical area into large public utilities. The initial geographical boundaries were to follow administrative county delineations—with 2,600 localities of more than 2,000 inhabitants to be merged into some 40 strong public operators. It was originally envisaged that this would be a gradual process, the ultimate goal being utilities organized around river basin boundaries.

The regionalization was carried out by an agglomeration of existing public services owned and operated by municipalities on the basis of the framework presented in figure 4.1: (a) the Intercommunity Development Association **(IDA)** that united a number of municipal authorities as owners of the infrastructure delegated to the regional operators, (b) the **Regional Operating Company (ROC)**, to which the municipalities under an IDA delegated the responsibility for operating the systems and providing the WSS services, and (c) the **Contract of Delegation of Services**, which formalizes the relationships between each IDA and ROC.

The regionalization process was carried out in parallel with commercializing the newly created regional public utilities. Although publicly owned and managed, a financial framework was put in place, aimed at making the service providers accountable, and setting them on a path towards improved operational performance and financial sustainability. This includes public service obligations embedded in the contract of the delegation of services, performance targets (monitored by Key Performance Indicators, KPIs) as well as a tariff regime regulated by the national WSS operator National Regulatory Agency on Communal Services (ANRSC).

Regionalization was not made compulsory, but local authorities were strongly encouraged to join the newly established ROCs, as it was made a pre-condition for access to EU grants. Accessing EU funds under SOP was a very strong incentive for local authorities as there was no other major investment source available to finance the rehabilitation and expansion of their WSS services, and tariff levels were too low to cover investment costs. Under the new regionalization framework, local authorities in a given county not only delegated the management of WSS services to a ROC, but also the preparation and implementation of regional development plans—thereby fostering better investment planning coordination between cities and towns. The ownership of public assets and the responsibility for ensuring that WSS services were supplied at affordable costs remained with the local authorities.

FIGURE 4.1. Institutional Setup for Regionalization



Source: FOPIP 1 Technical Assistance.

The main role of IDAs as representatives of local authorities is to monitor the performance of ROCs, and validate and

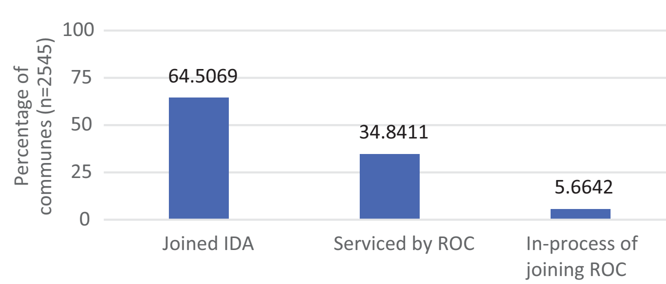
approve regional development plans. These are periodically prepared and submitted by the ROC to the national regulator ANRSC, and include *inter alia* proposals for capital investments and tariff adjustments. Their functioning is regulated by Governmental Decision 855: each municipality has one vote (regardless of size) in the general shareholders' assembly, but most decisions are taken at the level of the Board of Directors. Initially, tariff adjustments were supposed to be voted in unanimously, but this was changed and now only requires a majority. In practice, there is a wide disparity between the IDAs in their capacity to carry out their supervisory function—with several of them lacking human resources and capacity to play their role efficiently.

It is important to note that, in practice, there is not a simple overlap between ownership of assets, representation in an IDA, and the shareholding structure of a ROC. Each IDA represents the local authorities which have delegated the provision of WSS services in their territory to the respective ROC (or intend to do so, as many municipalities have joined an IDA but not yet formally delegated their WSS services to a ROC), under the terms of the delegation contract. Yet, there has been no transfer of the ownership of the water and sewerage infrastructure, which has remained with the local authorities who carry them on their own books. In contrast, each ROC is controlled as a commercial entity by the participating local authorities, but the actual relative shareholding may vary, and there are many cases where it is controlled at Board level by one large local council holding over 90 percent of the shares. **The effective control of a ROC by the various delegating local authorities is carried out through the delegation contract, not through the shareholding and control of the ROC.**

The delegation contracts were signed between IDAs and the ROCs following a template prepared at the national level. They outlined the roles and responsibilities of each party. Over the past decade, the delegation contracts have remained unchanged except for some addenda referring to extensions of areas of operation with new localities or minor changes to tariff strategies. Because the preparation time for the initial delegation contracts was relatively short (there was a time pressure to sign the contracts as a precondition to access EU funds) and because of several changes in the sector framework that have occurred over the past decade (e.g., changes in legislation regarding performance indicators, benchmarking, etc.), there is a consensus among stakeholders that the delegation contracts would now need to be revised and updated.[1]

It is estimated that by 2015 only about two-thirds of local authorities had joined an IDA, but the proportion of those that had delegated their WSS services to a ROC is actually even lower (figure 4.2). The regionalization process over the past decade has been a gradual process which is far from being completed—but the actual process is difficult to track. Not only is there no up-to-date record-keeping on the

FIGURE 4.2. Overview of Communes Who Have Joined IDA and Have Delegated Service to ROCs



Source: WB 2017.
Note: IDA = Intercommunity Development Association; ROC = Regional Operating Company.

proportion of local communes that have joined Intercommunity Development Association (IDAs), but the available data are complicated by the fact that many have joined IDAs but not formally delegated their WSS services to a ROC (for a variety of reasons). ANRSC has estimated that only 57 percent of local governments ("communes") had joined an IDA by 2015, but no data was reported on the proportion that effectively transferred WSS services to a ROC. Based on a WB survey conducted in the summer of 2017 and covering 85 percent of all communes in the country,[2] it appears that 65 percent of rural communes have joined IDAs—a figure broadly in line with the one reported by ANRSC—but that only 35 percent of rural communes had effectively transferred of their WSS services to ROC, while for another 6 percent the delegation was in the process of transition.

This means that, overall, **only around half of the municipalities that have joined an IDA over the past decade are currently benefitting from the professionalized services that ROCs can deliver and from access to large-scale EU funds for investment**. In addition to those municipalities which have still not joined an IDA or are in the process of doing so, there are also several dozens of cases of rural municipalities that withdrew from an IDA due to either dissatisfaction with the lack of service improvements and investments, the tariffs which they perceived as excessive, or a change in mayors following local elections.[3] Another cause for concern is that only 40 percent of non-IDA municipalities reported an intention to join an IDA in the future, the remaining indicated that they were satisfied with their current service levels, had a preference to remain autonomous, or expected potential negative consequences, such as tariff increases. While the expectations and perceived benefits and challenges that come with regionalization are a complex topic that will be further explored later in this report, this calls into question the incentives and underlying assumptions that were made a decade ago with the policy decision to embark on a widespread regionalization. Several stakeholders believe that one of the reasons for the incomplete regionalization process is that small authorities were not pressured enough to comply with the national and EU standards—thereby weakening the incentives to join a ROC and access EU grants for compliance (the current legislation even allows them to provide services with no license from the ANRSC).

4.1.2. Regional WSS Public Utilities Supply Most of the Connected Population

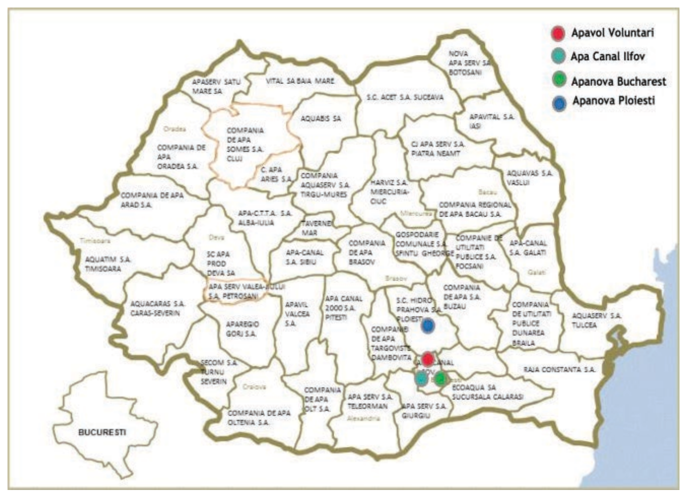
According to the ANRSC data from 2015, **WSS services in Romania are currently provided through a combination of 43 large regional public operators, 2 large private operators under mixed-ownership companies, and approximately 900 small local operators**. The small operators are mostly municipal departments that are not ring-fenced from the other municipal services (and are referred to as "Communal operators"), but they also include a number of corporatized enterprises under the limited liability structure, the so-called "SRL-operators," some of them were established before the regionalization reform.

As a result of the regionalization process over the past decade, **more than two-thirds of the population connected to piped water—about 9 million people in total—is now being served by regional public utilities (ROCs).** The market share of each category of WSS service providers is outlined below (table 4.1). It is important to note that the percentage figures correspond to the relative market shares based on the total population with respective access to piped potable water and sanitation services—which is much lower than the total population (about one third of the Romanian population rely on self-supplied systems such as private wells for potable water, and less than half has access to sewage collection systems). WSS services coverage and the access gap will be discussed further in the next sub-chapter.

The geographical location of the 43 Regional Operating Companies (ROC) currently in place, as well as the main cities served by private operators, are shown in map 4.1.[4] Appendix D provides a detailed list of these ROCs with estimates of the total population in their respective service areas, and size of the population served for potable water. The two largest ROCs are located in Constanta (Raja Constanta) and Cluj, providing a total population of about 630,000 and 750,000 people respectively with potable water services. **The size of most ROCs is in the range of 100,000–300,000 people served with potable water**. On average, the ROCs provide service to about 80 percent of the population located in the municipalities covered by their service territories (i.e., under delegation contracts).

Raja Constanta is by far the largest ROC, serving a population of about 750,000, and is worth discussing in more detail as an example of well-managed regionalization process. As illustrated in figure 4.3, the agglomeration of municipal services took place over the period between 2008 and 2014, as new municipalities in rural areas where incorporated every year. Back in 2008, Raja Constanta was providing water services to approximately 500,000 inhabitants in 57 localities in the Danube delta, and 6 years later in 2014 it served 750,000 people across a total of 152 cities, towns, and villages. The agglomeration process was enhanced by Raja Constanta's decision to take on all former staff from

MAP 4.1. Regional Operators and Major Privately Managed Operators



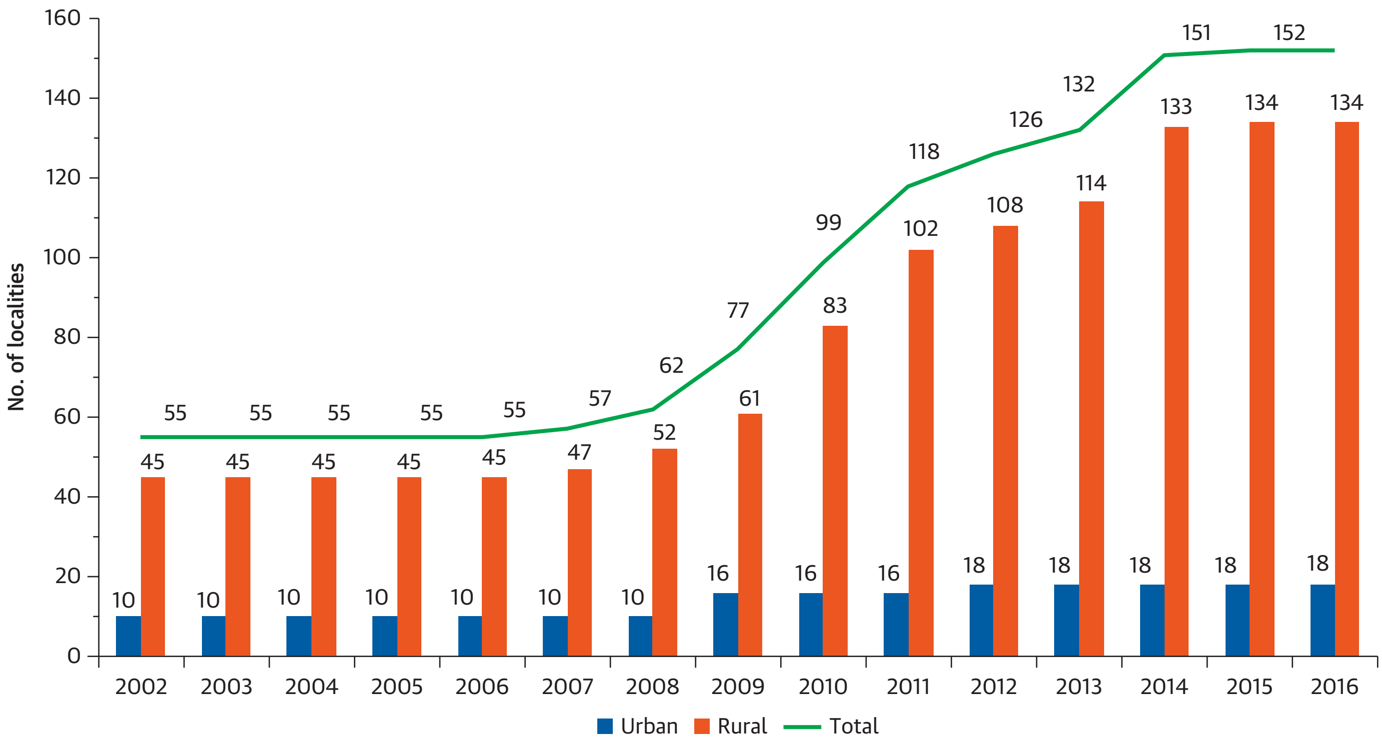
Source: BDO 2017b.

TABLE 4.1. Population Connected and Market Share for Different WSS Providers (2015)

Type of WSS operators	% Connected to water services	Population served with piped water	% Connected to sewerage services	Population served with piped sanitation
Regional operators	**71.64**	**9 million**	**70.82**	**6.9 million**
Large private operators (mixed capital companies) in Bucharest and Ploiesti	15.33	**2 million**	20.11	**1.7 million**
Other small local private operators	2.60	**0.1 million**	1.81	n.a.
Municipal operators organized as departments or public companies	10.42	**1.5 million**	7.26	**0.9 million**
Total population served by WSS providers		**12.6 million**		**9.5 million**

Source: Calculation based on ANRSC data 2015.
Note: n.a. = not applicable.

FIGURE 4.3. Evolution of Raja Constanta Service Area

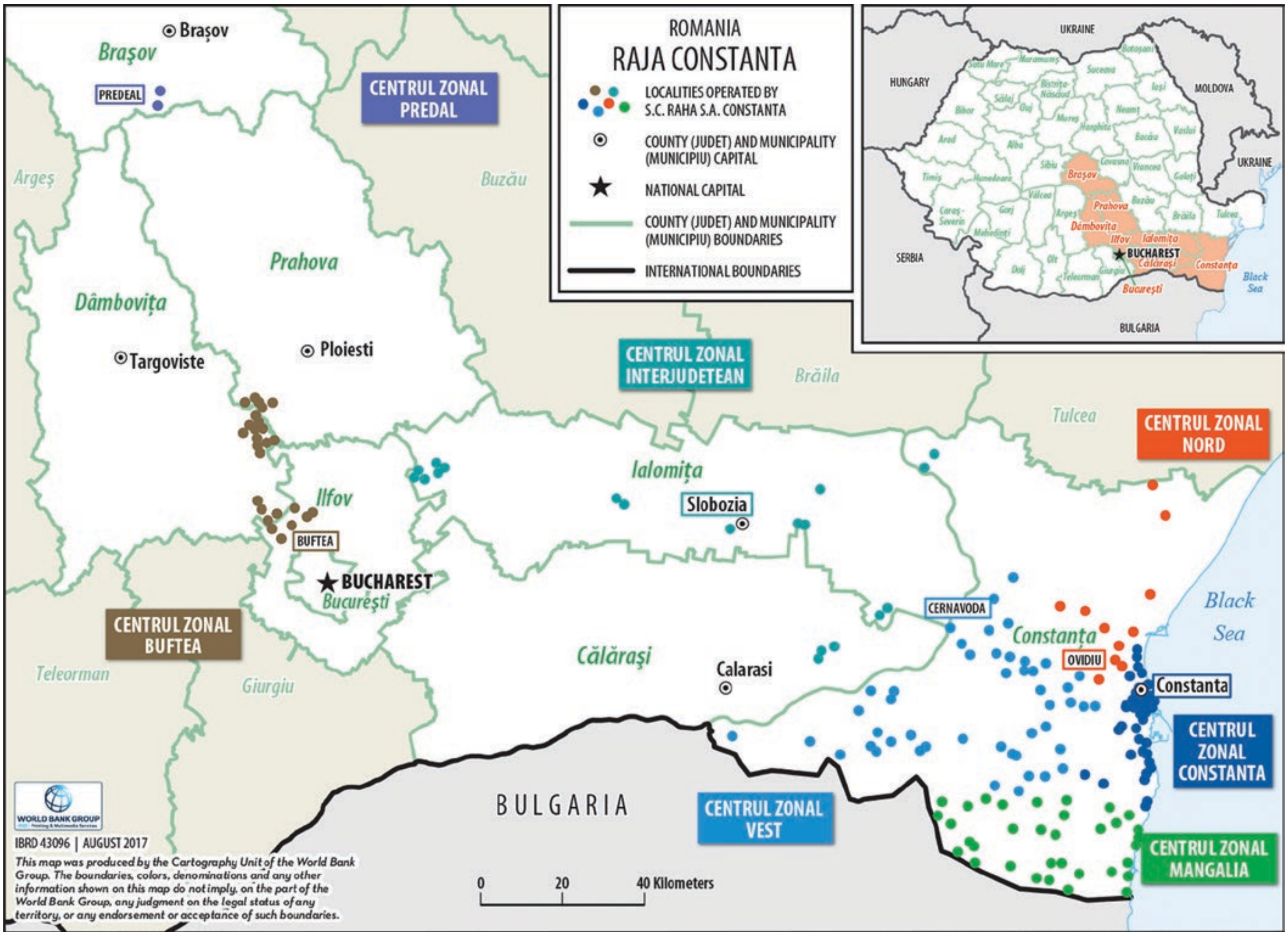


Source: Popa and Salvetti 2017a.

the municipal WSS departments with increased salaries—thereby facilitating political acceptance of joining for local authorities—but this was somewhat interrupted in 2013 when overstaffing became critical, and the company had to launch a restructuring plan (25 percent of the employees were dismissed). In addition, one specificity of Raja Constanta—and the reason why it succeeded in becoming the largest ROC—is that is expanded beyond the strict limits of Constanta County, adopting a commercial orientation and taking over localities from seven other counties.

The capital city Bucharest has the largest WSS utility in Romania that is run by a private operator and serves 1.9 million people. The public-private partnership (PPP) scheme has been in place since 2000 and involves a 25-year concession contract between the municipality and the concessionaire *Apa Nova Bucuresti*, a mixed ownership company controlled at 73 percent by the international private operator Veolia, with the remaining 27 percent owned by the municipal authorities and employees. Supervision of the concession contract—including 24 service quality indicators (KPIs)—is carried out by AMRSP, the Municipal Authority for Public Services Regulation. Investments are financed by a mix of public and private sources: those financed directly by the private operator are directly incorporated into its tariff, while those financed by the municipality (using EU grant funds with co-financing supported by

MAP 4.2. Municipalities Served by Raja Constanta



Source: Popa and Salvetti 2017a.

EIB-EBRD) are repaid through a special volumetric wastewater charge in the water bill that goes directly into the municipality treasury.

The second large private WSS operator provides services for the city of Ploiesti (population 200,000) which is located about 60 km from Bucharest. The PPP scheme is similar to the one in place in Bucharest and was also signed in 2000, with a 25-year concession contract between the municipality and *Apa Nova Ploiesti,* a mixed ownership company controlled by Veolia (73 percent) and the municipality (27 percent).

It is noteworthy that **there are also several small-scale privately operated water and wastewater services, run by local private companies with no foreign capital**. They mostly serve localities between 2,000 and 8,000 people and started operation during the decade following the fall of the communist regime, at the time when small municipalities could not benefit from any publicly-funded investments. The largest one is *SC Jovila Water SRL*, a private operator providing water supply and sanitation services to about 30,000 people under a series of 15- to 29-year concession contracts with 11 local authorities (10 communes and the town of Boldesti-Scaieni) in Prahova County. These local private operators are largely a legacy of the past, from the period between the 1989 revolution and the entry into the EU. They have been gradually losing ground during the regionalization process, as access to EU funds for investments was restricted to those local authorities that joined an IDA and delegated their WSS services to a ROC. Several of these concession contracts have been terminated in recent years.

4.2. WSS Access Rate and Tariff Levels

4.2.1. Potable Water and Sewerage Coverage: Lowest Access Rate among EU Countries

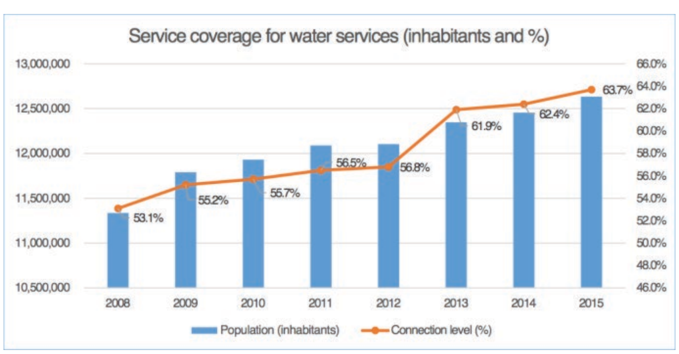
According to the data provided by the ANRSC, **the total population connected to potable water services in 2015 was of 12.6 million inhabitants, with an overall connection rate of 63.7 percent**. Most of the unconnected population lives in rural areas: the connection rate to potable piped water in urban areas in 2015 was 93.8 percent while in rural areas the connection rate was 28.7 percent. The evolution of the coverage rate and total population connected to potable water networks is presented in figure 4.4. Back in 2008, the total population connected to piped potable water services was estimated at 11.4 million, with a connection rate of 53.1 percent—meaning that **the coverage rate for piped potable water would have increased by about 10 percentage points over the last 8 years**, with 1.2 million people gaining access.

As already mentioned, a large majority of the population connected to piped potable water (11 million in 2015) is served by large operators—either the regional public utilities (ROCs) or the two large private operators. The size of the population served by local municipal services (not incorporated into ROCs) has remained stable between 2008 and 2015, at about 1.5 million.

A large part of the growth in the size of the population connected came from building piped water and sewerage systems in rural municipalities previously unequipped thanks to the expansion carried out by regional operators. Between 2008 and 2015, the number of urban localities equipped with piped water system remained stable at 317, while the number of rural localities equipped went up from 1,806 to 2,157. For sewage collection systems, the number of urban localities equipped went up marginally, from 309 to 313, while the number of rural localities went up from 451 to 809. It is noteworthy that while the number of rural municipalities gaining access to piped water and sewerage systems is broadly the same—351 and 358 respectively—there is a considerable backlog for sewerage systems in rural localities, with only about a third of the rural localities equipped with piped water distribution system having also a sewerage collection system.

There is a wide disparity in the connection rate to piped potable water across the various territories covered by ROCs, depending largely on the relative proportion of urban and

FIGURE 4.4. **Service Coverage with Water**



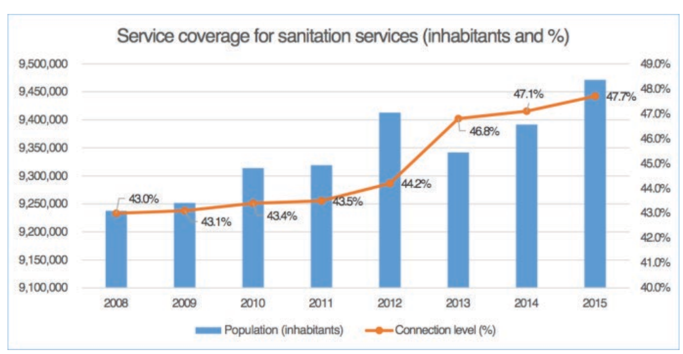
source: ARA 2016.

rural areas in each county. Table in appendix D provides the population served and access rate in the various areas of service of the various ROC. On average, the access rate stands at about 80 percent but there are considerable discrepancies—from more than 95 percent in some well performing utilities such as Brasov, Constanta and Cluj (as well as the private operator in Bucharest), to less than 70 percent in others. It is important to note that this access rate is based on the territory of the municipalities which have joined the IDA served by the corresponding utility and have signed delegation contracts with it—and not the overall access rate in the notional territory supposed to be served by each ROC at county level, and which in most cases still includes many municipalities that have not joined a ROC. Overall, **it is estimated that about 2.2 million unconnected people are located within the current area of service of the ROCs**.

According to **the ANRSC data, the population connected to sewerage networks in 2015 stood at 9.5 million inhabitants, with an access rate of 47.7 percent (64.2 percent in urban areas)**. This means that, nationwide, an estimated **3.1 million people (or 15 percent of the national population) have access to piped potable water networks but not to a sewerage collection system**—thereby having to use some form of individual sanitation to dispose of their wastewaters. Since 2008, the increase in the coverage of sewerage collection systems has been even more modest than for water, up by less than five percentage points over 8 years (it was at 43 percent in 2008). As for the connection rate to wastewater treatment plants, it was estimated at 45.7 percent of the total population in 2015, and 96 percent for the population already connected to sewerage collection networks. In rural agglomerations, the sewerage networks are largely under-developed and the connection rate is well below the national average—with only about 15 percent of the pollution load currently collected (as was discussed in section 2.2.2). The evolution of the population connected to sanitation, since Romania joined the EU, is presented in figure 4.5. There is no data on the proportion of the population equipped with "appropriate sanitation solutions" such as well-managed septic tanks.

These piped WSS connection rates in Romania are by far the lowest amongst EU countries—both for piped potable water and for sewerage services, even though the connection rate is expected to record increasing values when the 2016 and 2017 figures will be released due to the delayed impact of the implementation of SOP financed investments (a significant part of the connections related to the investments had not been finalized yet by 2015). This can be explained partly by the large proportion of rural population, which represents about 46 percent of the national population (estimated at 19.7 million), and the abundance of shallow underground water in most parts of the country, which explains why piped water networks were historically

FIGURE 4.5. Service Coverage with Sewerage Collection Networks



Source: "Report on the state of the water and sanitation services," ARA 2016.

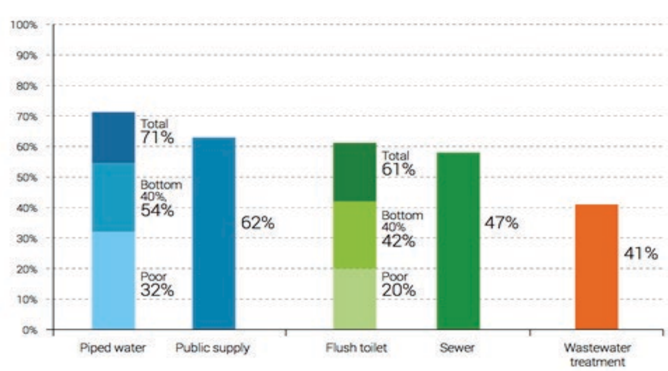
developed mostly in cities and large towns. Interviews with stakeholders also suggest that the proportion of illegal (and therefore unregistered) piped water connections in rural areas may be high.

Another reason for the low connection rate has been the resistance, by a portion of the population, to connect to both piped water and sewerage networks, especially in rural areas. There have been numerous cases in recent years where a new water and sewerage network was installed in the streets, but residents refused to connect to the services claiming affordability constraints (both to finance the connections and to pay the recurrent bills). Even though the obligation to connect to centralized systems has been reinforced through the changes to the Water Law in 2015,[5] the impact on the connection rate has been so far limited due to the difficulties encountered by the utilities in enforcing it. This low connection rate is affecting the financial situation of the utilities because they have to operate these new networks with an even lower density of connection than envisaged in their development plans.

It important to note that the above WSS access figures are only estimates from the ANRSC, and the data obtained from national household surveys somewhat differ. The national regulator calculates the national coverage rates based on data provided by each WSS service provider, based on their total number of active connections with estimate of size of households. This leaves significant scope for error, as it does not account for illegal connections (frequent in urban marginal settlements), as well as for the frequent practice in rural areas across Romania of using a private well which is connected to the house's pipe water system. The review of the State of the Sector (SoS) carried out under the Danube Water Program—a joint initiative between the WB and the International Association of Water Utilities of the Danube Basin (IAWD)—provides slightly different figures for access to potable water and sanitation services, based on the 2012 national household survey (see figure 4.6 and figure 4.7). The latest national household survey released in early 2018 and based on 2016 data gives the more recent **access rates: at 77.6 percent for piped potable water and 68.3 percent for flush toilets**—up from 71 to 61 percent respectively in 2012.

Still, even using the higher 77.6 percent figure, the access rate for potable water in Romania is very low: at least 4.5 million Romanians lack access to piped potable water in their house. This is low not just by EU country standards (neighboring Bulgaria has almost universal access for potable water) but **even when comparing Romania to other non-EU neighboring countries**. In the region, only Moldova has a lower access rate for potable water—at about 50 percent nationwide—while Ukraine (a much poorer country, and not a member of the EU) achieves a similar rate to Romania. All other non-EU countries located in the

FIGURE 4.6. Access to WSS: Total Population, Bottom 40 Percent of the Population and the Poor



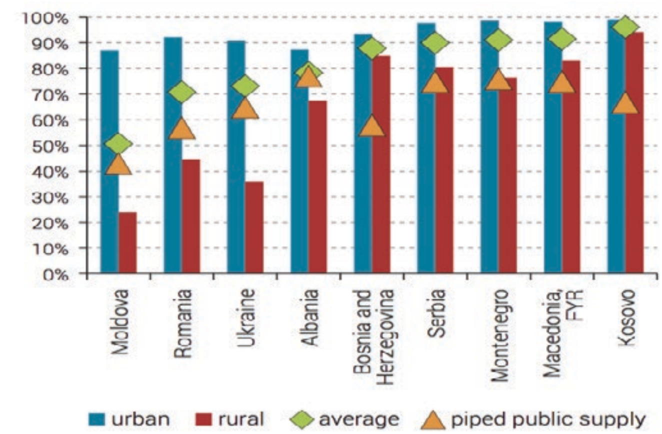
Source: Danube Water Program, State of the Sector 2015.

Danube basin—namely Albania, Bosnia, Serbia, Montenegro and the Former Yugoslav Republic Macedonia—have a higher access rate for piped potable water than Romania.

Lack of universal access to piped water is a serious public health problem, with an estimated 12 percent of the Romanian population—more than half of those without access to in-house pipe water—using unsafe water sources in 2015. Most of the self-supplied population uses shallow wells, which are not protected from contamination including from fecal sources from neighboring houses' latrines of cattle manure. Only a small proportion of Romanian households carry out regular testing of the quality of the water from their well. The Joint Monitoring Program (JMP) from WHO-UNICEF (wssinfo.org) estimated that only 88 percent of Romanians had access to "safely managed" potable water in 2015, that is, 12 percent used unsafe water sources.

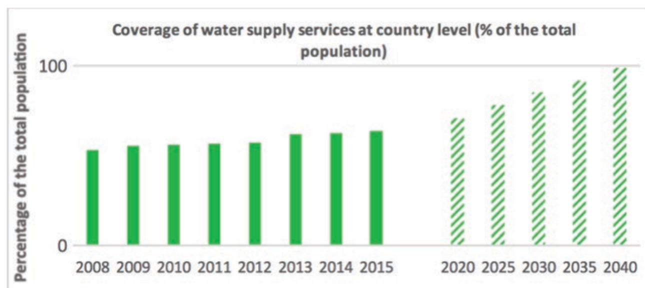
Based on the current access rate increase for piped potable water—maintaining a "business as usual" approach—Romania would have to wait until at least 2040 to achieve almost universal access and align with other EU countries. This can be easily inferred from the fact that over the past 8 years and despite massive EU grants to the sector, less than 1 million people have been connected to piped potable water—and the current rate of increase in piped water access coverage stands at 1.4 percentage point per year. As illustrated in figure 4.8, at the current pace of annual access increase, universal coverage would be achieved by 2040, but most likely by 2050, since increasing access will inevitably become more difficult and expensive as coverage gets higher. As far as access to piped potable water is concerned, the current situation of Romania is actually comparable to developing countries on other continents striving to achieve the SDGs. **Whether this situation is acceptable—both politically and socially—for an EU member country is open to question.**

FIGURE 4.7. Regional Access to Potable Water



Source: Danube Water Program, State of the Sector 2015.

FIGURE 4.8. Projected Coverage of Water Supply Services, Based on Current Annual Growth Rate



Source: World Bank's calculations.

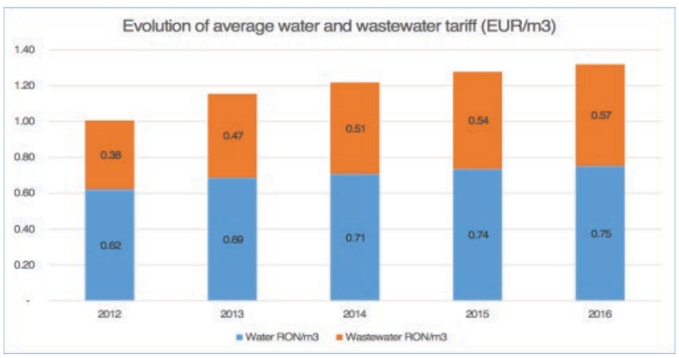
4.2.2. WSS Tariff Levels have Increased Significantly, with Growing Concern over Affordability

The average WSS tariffs for large utilities (ROCs and the two concessions in Bucharest and Ploiesti) **stand at 3.37 lei/m³ for water and 2.60 lei/m³ for sanitation** as of April 2017—that is, respectively **0.74 and 0.57 Euros/m³** (for ROCs). These figures do not include VAT, which is added to the utilities' bill sent to customers at 9 percent for piped potable water (reduced rate) and 19 percent for sewerage (standard rate). No data was obtained on tariffs from municipal operators (communal and SRL), but they are typically much lower (about half) and the bill typically covers only water (no sewerage systems). The tariff structure is based on single volumetric rate, with no fixed charge (as is the case in most Central and Eastern countries, contrary to older EU countries). Figure 4.9 shows the evolution of average WSS tariffs in the past 5 years—showing annual increases, and with the sanitation portion increasing much faster than potable water due to the large investments in sewerage collection and wastewater treatment infrastructure to comply with the EU Urban Wastewater Treatment Directive.

Steep WSS tariff increases over the past two decades have gradually brought WSS tariffs in Romania to about three times the tariff levels in non-EU countries of the region; and they are slowly approaching the tariff level in other EU-13 countries. This is illustrated in figure 4.10, which compares average WSS tariffs for both EU and non-EU countries in the Danube basin (2015 data). WSS tariffs in Romania are now almost twice as high as in neighboring Bulgaria (which also joined the EU in 2007), and two- to three-times higher than in non-EU countries of the region such as Serbia, Ukraine, Moldova, Albania and FYR Macedonia.

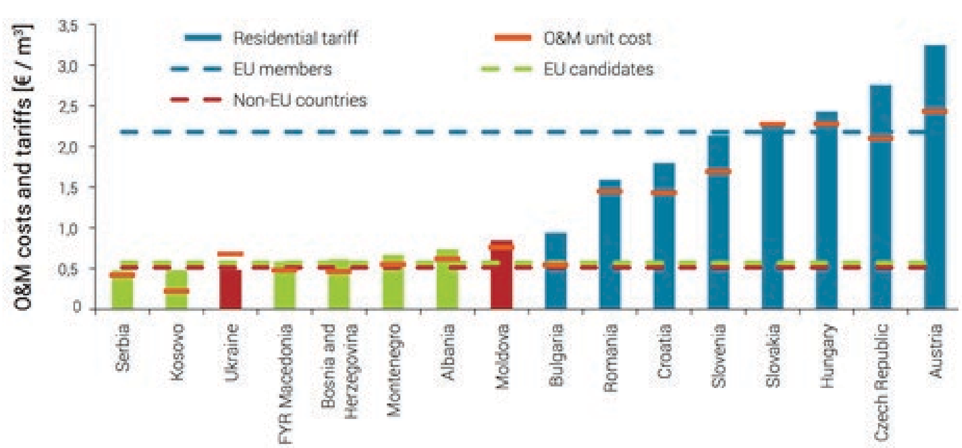
The magnitude of the WSS tariff increase over the 2000–10 decade was considerable. This is illustrated in figure 4.11, which compares the evolution of the average tariff between 2000 and 2010 for 10 large cities. **WSS tariffs increased 5 to 10-fold** during the decade when Romania joined the EU—underlining the considerable changes to which the WSS sector had to adapt.

FIGURE 4.9. Evolution of Average Water and Sanitation Tariffs



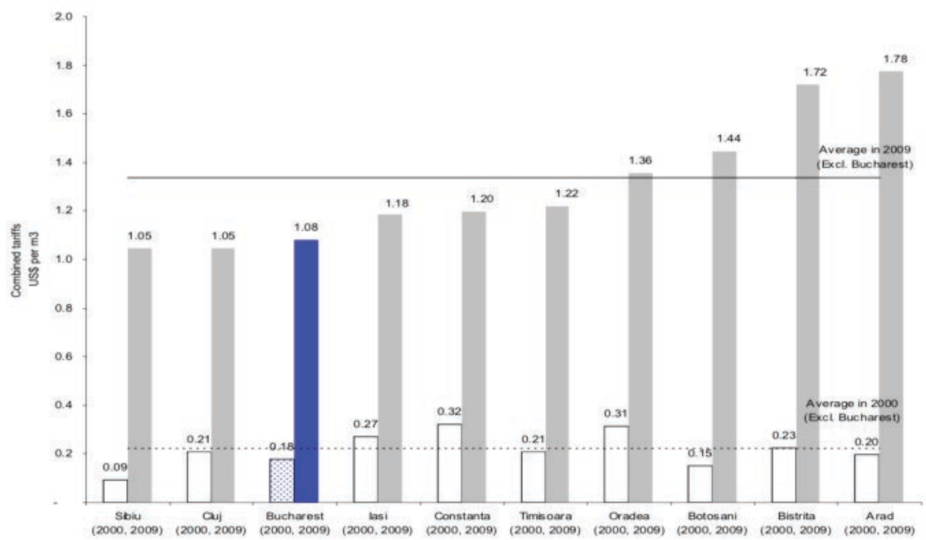
Source: BDO Business Advisory Financial Survey, 2012–16.

FIGURE 4.10. O&M Costs and Residential Tariffs (Water and Wastewater) in the Danube Countries



Source: WB DWP, State of the Sector, 2015.
Note: EU = European Union; O&M = operations and maintenance.

FIGURE 4.11. **Evolution of WSS Tariffs (USD) in 10 Large Cities between 2000 and 2010**



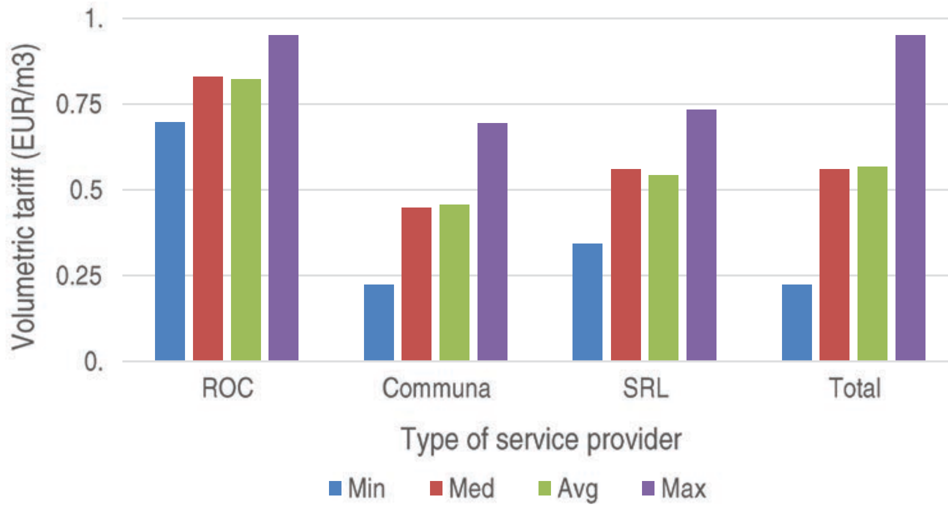
Source: Castalia, based on IBNET for 2000 and ANRSC for 2010.

While the current average WSS tariff stands at 1.32 Euros/m³, there are variations of tariff levels among regional operators (ROCs). The lowest water plus sanitation tariff is around 1 euro/m³ while the highest tariff is around 1.7 euro/m³. All WSS tariffs amongst the ROCs follow a similar structure, with a single volumetric fee and no fixed charge (as is the case in most Eastern European countries, in contrast with older EU countries in Western Europe where fixed charges often represent a sizeable portion of tariff revenues).

The average tariffs for the rural localities that are not operated by ROCs usually do not cover the full costs of operations and maintenance (O&M) and are much lower (whether for water only or combined water and sewerage)—**typically at about half the level of ROCs' for water services**. This is made possible because they are organized as departments inside the local authorities and part of their operating costs is "hidden" in the municipal budget. While there seems to be no reliable database available at the national level, the 2017 WB study of WSS access in rural areas (see below) established that, for the services providers reviewed in the sample, average water tariffs were 0.83 EUR/m³ for ROCs, 0.45 EUR/m³ for municipal departments (*Communa)*, and 0.56 EUR/m³ for the corporatized local operators (SRL-operators). The relative distribution of tariff (minimum, median and maximum) for the various categories of WSS providers is provided in Figure 4.12.

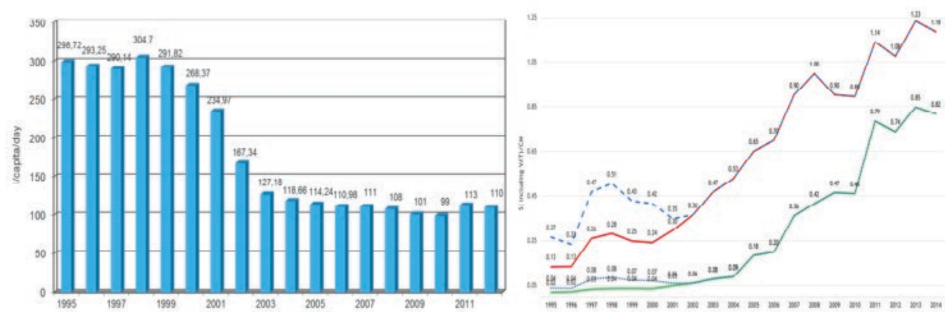
Over the past two decades, billing practices by WSS services providers have switched from relying on consumption estimates to billing based on metered consumption. Back in 1995, almost no water connection was metered in Romania, and all the water consumption was invoiced based on consumption norms (based on individual water consumption for households of 250-300 liters/capita/day on average—which was very high). Since then, the

FIGURE 4.12. Volumetric Tariffs for Various Service Providers



Source: WB 2017.
Note: ROC = Regional Operating Company; SRL = Limited Liability Company.

FIGURE 4.13. Evolution of Billed Volume in the Case of Brasov Regional Utility



Source: T. Popa.

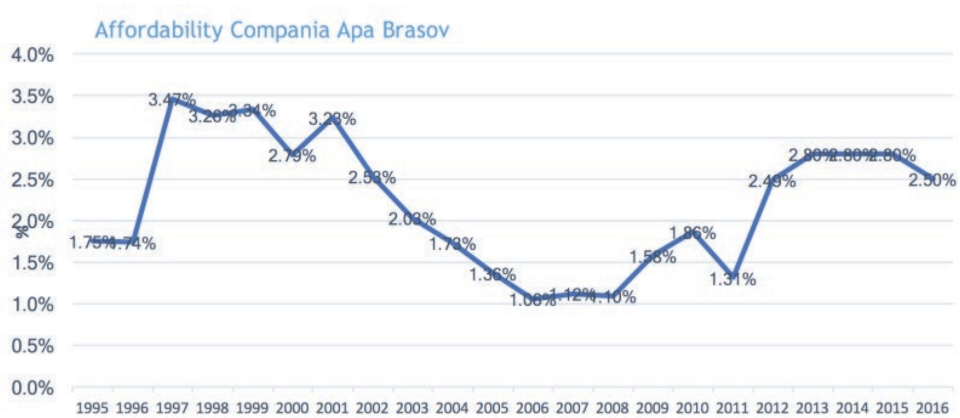
metering rate at national level has increased constantly, reaching 81.4 percent in 2008, 89 percent in 2012, and going up to 93.5 percent in 2015 (96.1 percent for ROCs).

While tariffs rose sharply over the past two decades, the impact on the population has been partly offset by a sharp reduction in the level of per capita consumption—as a result of the spread of metering and billing on actual metered consumption—as well as by the fact that a large portion of the population (and even higher proportion of poor households) are not connected to WSS services and therefore do not have to pay a water bill. The total volume of water billed by large operators in 2015 stood at 573 million m^3, down from 666 million m^3 in 2009. The sharp reduction in billed volume compensated for the large tariff increases, as illustrated for the regional utility in Brasov (figure 4.13).

Public acceptance for steady WSS tariff increases was also made possibly by the overall improvement in living conditions that has accompanied the EU joining process. The average income of Romanian households has increased steadily over the past 15 years. The minimum wage has doubled, and a minimum income social scheme has been introduced at the national level. This is illustrated in the case of the Brasov ROC by the evolution of the percentage of average households' income spent on the WSS bills over the period 1995–2016, as shown in figure 4.14.

Tariff revision mechanisms are based on regular reviews by the national regulator ANRSC. It is the second longest-established water regulator in the Danube region, with more than 15 years of experience (see figure 4.15). Together with the regionalization process, a new tariff approach was implemented in the sector consisting of designing medium term tariff strategies for 5- to 7-year periods. These tariff strategies include annual automatic indexation for inflation as well as other pre-defined adjustments over the period.

FIGURE 4.14. Percentage of Households' Income Spent on the WSS Bill in Brasov (1995–2016)

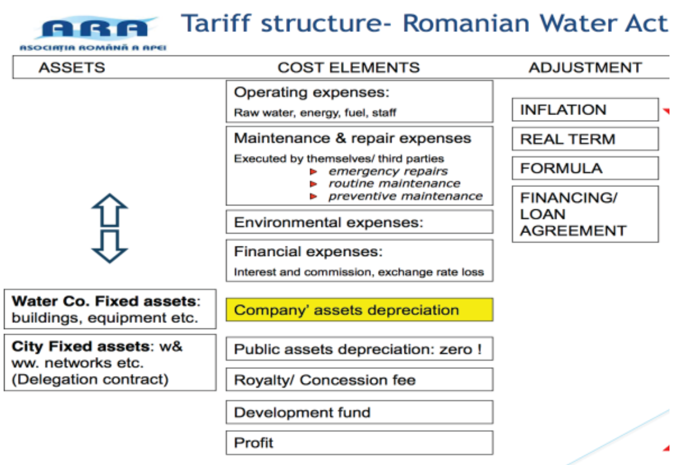


Source: T. Popa.

FIGURE 4.15. History of Establishment of Water Regulators in Danube Countries

Source: WB DWP, State of the Sector, 2015.

FIGURE 4.16. Structure of WSS Tariffs for Utilities Regulated by ANRSC



Source: ARA.

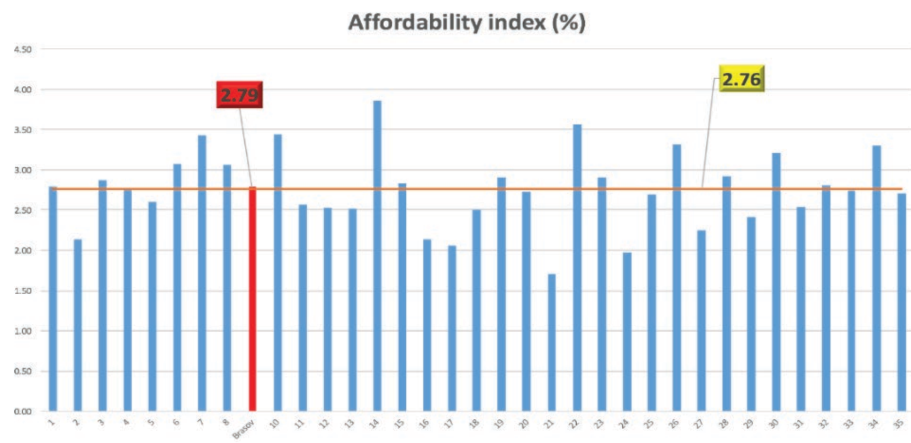
The cost elements used for setting the WSS tariff level under the Romanian Water Act are presented in figure 4.16. The tariff approval process involves first the local authorities via IDA who have to approve the medium-term tariff strategy, and then ANRSC that validates it and approves the annual tariff adjustments according to the strategy. The tariff strategies of ROCs are usually designed based on the methodology from the Cost-Benefit Analysis Guides for investment projects (issued by the European Union for each programing period), which involves a cost-plus approach (with allowed rate of return and profit sharing). In practice, many tariff strategies are part of IDA agreement delegation contract, and are reviewed by international experts supervised by JASPERS. It must be noted that currently assets depreciation is not accounted for in the calculation of tariffs, but this should be initiated in the next tariff regulatory period.

The current WSS tariff regulation includes a mechanism intended to ensure the affordability of water bills—a maximum percentage threshold of the average household income. This threshold has evolved over time through the successive phases of WSS reforms. It was set at 4 percent during MUDP (1996-99), went down under ISPA from 3.5 to 3 percent (2000-07), and for the current SOP period has been set at 2.5 percent, which reportedly was set so as to correspond notionally to about 4 percent for the lowest decile. However, this average 2.5 percent threshold was exceeded in 2015 due to the impact of the financial crises of 2008-09 on the evolution of the household revenues.

As of 2015, it is estimated that the average WSS bill represents about 2.9 percent of the average Romanian household's disposable income—up from about 2 percent back in 2005[6]—**which suggests that affordability is now becoming a concern**. In practice and due to the significant variations in tariff levels across utilities, there are some ROCs, where the percentage income spent by the average household is even higher, close to or above 3.5 percent, as shown in figure 4.17 (individual ROCs are not identified except Brasov). Considering that this threshold is based only on the average household income, this also means that poor households connected to WSS services probably have to pay close to or more than 5 percent of their disposable income on WSS bills.

The affordability concern is reinforced by the wide tariff discrepancies between regional utilities, which do not follow the differences in household incomes at county level. This is illustrated on the map in map 4.3, which provides the average household income levels by county, superposed with tariff levels for a selection of ROCs. The capital city has one of the lowest water tariff but also the highest income per capita, while several of the poorest counties (e.g., Buzau, Olt, Ciurgiu) are also those where the ROCs have the highest WSS tariffs.

FIGURE 4.17. **Affordability Index (%)**

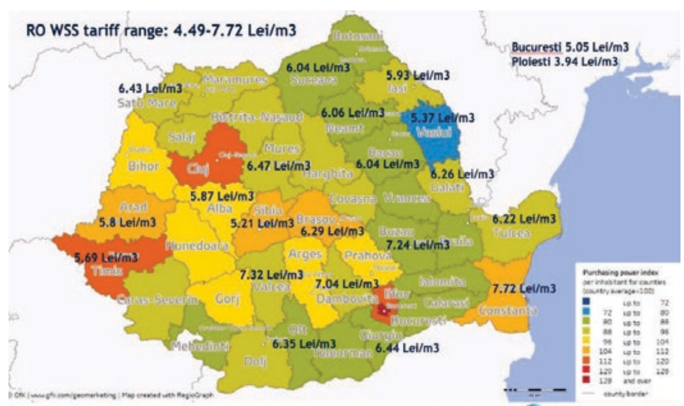


Source: T. Popa.

Data from the 2017 WB rural access study also indicates that **the proportion of disposable income spent on WSS bills varies significantly between the type of WSS providers, in line with the differences in tariff levels.** Connected households reportedly spend an overall median of 2.7 euros (12 lei) per capita on water per month—or around 2.2 percent of the average per capita monthly income.[7] This was slightly higher for ROCs (2.8 percent) and the lowest for *communa* (1.8 percent) and SRL operators (2.3 percent). 30 percent, 5 percent, and 15 percent of interviewed households connected to ROC, *communa*, and SRL managed systems respectively reported that high water charges were a top concern.

Overall, the current methodology adopted for ensuring affordability of WSS bills is questionable, since it is based on an income threshold for average households instead of poor households. To illustrate the problem, table 4.2 estimates the range of water bills among regional utilities, calculated for an average family of 5 and based on various income levels. Based on a per capita consumption of 100 liter/day and current ROC tariffs in the range of 4.49-7.72 lei per m^3 (2017), the monthly bill per capita is in the range of 13.47-23.16 lei.

MAP 4.3. **Map of Romanian WSS Tariff Range**



Source: World Bank's elaboration based on ANRSC data.

TABLE 4.2. **Water Bill as % of Household Income**

Water bill as % of household income *(Family of 5 people, per capita consumption of 100 liters per day)*	
Average household	**1.3–2.3%**
Poorest 30% households	**2.6–4.6%**
Poorest 10% households	**3.6–6.4%**

Source: World Bank's calculations.

Based on the average monthly household income per capita of 1,011 lei, the water bill (3 m^3/month/capita) as proportion of per capita household income stands at 1.3-2.3 percent.

However, considering that the poorest 30 percent of population earns about half of the national average, the range becomes 2.6-4.6 percent. And for the poorest 10 percent earning about 36 percent of the national average, the range becomes 3.6-6.4 percent. It must be noted though that this analysis does not apply to all households' situations. The average size of households is often lower (for instance, about 3 people in Brasov). More importantly, **in rural areas, the average per capita consumption is often less than 50 liters/day, as households also use water from their own well to reduce their WSS bill**.

As suggested in the above analysis, for poor households connected to WSS services, WSS bills are likely to now be close to or even over 5 percent of their disposable income,[8] **especially if they are served by a ROC**. One mitigating factor, which explains why WSS tariff levels have not yet become a major social and political issue, is obviously that one-third of the Romanian population do not have access to piped potable water, and it is likely that these include for a large part the poorest 30 percent of households. The other mitigating factor, as pointed out above, is the high proportion of private wells in rural areas, installed before the households were connected to a piped water system, and which allow them to reduce their overall consumption and bill. Still, there is a sizeable population of poor households leaving in areas served by ROCs (including in large cities), and it is likely that at least a portion of these do not have a parallel access to a private well, and may have difficulties paying their water bills.

4.2.3. There is a Major Poverty Inclusion Challenge in Rural and Marginal Areas

The WSS access gap is particularly critical for the poorest households with much lower coverage figures. While there is no data at the central level providing a clear profile of the 4.5 million people without access to piped water in-house,[9] the findings from the 2012 household surveys show that **for the two poorest income quintiles, only 54 percent have access to piped potable water, and 42 percent to flush toilets**—against 71 percent and 61 percent respectively nationwide. For the poorest share of the population—those living below the poverty line, that is, **on less than US$2.50 a day per capita—the access figure is even lower: only 32 percent have access to piped potable water, and a mere 20 percent to flush toilets**. This was confirmed by more recent data based on the latest 2016 household surveys, with the access rate for the poorest quintile standing at 37 percent for in-house piped water and 25 percent for in-house toilets. While some progress has been made, lack of access to piped potable water and flush toilets remains a major poverty inclusion issue in Romania (table 4.3).

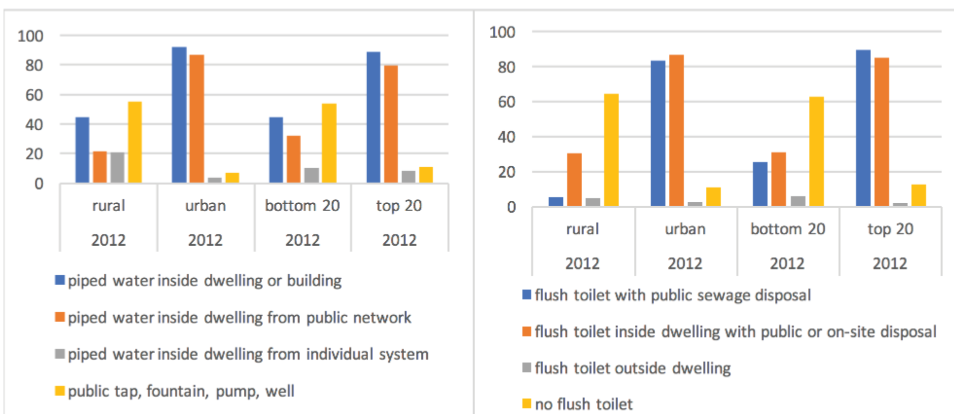
Access gap to water and sanitation is largely driven by location and concentrated in rural areas, which is also the main foyer of poverty across the country. Figure 4.18 shows access levels for households in urban and rural areas as well as the disparities in access found among the poorest and richest 20 percent of the population, based on Household Budget Survey (HBS) data from 2012. An urban household was four times as likely to enjoy public piped water services as a rural household, while at the same time rural households are eight times as likely to rely on public taps, fountains or wells, and six times as likely to have no flush toilet. Only 30 percent of the rural population had access to indoor flush toilets, while

TABLE 4.3. Access to Piped Potable Water and Flush Toilets

Indicator	Year	Source	Value	EU MS average	Danube average	Danube best
Water Supply						
Piped supply – average *[%]*	2012	Authors' elab.	71	91	83	100
Piped supply – bottom 40% *[%]*	2012	Authors' elab.	54	85	76	100
Piped supply – below $2.50/day *[PPP] [%]*	2012	Authors' elab.	32	77	61	100
Including from public supply – average *[%]*	2013	INS 2014b	62	83	74	99
Sanitation and Sewerage						
Flush toilet – average *[%]*	2012	Authors' elab.	61	83	79	99
Flush toilet – bottom 40% *[%]*	2012	Authors' elab.	42	74	70	98
Flush toilet – below $2.50/day *[PPP] [%]*	2012	Authors' elab.	20	63	54	100
Including with sewer – average *[%]*	2013	INS 2014a	47	67	66	94

Source: WB DWP, State of the Sector, 2015.

FIGURE 4.18. Access Levels for Households in Urban and Rural Areas

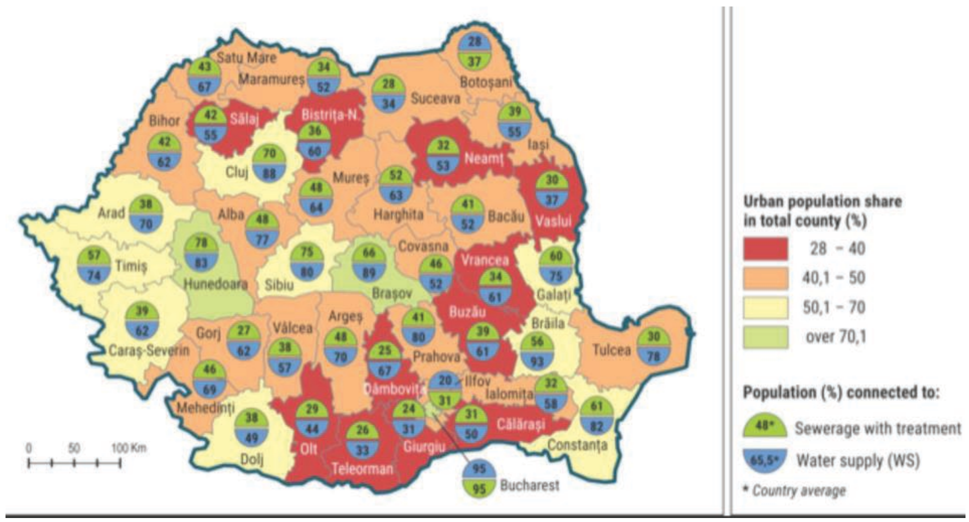


Source: WB 2017, based on 2012 data.

86 percent of urban households enjoy such comfort. While progress was made in recent years—with 47.7 percent of the rural population having access to in-house toilets in 2016—the rural access gap is still there.

The access rate to piped water and sewerage networks (with treatment) shows significant geographical disparities—confirming that the access gap is concentrated in rural areas. This is illustrated in map 4.4, which shows a strong correlation between rurality and low WSS access rate. The counties with the highest proportion of rural population (in red) are usually those with the lowest access rate, and *vice versa*. It is noteworthy though that, while a large part of the increase in access rate over the last decade benefited the urban population, there are also rural counties with relatively high WSS connection rate (e.g., Alba), and also urban counties with relatively low WSS connection rates (e.g., Caras-Severin, Dolj).

MAP 4.4. Access Rate for Piped Water and Sewerage Networks by County



Source: World Bank's elaboration based on ANRSC data.
a. country average.

The hotspot counties for WSS access gap are concentrated on the lower Danube (south), and on the Moldovan and Ukrainian borders (northeast). The counties with the lowest WSS access rate—hotspots for WSS inclusion—are largely grouped around two main clusters. The first cluster is located in the northeast at the Moldovan and Ukrainian borders with the counties of Suceava, Botosani and Vaslui. The second cluster is on the lower Danube, with the counties of Dolj, Olt, Teleorman, Giurgiu, Ilfov and Calarasi.

The WSS access gap in rural areas has been only slightly reduced over the past two decades. The rural access rate for piped potable water networks went up from 16 percent in 1992, to 22 percent in 2001 and 33 percent in 2012. The total rural piped water access including in-house pipes supplied by private wells stood at 60.2 percent in 2016, up from 45 percent in 2012. Between 2008 and 2015, the number of rural localities with a piped water system went up from 1,806 to 2,157—meaning that 351 rural localities gained access. Progress was also achieved for access to flush toilets: while in 2008 only one in five households used an indoor toilet, in 2012 this had increased to almost one in every three, and up to about half of all rural households in 2016—a result of private investments and increasing preferences for more comfortable and hygienic living conditions.

Additional insights into the WSS access gap are provided by a new WB 2017 survey. In order to better understand the WSS access gap in rural and marginalized areas, the WB commissioned a regional study covering seven countries in the Danube basin including Romania (see map in map 4.5). Within eight counties and three regions in Romania (West, South West and South East), a total of 30 municipalities were randomly selected, where the population is served respectively by 8 ROCs, 14 Communal operators, and 9 SRL operators.

A total of 900 households were interviewed (30 per commune), with 5 communes deliberately selected for their high share of the Roma population. While the sample is not representative for all rural areas in Romania, due to its size and geographic focus, the findings do bring additional light on the WSS access gap and inclusion issues, both for households connected to piped water systems and those relying on private water sources. These are summarized below.

Among those rural households connected to piped water networks, the study found that a significant proportion—from 10 percent to 25 percent depending on localities—did not have in-house piped systems. Although they have their own private in-yard connection, these households still had to go out of the house to fetch water. The largest proportion (up to a quarter of households connected to piped water networks) of these was found in smaller villages served by Communal operators. Overall, the services provided by ROCs and SRL showed high level of reliability, with 97 percent and 96 percent respectively providing continuous water supply (24/7), but the reliability for Communal operators was lower at 87 percent.

MAP 4.5. Selected Municipalities in the WB 2017 Survey

Source: World Bank 2017.

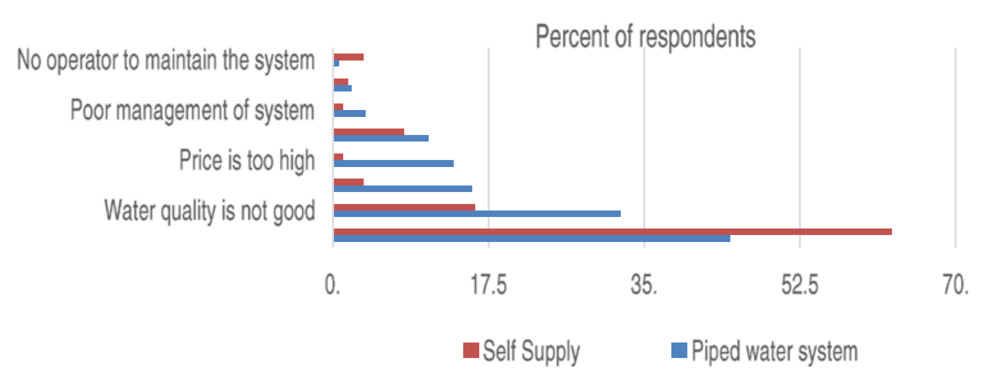
Not all rural piped water systems have adequate disinfection processes in place, and some rely on groundwater contaminated with nitrates. Many small rural water systems use water from groundwater aquifers which can be chemically and bacteriologically contaminated. While ROCs covered by the study were achieving 100 percent disinfection, only 78 percent of SRL-type and 57 percent of Communal operators reported to have disinfection in place at the water source. Only half of *Communal* and three quarters of SRL operators reported carrying out water quality tests, and non-compliance with bacteriological parameters was reported in 9 percent of local-operated systems, and for nitrate and nitrite content in 20 percent of them. A 2015 report by the National Institute of Public Health found that out of about 2,200 small local water systems, 8 percent did not comply with nitrates and 22 percent with bacteriological parameters. The National Administration "Romanian Waters" (ANAR), responsible for the water source quality monitoring, with over 1,300 groundwater observation points, noted in its 2015 annual report that 14.5 percent of its observations did not comply with nitrate standards (< 50 mg/l) as per the EU Nitrate Directive.

Among those rural households that rely on private wells or springs, about two-third need to go outside of the house to fetch water, and only a quarter have in-house piped systems. Although in most cases the water source is located close to the house, **about 10 percent of households do spend more than 30 minutes each day** to fetch water (a task equally shared by adult men and women in rural Romania). The large majority of self-supplying households rely on protected dug wells (62 percent) and boreholes (23 percent), but 9 percent use unprotected wells. Furthermore, while 56 percent of households reported using an electric pump to extract water, 14 percent used a hand-pump and around one-third of households had to draw water manually.

The 2017 WB study confirmed that there are serious water safety concerns for self-supplied households in rural areas. Most private household wells tap into shallow aquifers which have a high risk of contamination due to anthropogenic influences (fertilizers, animal manure and the lack of safe sanitation disposal). Yet, only 30 percent of interviewed households reported carrying out some form of in-house water treatment, and only 1 in 5 tested the quality of their well water over the past 2 years. Given the widespread contamination of shallow groundwater in many parts of Romania (due to the absence of adequate rural sanitation facilities), it seems that many households lack awareness of their risk to exposure to contamination, and how it could be mitigated. This does call for more public communication to increase awareness and promote regular testing of individual drinking water wells by households.

Surprisingly, most non-connected rural households relying on private wells report to be satisfied with their current arrangement, and do not wish to be connected to a water network. As indicated in figure 4.19, it is noteworthy that most households (63 percent) that rely on self-supply perceive their situation to be "perfect"—much more actually than the satisfaction rate for those rural households connected to piped water networks (44 percent). Among those unconnected households that were not satisfied with their situation, the quality of water was by far the main concern, followed by quantity. Among those connected, the main reason for dissatisfaction was, by far, the quality of services—both water quality and supply pressure—with high tariff levels coming second. It is noteworthy that the proportion of households raising concerns about water quality and quantity was much higher among those connected to piped networks that those relying on self-supply.

FIGURE 4.19. Concerns of Households about their Water Supply Situation (Household Survey)

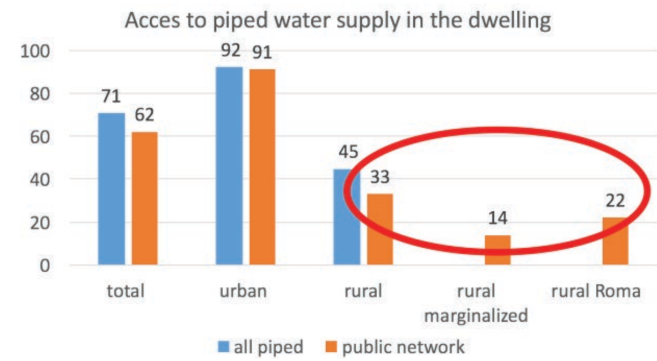


Source: WB 2017.

The 2017 WB study also provided additional insights on the WSS access gap for the Roma (figure 4.20 and figure 4.21). In the five rural settlements with high share of Roma population that were covered (150 households interviewed), the access rate to piped potable water was significantly lower for Roma than for non-Roma—53 percent versus 73 percent—and connected Roma households were also much less likely to have an in-house piped system—19 percent vs. 60 percent. However, on a broader basis, it seems that **the access gap may be more related to marginality than ethnicity**: while the access gap to piped water for rural Roma was higher than for the average population (22 percent against 33 percent), it was nonetheless lower (22 percent against 14 percent) than for the rural marginal areas with non-Roma populations. Also, for Roma households connected to the piped water network, **the study did not find any difference in treatment by the WSS service providers** between Roma and the non-Roma population.

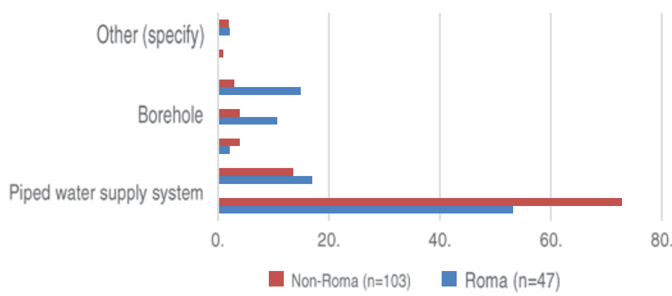
It also appears that Roma households without access were more likely to be exposed to public health risks—partly because of poor practices. For those relying on self-supply, Roma households were also less likely to carry out some form of household water treatment practice (79 percent vs. 98 percent), and while they expressed a higher concern over water quality, they were also more likely to get supply from surface sources, with high risk of contamination.

FIGURE 4.20. Rural Access to Piped Water, Roma and Marginalized Areas



Source: WB survey of WSS access gap in Danube countries, 2017.

FIGURE 4.21. Comparison of Drinking Water Sources for Roma and Non-Roma Households



Source: WB 2017.

4.3. Still Much Room for Improving the Performance of Regional Public Utilities

Public access to performance data from WSS service providers in Romania is a challenge. Such data is typically considered confidential and utilities are reluctant to share openly their performance indicators with outsiders—in contrast with many other EU countries where public WSS utilities performance is considered public information.[10] It was not possible to obtain for this study performance indicators for individual ROCs from the national regulator ANRSC. Reporting of key operational performance indicators by ROCs has been required by some IFIs as part of their loan covenants, but there is no requirement that such information be made publicly available. While some underlying sensitivities are understandable—considering that the WSS sector is still undergoing a difficult reorganization under the regionalization process—this however raises questions **of lack of transparency and public accountability for such an essential public service.** This also reduces the pressure on the management of the ROCs to improve their performance, and may make it more difficult for customers to accept future tariff hikes.

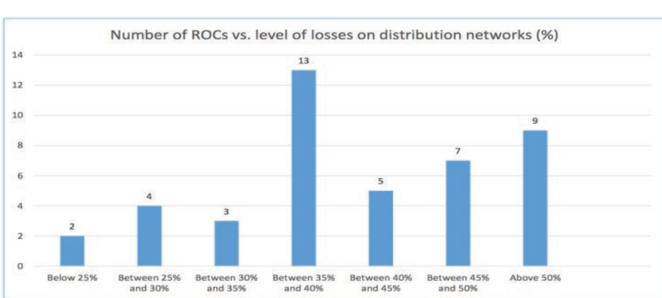
Much of the performance analysis presented in this sub-chapter comes from an analysis carried out independently by consulting firm BDO (BDO Business Advisory Financial Survey, 2012-16) which has been heavily involved in the WSS reforms in Romania over the past decade. Because of the above-mentioned limitations, it does not purport to be comprehensive, and **covers only the 43 ROCs**. When available, some limited information will be provided on other providers.

Overall, **the ROCs and two large private operators (Bucharest and Ploiesti) achieve a reasonably good level of performance.** Continuous 24/7 water supply is the norm, and so is compliance with drinking water potability parameters. The majority (94 percent) of customers are metered and many utilities have bill collection rates above 95 percent. However, the NRW performance is quite poor and so is labor productivity—with a national average of respectively 50 percent and 6.5 staff per 1,000 customers for ROCs, and a much worse performance for smaller local operators.

4.3.1 Romanian Water Utilities Have High Levels of Water Losses (NRW)

The overall level of Non-Revenue Water (NRW) in Romanian water utilities is high. It was close to 50 percent in 2015 for the large operators—that is, the 43 regional utilities (ROCs) and the two large private operators (Bucharest and Ploiesti). This reflects the fact that the **physical conditions of the water distribution networks are poor** and require significant investments in rehabilitation. The nationwide average for NRW in water distribution only (without losses in production and transmission) stood at about 40 percent. As shown in figure 4.22, there are considerable variations in reported NRW level among utilities: six large utilities do report a NRW levels in distribution lower than 30 percent,[11] while as many as 16 large utilities report NRW levels in distribution above 45 percent.

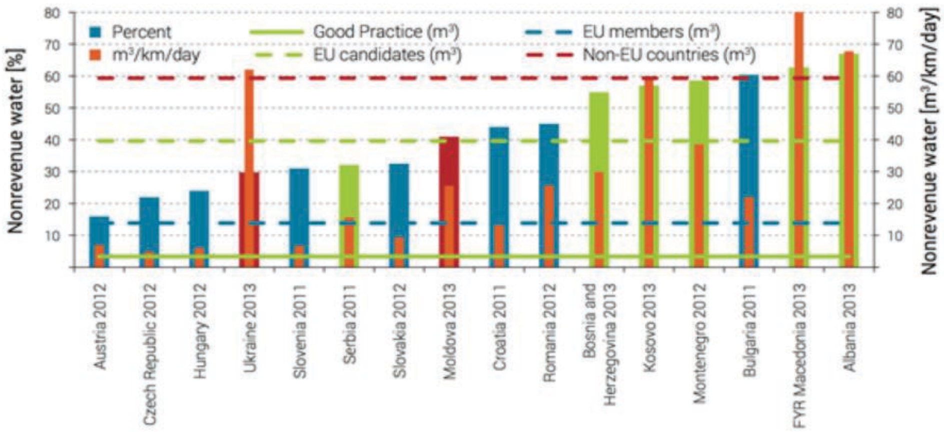
FIGURE 4.22. Distribution of NRW Level amongst Regional WSS Utilities



Source: BDO 2016.
Note: ROC = Regional Operating Company.

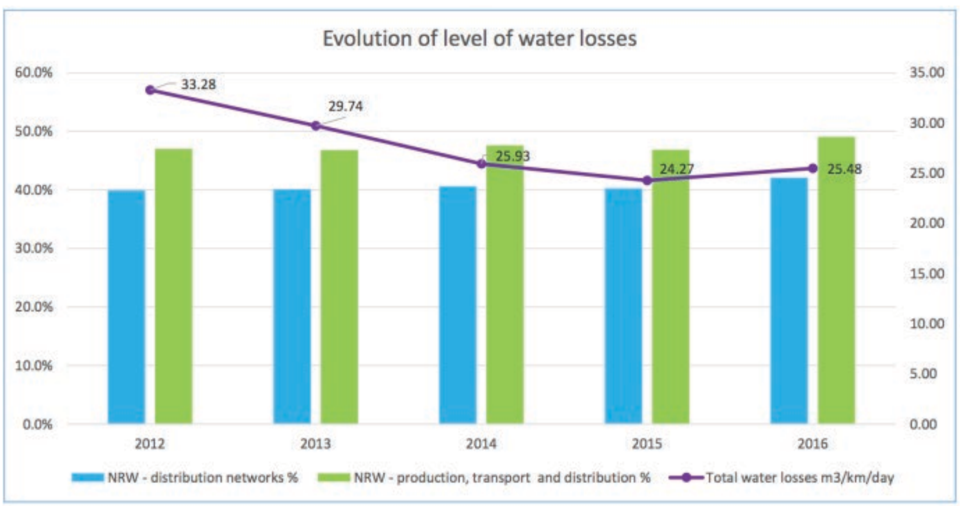
Such levels of water losses are high by both international and regional standards. Figure 4.23, which is extracted from the DWP regional State of the Sector 2015 (based on 2011-13 data), provides a comparison of NRW levels among countries in the Danube Basin. Among EU member states, only Bulgaria has a higher percentage of NRW than Romania, but its NRW level calculated in m^3/km/day is actually lower, suggesting a comparable overall water losses performance since the Bulgarian population enjoys universal access to piped water and a large proportion of the systems are rural networks with low population density. While Romania has a better NRW than several non-EU countries of the region (Albania, FYR Macedonia, Montenegro and Bosnia), it appears to be however out-performed by Serbia, Ukraine

FIGURE 4.23. **NRW Level in the Danube Countries**



Source: WB DWP, State of the Sector, 2015.

FIGURE 4.24. **Evolution of NRW Level amongst Regional WSS Utilities (2012–16)**



Source: BDO 2016.

and even Moldova (though this might be due to inaccurate reporting). Except Croatia that only recently joined the EU and has a similar NRW level, all other EU-13 member states in the region reported lower levels of NRW: of between 20 and 30 percent (the Slovak Republic, Slovenia, Hungary and the Czech Republic) while Austria reported NRW as low as 16 percent.

There has been little evolution in the average percentage of NRW of ROCs in the past 5 years, as shown in figure 4.24. This is can be largely explained by the fact that, with the regionalization process, the regional utilities have been gradually incorporating small systems previously operated by municipal services that were in very poor conditions. Still, the level of losses expressed with the m^3/km/day as indicator shows some improvements, mainly as a result of the networks expansion and rehabilitation performed in the last years and financed from SOP Environment—the total length of newly expanded and rehabilitated water networks during that period was 3,100 km and 1,850 km respectively.

Romanian utilities do not seem to have a clear knowledge of the proportion of physical vs. commercial losses.[12] The NRW data reported by ROCs is not always accurate,[13] and even though the implementation of the national benchmarking exercise (see below) in the past 5 years has led to improvements,[14] no regional utilities seem to have developed an International Water Association (IWA) Water Balance to better understand the various components of their NRW performance. Discussions held with various stakeholders during the preparation of this diagnostic show that while there is a good overall understanding among Romanian practitioners of the importance of physical losses in distribution and the need to invest massively in networks rehabilitation,[15] there is relatively less awareness and concern over the issue of commercial losses, which is considered of secondary importance. The level of the commercial losses in Romania has never been assessed and there are no studies in this respect.

However, the level of commercial losses in regional utilities is probably significant, and can be broadly estimated at between 80 and 135 million m^3 per year. Based on the WB's international experience, the proportion of physical vs. commercial losses in water utilities showing high levels of NRW is typically of one-third vs. two-thirds. This is consistent with the fact that most ROCs (unlike to the two large private operators) do not have a clear meter replacement policy, illegal connections are an issue in some marginal neighborhoods and rural areas (as well as non-metering of public buildings in some cases), and little attention seems to be paid to the challenge of under-metering and the calibration of meters for large customers. This would mean that, out of an average 40 percent NRW level in distribution,[16] about 14 percentage points correspond to commercial losses that is, water which is delivered to customers but not billed. Considering that NRW in distribution for ROCs represented a total of 405 million m^3 in 2015 (ANRSC), this means that as many an estimated 135 million m^3 corresponded to commercial losses. Even assuming an 80-20 percent ratio between physical and commercial losses (which is very conservative), the total volume of commercial losses among ROCs would still represent 81 million m^3 annually.

A dedicated national program to reduce commercial losses would bring significant financial benefits—with estimated annual additional revenues of 245–410 million RON. While NRW reduction program for reducing physical water losses (leakages in distribution network) require major rehabilitation investment, can be technically complex to implement (requiring not just pipes replacement but a good understanding of the hydraulics of the networks) and often have a low financial payback, **NRW reduction programs targeted at commercial losses have usually much faster financial payback and are typically considered "low-lying fruits**." This is because the benefit from one m^3 saved from physical leakage is typically equivalent to the marginal (variable) cost of water and represents only a small portion of the water tariff—while the benefit from 1 m^3 saved from commercial losses translates into one additional m^3 of water billed at the current tariff. Considering the current average WSS tariff of 6 lei per m^3 (1,3 euros per m^3), this means that the value of commercial losses in ROCs is likely to be in the range of 490-810 million lei per year—or 105-175 million euros. A dedicated national program for reducing commercial losses, by focusing on meters' replacement, closing illegal connections and calibration of large meters, should be able to reduce these losses by half over a period of 2-3 years—generating annual savings of between 245 and 410 million lei (52-87 million euros).

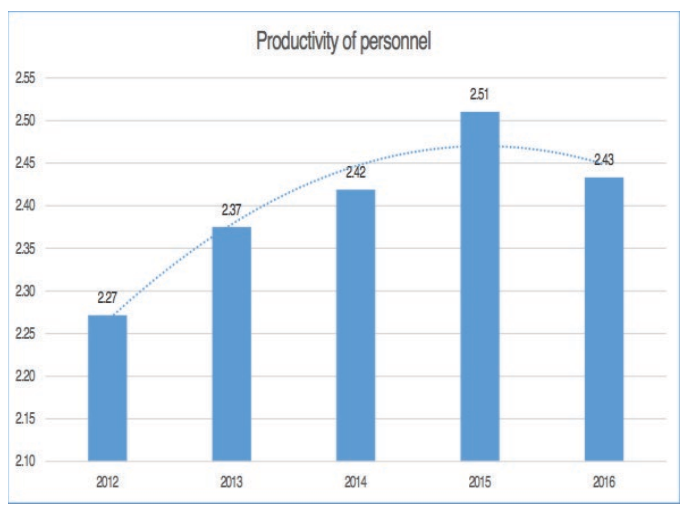
A positive recent development is that some regional companies have started to look at partnering with the private sector for reducing NRW. A recent EBRD project with RAJA Constanta aimed at introducing for the first time in Romania a Performance-Based Contract (PBC) for the reduction of NRW. The project shall involve dividing the city network in District Metered Areas (DMAs), and the private contractor shall be partially remunerated based on its performance and achievements. During the PBC study a market sounding exercise was conducted among 10 international water companies and six of them showed real interest and were very active in the preparation process. Currently, the project is in the negotiation phase of financing between EBRD and Raja Constanta and most probably the tender for selecting the private partner will be launched in the near future.

4.3.2. Labor Productivity, Energy Efficiency and Bills Collection

The staffing level of ROCs is relatively high, at 6.5 staff per 1,000 connections on average in 2016. This is due to a combination of factors. First, Romanian ROCs are well behind Western EU countries, where subcontracting is widespread (and often accounts for up to half of total labor); the degree of outsourcing of operational activities is close to zero. Second, relatively low salary levels in the country make it less economical for utilities to push for more automation. Third, as part of the regionalization process, many ROCs have incorporated employees working previously in the municipal services. There are nonetheless large differences between utilities, with some achieving ratios of 3-4 staff per 1,000 connections, and others with ratios as high as 12 staff per 1,000 connections.

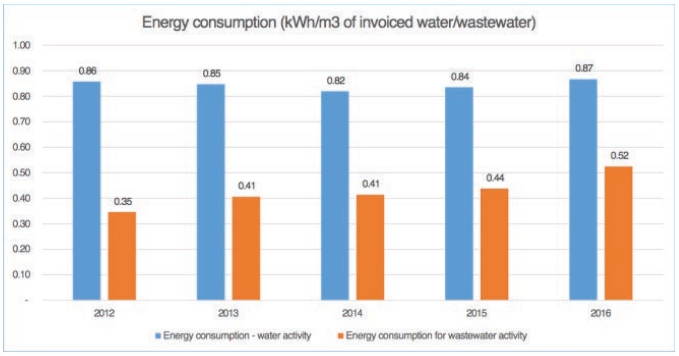
On average, the labor productivity performance has been improving in recent years. The ratio of staff per 1,000 connections has gone down from 7.6 in 2013 as the result of the combined effect of an increase in personnel efficiency and increase in the number of connections as a result of the extension of networks. As a result of the implementation of the national benchmarking program (see below) labor productivity has been on top of the agenda for many ROC management teams. Figure 4.25 shows the evolution of the "productivity of personnel" ratio, a measure widely used in Romania and

FIGURE 4.25. Evolution of the Productivity of Personnel



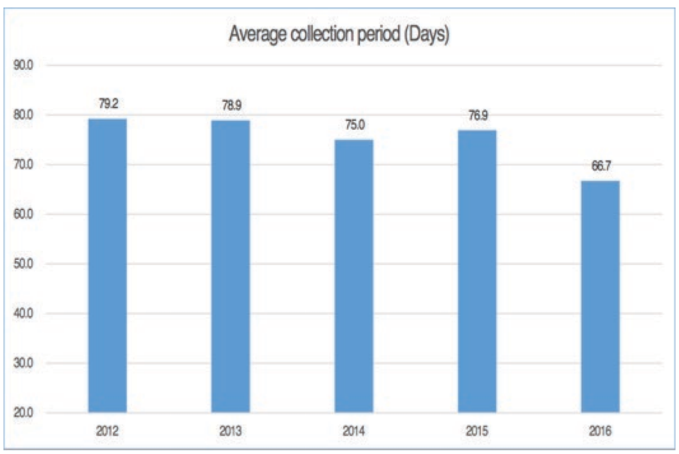
Source: BDO 2016.

FIGURE 4.26. Evolution of Energy Efficiency in kWh/m³ of ROCs in 2012–16



Source: BDO 2016.

FIGURE 4.27. Average Collection Period (Days)



Source: BDO 2016.

representing the ratio of the operating revenues per employee to related costs per employee. It suggests improved productivity of personnel during the period 2012–15, although this is the result of both efficiency measures implemented by the utilities and tariff increases at a higher pace than salaries.[17] In 2016, the productivity of personnel recorded a decrease due to an increase of the national minimum salary.[18]

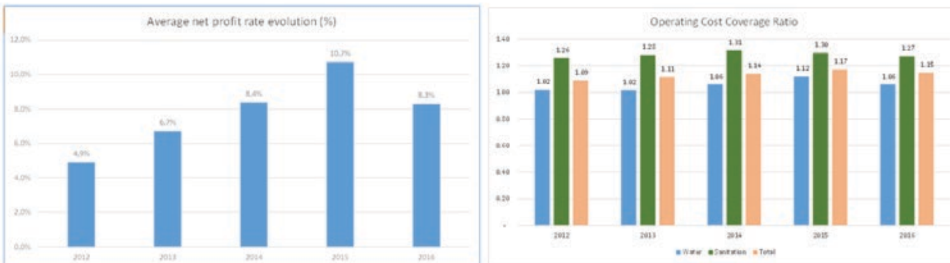
The energy efficiency of the ROCs has remained stable in recent years, at about 0.85 kWh/m³ for water supply (per m³ billed) figure 4.26. Nonetheless, the energy efficiency for sewerage services has gone up significantly, reflecting the development of wastewater treatment plants (while before the electricity costs were mostly for re-pumping stations in the collection networks), up to 0.52 kWh/m³ billed. **Overall, the electricity costs represent about 10 percent of the total operational costs of ROCs**. Significant cost reductions were achieved in recent years, as the regional utilities were able to take advantage of the liberalization of the electricity market in Romania that became effective in 2014. The utilities organized tenders for acquiring their electricity supply in the open market and managed to reduce their unitary electricity costs. However, this was largely offset by the expansion trend into rural areas, where the low population density tends to increase the unitary energy consumption.

The level of bills collection amongst ROCs is reported to be relatively high, with an average collection period ranging between 70 and 80 days. Although no data was obtained for the collection rate in percentage of billed amounts, it can be inferred from various interviews that at least for those utilities that are sufficiently creditworthy to have contracted commercial debt for their investments this ratio is above 95 percent.[19] For instance, in the case of Brasov, the bills collection rate has been consistently above 99.5 percent during the past 6 years. The evolution of the average collection period is presented in figure 4.27. The improvement from 2016 with a figure of 67 days can largely be attributed to the cumulative effects of the decrease of VAT—down from 24 to 9 percent for water and 19 percent for sanitation—which together with almost no tariff adjustments due to negative inflation made the water bills more affordable.

4.3.3. The Financial Performance of WSS Operators Shows Large Discrepancies

The financial situation of ROCs has significantly improved in the past 4 years, with many regional utilities now recording a profit and being cash-positive. This is illustrated by figure 4.28, which

FIGURE 4.28. Evolution of Operating Cost Coverage Ratio and Net Profit Rate from 2012 to 2016



Source: BDO 2016.

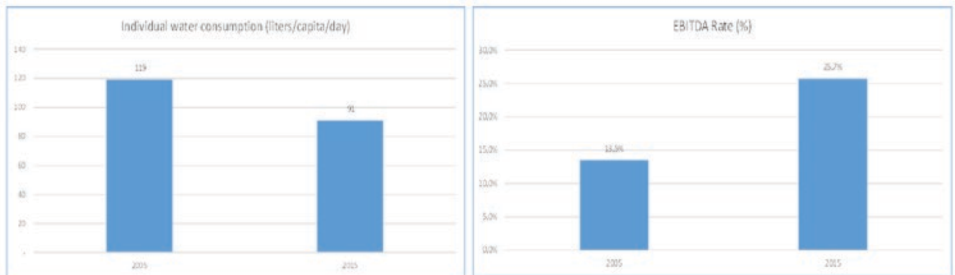
presents the evolution of the operating cost coverage ratio and net profit over the 2012–16 period. In 2016, the national average for the operating cost coverage ratio stood at 1.15, and for the net profit at 8.3 percent. It is important to highlight though that this improvement is mostly not due to improvements in operational efficiency—with NRW levels and bills collection rates remaining stable, and modest improvements in labor efficiency—but rather to the implementation of gradual tariff increases together with delays in implementation of the investments financed from SOP Environment.[20]

Thus, **the overall profitability of the sector is currently sufficient to assure the coverage of operating costs and the repayment of the co-financing loans for investments**. However, the financial performance started to deteriorate in 2016 and the deterioration is expected to continue also in 2017 mainly as result of the national minimum wage increases and expected further pressure on salaries. The balance of the **debt contracted by the regional operators was about 410 million euro** at the end of 2016 distributed as follows: 24 loans from EBRD (typically with no guarantees), 1 loan from European Investment Bank (EIB) (with local authority guarantee) and 12 loans from commercial banks.

There are still, however, a number of ROCs in a poor financial situation and struggling to finance their operational activities. This is especially the case for those serving a large portion of rural territory, with many small localities and low density of customers. These ROCs typically still face difficulties in the repayment of co-financing loans and in continuing the extension of their area of operation to other rural areas, and tend also to be those with the worst operational indicators.

After almost 10 years of implementation, **the impact of the regionalization reform on the financial performances of ROCs was analyzed in a study prepared in January 2017 by BDO Business Advisory.** It was conducted on the basis of financial data for 20 regional utilities and compared the situation between 2005 (before regionalization) and 2015. In addition to the increase in access rate brought about by the extension of networks in some rural areas, the impact of regionalization was particularly salient for the improvement in the operational profitability of the utilities (as measured by earnings before interest, taxes, depreciation and

FIGURE 4.29. Individual Water Consumption and EBITDA Rate: 2005–15 Comparison



Source: BDO 2016.

amortization [EBITDA][21]), and the reduction in per capita consumption as a result of the generalization of metering together with steep tariff increases (price elasticity effect), as shown in figure 4.29. **Over the past decade, water consumption decreased significantly from 119 to 91 liters/capita/day**, while the **EBITDA almost doubled from 13.5 to 25.7 percent**.

The 2007 WB survey of access in rural areas was able to gather some information on the situation of small local operators—pointing out their weak overall financial situation. Only two-thirds of them could report basic data on operational expenses and revenues from water sales. For more than half of local operators, the need for operational subsidies from local governments (or other entities) was evident. The majority of *Communal* and SRL operators complained about a low revenue base, many illegal connections, high levels of water losses, poor bill collection and low tariff levels.

4.3.4. The National Benchmarking System Has Been an Important Initiative

An important element in the reform process of Romanian regional public WSS utilities has been the recent implementation of the National Benchmarking System. It was started in 2012 via an EBRD technical assistance. The first benchmarking exercise was run in 2012 using the European Benchmarking Cooperation (EBC) methodology and platform, with 12 participating ROCs. Then, considering that the EBC methodology was not adapted to the state of the Romanian water sector,[22] it was decided to develop a customized national benchmarking methodology. A second benchmarking exercise was run in 2013 with 22 ROCs using this new methodology, which like for EBC's was largely based on IWA indicators but also included customized ratios relevant for national particularities of the Romanian WSS sector.[23] Then, considering the success of the first 2 benchmarking exercises, the Ministry of European Funds decided to extend the benchmarking to all 43 ROCs, and in 2015, a customized benchmarking IT platform was build and three benchmarking exercises were conducted (with data on 2012 as a test exercise and full exercises with data on 2013 and 2014).

Starting in 2016, a Centre of Excellence was established under the Romanian Water Association (ARA) to take over the management of the national benchmarking exercise and of the IT platform. In order to ensure the financial sustainability of the benchmarking process and as a sign of commitment, the participating ROCs agreed to contribute an annual fee based on the size of the company. The Center of Excellence was created as a separate structure from ARA, self-financed from the annual contributions from ROCs, having an executive director, a benchmarking coordinator at the central level and regional benchmarking specialists (usually personnel from participating ROCs) that assure the smooth implementation of each benchmarking exercises. It includes ARA, the Ministry of Regional Development, Public Administration and European Funding (MRDPAEF), the Ministry of Water and Forestry (MWF) and the national regulator for public utilities (ANRSC).

The impact of the national benchmarking exercise on the WSS sector has been significant: the operators compared and started improving their performance. Currently, it is the only national database with detailed information about all the regional operators, and it relies on indicators customized to national specificities. Each ROC can use the benchmarking platform to identify their main weaknesses, design action plans for performance improvement, and contact better performing peer companies for best practices. The benchmarking platform also allows local authorities that belong to an IDA to access a set of predefined indicators to help monitor the performances of their ROC.

The next objective of the center of excellence is to start performing a benchmarking of processes, starting in 2020. However, it must be mentioned that this benchmarking exercise has one downside: in order to motivate all ROCs to join and share their operational data with peers, a commitment was made that such data would not be made publicly available—raising issues about transparency and public accountability. Also, the fact that the benchmarking system was customized to the Romanian WSS sector makes it more difficult to carry out comparisons with WSS utilities in other EU countries and assess the progress of the sector, especially in relation to other EU-13 countries of Central and Eastern Europe.

4.4. Financing WSS Investments: Moving towards Commercialization

The remaining investment needs for expansion and rehabilitation of WSS systems are considerable, but the total is not well-known and the information available is not entirely consistent. One recently circulated figure indicates that a total of 13.8 billion euros would still be required in investment to ensure full compliance with the EU water directives (of which investments for WSS services would be only a portion). The costs for compliance with Urban Waste Water Treatment Directive (UWWTD) were initially estimated at 13 billion euros for agglomerations above 10,000 PE (a large portion having been already funded in the previous and current SOP program) and 4 billion euros for agglomerations between 2,000 and 10,000 PE (with 75 percent of the estimated costs for sewerage networks). The consolidated figure from the investments identified in the second RBMPs (submitted to the EC in 2016) provides a total figure of 21 billion euros for the cost of compliance, with 13 billion euros for the period 2016-21, and 6 billion euros for 2022-27, broadly in line with a 2015 WB stocktaking report on compliance that gave a total figure of 24 billion euros.

In the absence of a national financial strategy for the WSS sector, it is not surprising that there are no definite figures for the required WSS investments. The uncertainty is particularly important for the required investments for wastewater compliance in agglomerations between 2,000 and 10,000 PE, since the attention so far has been on the larger ones (above 10,000 PE). BDO consulting firm broadly estimates that the aggregate investment figure for ROC to build a backbone sanitation infrastructure (main networks and Wastewater Treatment Plant [WWTP]) in rural agglomerations above 2,000 PE should be about 6-7 billion Euros, but this will largely depend upon the degree of recourse to Individual Appropriate Sanitation (IAS) in the future. For potable water, the 2004 action plan for potable water has estimated at 5.6 billion euros the needs until 2015, and this figure was increased to 5.8 billion euros in LIOP 2014-20 (even though 1.38 billion euros were spent in 2007-13).[24] With only 1.26 billion allocated there is a gap of 4.54 billion until 2020. This figure seems to be broadly in line with international benchmarks, assuming that the cost of connecting households to piped water would be in the range of 1,000-1,200 euros per capita (total of 5-6 billion euros for providing access to 5 million people). It is to be hoped that, as the regional master plans are currently being updated, their consolidation should provide a clearer picture of the overall investment needs of the WSS sector for the next decade.

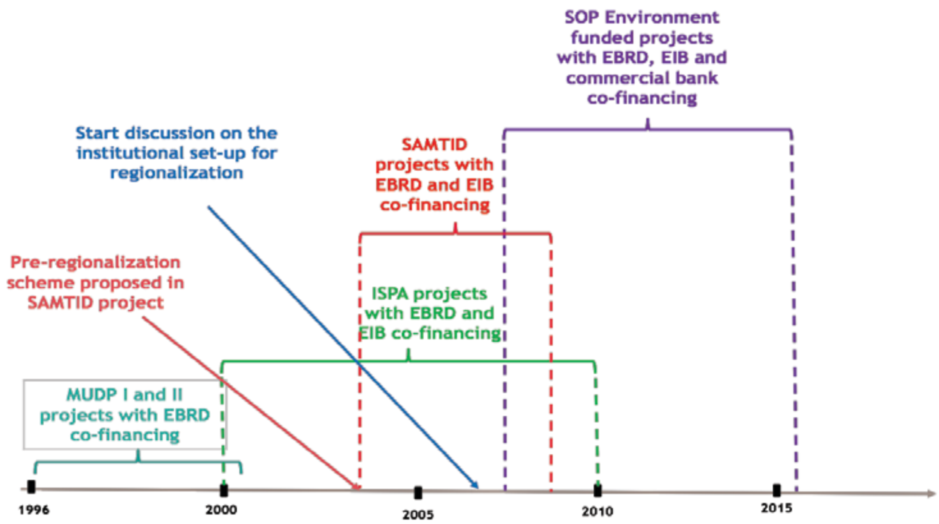
It is beyond doubt that there is a considerable WSS financing gap, in relation to currently available funding sources from the EU. The **Large Infrastructure Operational Program (LIOP)** (financed from state budget and EU funds) 2014-20 has allocated 4.1 billion euros for investments with the 43 regional operators (of which 2.4 billion euros for investments in wastewater collection and treatment), while the **National Program for Local Development (PNDL, financed from the state budget)** has allocated 8.61 billion lei (equivalent of 1.9 billion euros) for water supply, sewerage and waste water treatment (WSS) facilities in 2015-19.[25] Further, the **National Program for Rural Development (PNDR)** of the Ministry of Agriculture has allocated 0.34 billion euros for 2014-20 to finance WSS investments in agglomerations below 10,000 inhabitants.[26] It is not clear that this level of EU grant funding from Cohesion Funds will still be available for the next investment round after 2020.

The discussion in this chapter will focus on reviewing the history of WSS financing in support of reforms over the past two decades, with a special focus on the EU funds, where slow absorption has been an issue.

4.4.1. Successive WSS Investment Programs since 1996

Successive strategic investment programs since 1996 have been the backbone of WSS reform. The country was able to benefit from Pre-Accession funds and, later, Cohesion funds to bring its WSS infrastructure and service delivery to a higher level, combining investment for rehabilitation and expansion of infrastructure with institutional reforms. Figure 4.30 that follows summarizes the key programs that have been shaping the Romanian water and sanitation sector, with table 4.4 providing a summary of these programs.

FIGURE 4.30. Strategic Milestones of the WSS from Romania Over the Past 20 Years



Source: BDO 2016.
Note: EBRD = European Bank for Reconstruction and Development; EIB = European Investment Bank; ISPA = Instrument for Structural Policies for Pre-Accession; MUDP = Municipal Utilities Development Program; SAMTID = Small and Medium Town Infrastructure Development; SOP = Sectoral Operational Program.

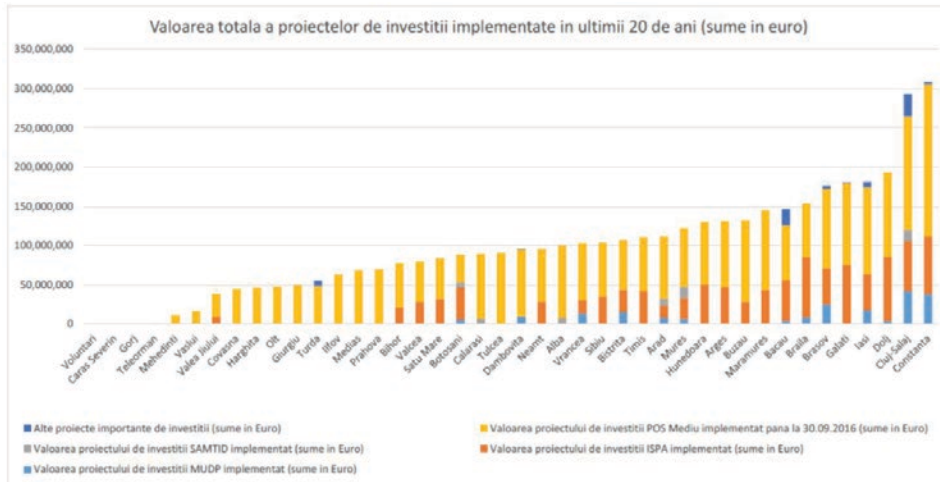
TABLE 4.4. Summary Data for Programs that Have Been Shaping the Romanian Water and Sanitation Sector

WSS investment program	Key features
MUDP 1 and 2	Respectively 5 and 10 municipalities, financed with loans from EBRD (120 million Euro, representing 50%) and grants from PHARE and state budget (50%)
Water Supply in Rural Areas	Through Governmental Decision 687/1997 and financed via external loans guaranteed by the Government (875 projects with a total approved value of 300 million USD)
ISPA	Water and sanitation projects in urban areas (26 projects) financed with 75% with EU grants and 25% with co-financing loans from EBRD, EIB and KfW
SAPARD	Rural water and sanitation infrastructure: 55 projects with a total value of 43 million Euro
SAMTID	Water infrastructure in small and medium cities. The total value of the project was 380 million euro (50% grant financing—PHARE and 50% debt financing from EIB and EBRD)
SOP Environment	Covering 42 regional operators with a total approved investment value of 4.1 billion Euro.

Source: BDO 2016.
Note: EIB = European Investment Bank; ISPA = Instrument for Structural Policies for Pre-Accession; MUDP = Municipal Utilities Development Program; SAMTID = Small and Medium Town Infrastructure Development; SAPARD = Special Accession Program for Agriculture and Rural Development; SOP = Sectoral Operational Program.

There have been large discrepancies in access to WSS financing for investment between WSS services providers over the past two decades. As already mentioned, small local operators (*communa* and SRL) had limited access to investment financing in the past, and currently can only access limited PNDR funds with an allocation which is well below the needs, considering the low access rate to WSS services in rural areas. But there has also been a

FIGURE 4.31. Total Allocation of WSS Investments by County



Source: MWF.

considerable imbalance in access to investment financing for the regional operators (ROCs), as shown in the figure 4.31. While the two largest allocations have been for the two largest utilities in Constanta and Cluj, the differences between other utilities cannot be entirely explained by their relative sizes.

The financing of WSS investments under large private operators (Bucharest and Ploiesti) represent a special case. For the Bucharest concession, Veolia provided 35 million euros in equity, and the bulk of the 270 million euros investment in 2000-07 was financed through commercial loans, although some funding was also obtained from development banks.[27] The Municipality of Bucharest succeeded in accessing EU funds to finance the Glina WWTP (operated by the private concessionaire) via ISPA financing (approximately 105 million Euro) and then via SOP Environment and LIOP (approximately 416 million Euro). The first phase of the Glina WWTP plant was financed by a grant from the EU, loans from the EIB and the EBRD, as well as government funds.

4.4.2. Absorption of EU Funds by Regional WSS Utilities Has Been Slow

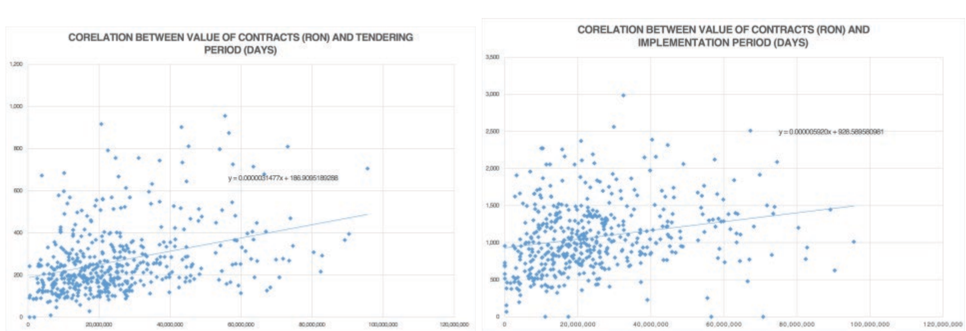
Grant funding from the European Union has so far represented the main financing source in water and sanitation infrastructure for Romania in the past decade. These investment projects were prepared and financed under the provisions of the Sectoral Operational Program Environment (SOP Environment) for the programing period 2007-13. The total approved value of the program was 18.5 billion lei (about 4.1 billion euro), consisting of 210 service contracts (technical assistance, supervision, and audit) and 644 civil works contracts, benefiting 42 regional operators. The first financing contracts were signed in 2007 and most of the investments were finalized by the end of 2015.

The implementation of SOP has proved a major challenge for the WSS sector, even though the grant component represented 90 percent of total capex,[28] with 10 percent co-financing from the ROCs typically financed through loans from EBRD and commercial banks. A 2015 report by the European Court of Auditors on implementation of EU-funded wastewater investments for the 2007–13 period reviewed the performance of Romania as well as Hungary, the Slovak Republic and the Czech Republic. While all countries had failed to absorb all allocated funds, Romania was found to be by far the worst performer, with only 954 million euros implemented out a total of 4.4 billion euros—that is, an absorption rate of only 21 percent. In comparison, the absorption rates for Hungary, the Slovak Republic, and the Czech Republic were 28 percent, 46 percent and 87 percent respectively.

One main bottleneck for the implementation of SOP 2007–13 has been the lack of institutional capacity of the ROCs, given the size and complexity of investment projects. The regional utilities had just been established and were engaged in parallel in a politically challenging process of expanding in rural areas with local authorities joining on a voluntary basis. Also, the WSS sector had never had to implement a national investment program of this size. Regional Operators created special Project Implementation Units (PIU), with an average size of 15 employees, to implement the investments, but these new departments had to be trained and nurtured, and faced multiple practical challenges for implementing the various projects.

The tendering process proved difficult and challenging and generated a lot of delays. The main criterion used to award the contracts was the lowest price, which created quality of the works problems during the implementation phase. The main statistical figures related to the tendering process are worth reflecting upon, because they underline the considerable delays. The average period for each ROC between signing the financing the contract with SOP and signing all the works contracts was about 3½ years. The average time for tendering a civil works contract was about 10 months. It is worth noting that the ROCs adopted different approaches for grouping civil works into individual contracts, with the number of civil works tenders for each ROC ranging from 6 to a maximum of

FIGURE 4.32. SOP 2007–13: Correlation between the Value of Contracts and Time for Tendering (Left) and Time for Implementation (Right)



Source: BDO 2016.

43 contracts. Most contracts had values below 30 million RON. Figure 4.32 shows the large variations in the duration of the tender processes, which in some cases exceeded 2 years even for small contracts.

The other main bottleneck was the local construction industry, which was sometimes overwhelmed. As a result, the construction phase of the SOP projects was also challenging and suffered delays. This is not surprising considering the high number of contracts that had to be implemented in parallel, leading to delays in implementation and to tension between the regional operators and construction companies which were stretched to their limit. Also, many construction contractors were in a weak financial situation in the aftermath of the financial crisis, and had sometimes tendered with low prices in order to get the contracts. Statistical figures underline the considerable delays. The **average period between signing a construction contract and completion of the works was 3 years**—which is considerable considering that most contracts had values of less than 30 million lei (less than 7 million euros). Figure 4.32 illustrates the wide variation in the duration of contracts implementation, irrespective of the value of the contracts.

As a result of these delays, it took for each ROC an average of 292 days to spend 1 million euro of SOP funding. This is long and underlines their limited capacity for swift absorption of EU funds. Many contracts which were not finalized during the programming period had to be moved for financing in the new programming period 2014-20 (about 2.3 billion RON).

Still, the implementation of SOP 2007–13 achieved considerable improvement in WSS infrastructure. While the previous ISPA program had focused mostly on rehabilitation of existing infrastructure, the SOP program carried out major investment for expansion of access to WSS services. Overall, a total of 131 water treatment plants were built or rehabilitated, together with 172 wastewater treatment plants. The rehabilitation and extension covered 5,000 km of water networks and 6,500 km of wastewater networks. The program also strengthened the investment execution capacity of regional operators and prepared them for preparing and implementing larger scale investments in the future.

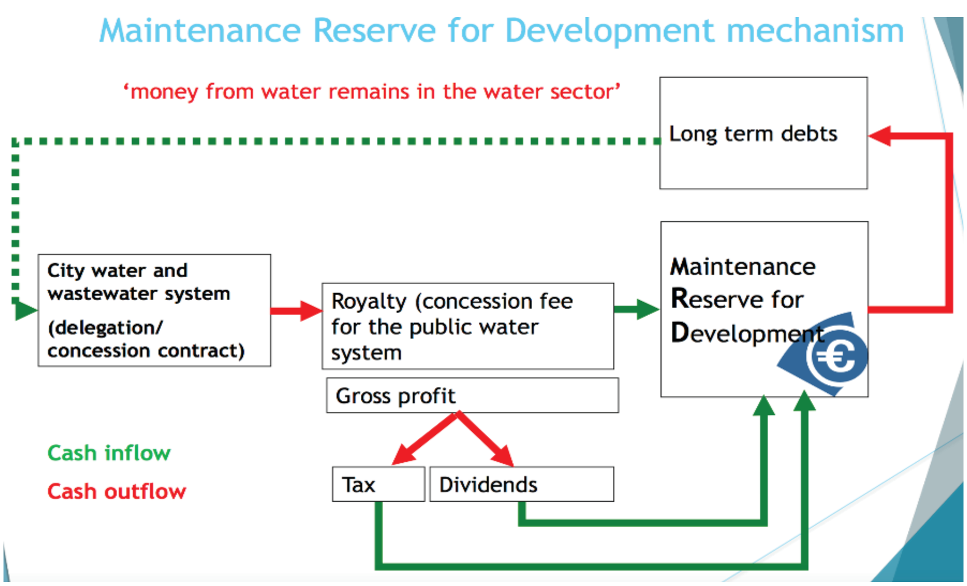
4.4.3. Ensuring Financial Sustainability: Tariff Setting Policies, Co-Financing and MRDF

Medium-term tariff strategies have been the backbone of the new WSS financial framework based on achieving full cost recovery for both O&M and capex. As part of the regionalization process and considering the feasibility studies for the investment projects financed from SOP Environment, each regional operator with the assistance of consultants prepared a medium-term tariff strategy covering a period of 4-7 years. The design of these tariff strategies has been based on the following principles: (a) unified tariffs for each regional utility, based on the solidarity principle, (b) taking into consideration the impact of the new investments on revenues and operating and maintenance costs (business plans); (c) each tariff strategy is approved by the local authorities (IDA), and is annexed to the financing contracts for SOP Environment, with implementation mandatory, thereby mitigating the risk of local political interference.

These tariff strategies have been implemented smoothly, ensuring the coverage of both O&M costs and the repayment of contracted debt for most regional operators in the past decade. The regional operators are currently preparing their new medium-term tariff strategy, but none has yet managed to finalize and agree on specific proposals with the local authorities. The regional operators are awaiting the feasibility studies for the investments financed from LIOP to design new medium-term tariff strategies—to facilitate acceptance by local authorities—but unfortunately most are delayed, and only 3-5 projects (out of 43) are expected to be finalized and approved by the end of 2017. It is to be expected that further tariff increases may stretch the political consensus and raise issues of affordability for the poor households, especially in rural areas.

Co-financing of EU funds is undertaken by local authorities, but there is no clear framework for covering corresponding debt repayment through tariff. In the Romanian terminology, "concession fees" are paid by ROCs to local authorities for covering the debt they have to contract for the co-financing of the EU funds, since the infrastructure assets are held on the books of the local authorities and not of the ROCs. Yet, there is no clear framework for setting and structuring such concession fees. In practice, various approaches have been used including a percentage of turnover (e.g., 1 percent), a volumetric charge per m^3, or negotiated specific formula between local authorities (often linked to equivalent depreciation of assets. Depending on each regional utility, the concession represents from less than 1 percent up to 18 percent of operating revenues. EBRD has provided loans based on commercial conditions (limited

FIGURE 4.33. **Mechanism of the MRDF**



Source: BDO 2016 and T. Popa.
Note: MRDF = Maintenance, Replacement and Development Fund.

recourse non-sovereign lending) for the co-financing of EU grants to a total of 23 ROCs during SOP 2007-13, for a total amount of 330 million euros (15-year maturity with 4-year grace).

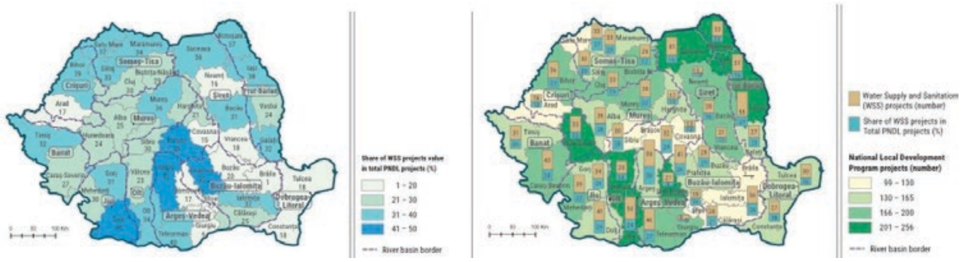
The Maintenance, Replacement and Development Fund (MRD Fund) has been a key feature of the WSS financial framework in Romania for the past decade (figure 4.33). It is a reserve cash account the purpose of which is to ensure that the regional utilities are forced to set aside sufficient funds to guarantee their debt obligations linked to investment programs. It was initially introduced in the Romanian sector in 1995-97 by EBRD for the MUDP projects, and the obligation create the fund was introduced in the national legislation for all operators that benefited from the EU funding starting in 2005. Currently all the regional operators have created and are using this fund.

The ring-fencing mechanism of Maintenance, Replacement and Development Fund (MRDF) is based on capturing various sources of funds at RIOCs level to guarantee their debts repayment. It is presented in figure 4.33. Sources of funds can include dividends, income taxes, profit sharing, concession fees, interest on the cash balance and other sources chosen by the local authorities or by the ROC. The MRDF funds are used for repayment of the debt service to co-financing loans, as well as directly financing small investments in line with the approved investment plans. It is estimated that the largest ROCs currently have more than 10 million euros in their respective MRDFs. In the opinion of many stakeholders, the creation of the MRDF was a reform decision that had one of the most positive impacts on the sector, by creating a financial discipline among the operators, increasing bankability and creditworthiness through a transparent and clear debt repayment mechanism, and by increasing transparency in performing investments from own sources.

Financing of WSS investments in rural areas not served by ROC has been largely insufficient. The 2017 WB household survey on WSS in rural areas sheds some light on the situation with the financing of WSS systems operated by local authorities in rural areas. Approximately 77 percent of *communa* in the sample reportedly spent funds on WSS related activities (for the past fiscal year), mostly coming from their own budget. Only 40 percent received some form of support to implement their mandate for WSS service delivery, mostly financial (58 percent) or technical (17 percent). Half of the communes surveyed indicated that there were no capital investments made in the past fiscal year—a worrisome situation considering the considerable access gap in rural areas. Overall, funding allocations for WSS expenditures, both capital as recurrent costs, are low, equating to around 6 euros (27 lei) per capita per year. Local authorities consistently (77 percent) named the lack of funds to increase access to WSS as a key problem, though complicated procedures for fund applications and slow delegation of services to ROCs were also mentioned.

The PNDL program provides significant investment funds for local authorities, but only a small portion of small local WSS operators appear to be benefiting. A review of PNDL allocation for WSS investment by county has also shown considerable territorial discrepancies, as seen in map 4.6. Although PNDL 2015-19 projected allocations are mostly directed to rural areas, it is likely that these funds are mostly spend in small towns within larger communes, as three

MAP 4.6. Share of WSS in PNDL Projects by County



Source: World Bank's elaboration based on PNDL data.

quarters of funds are allocated to sewer and wastewater treatment capacity. PNDL resources allocated to improve drinking water services are spread thinly across the country and may thus sparsely reach the smaller communes served by Communal and SRL-type operators serve. Such rural communes thus remain largely unable to renovate, expand and upgrade their water systems to solve the access gap.

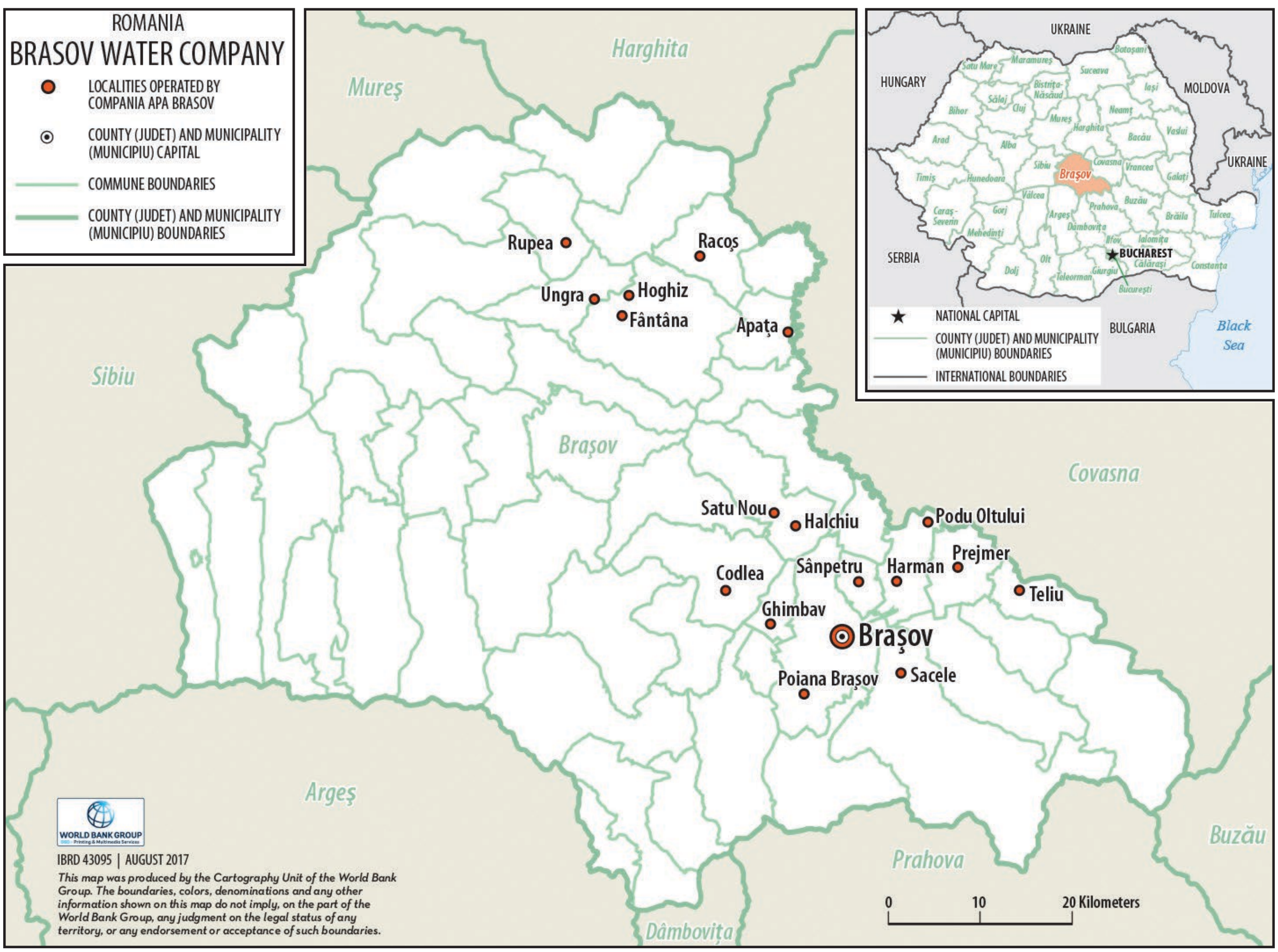
4.5. Further Steps in WSS Reform Would Need to Address Several Bottlenecks

The regionalization approach adopted in 2007 and carried out in parallel with commercialization of newly established regional public utilities may have now reached its limits. While the regionalization process, together with commercialization, has been successful over the past decade in establishing a number of relatively well-performing regional utilities, this has been largely done by focusing on large urban areas. This is entirely understandable, and is due both to the resistance from households and local authorities is rural areas, and the need to prioritize infrastructure investments given the limited budget and execution capacity of the utilities and construction sector. Still, this means that many rural areas—which represent in total about half of the Romanian population and concentrate most of the poverty—have been largely left out of the WSS reform so far.

There are today several large and relatively well-performing Romanian WSS utilities, with a healthy financial situation and sufficiently creditworthy to be able to borrow on commercial terms (complementing EU grants)—**but the focus on promoting creditworthiness and commercial borrowing has also created incentives for the ROCs to avoid taking over rural WSS services**. The original idea behind the regionalization, in addition to promoting economies of scale and a more professional management of utilities, was also to promote financial solidarity at county level through cross-subsidies, as well as integrated water resources management to generate environmental and public health benefits. Given the current access gap for potable water in rural areas (about 5 million people without access) and slow implementation of the UWWTD in agglomerations of less than 10,000 PE (about 15 percent), this is clearly not happening as originally envisaged when this policy was decided upon in 2007 by the Romanian Government and the European Commission.

This is well illustrated by the case of the Brasov regional utility BSW, which is widely seen as one of the best performing Romanian WSS public utilities, well managed and in a healthy financial situation. It serves about 350,000 people in Brasov country, and was established in 2008 with the municipality of Brasov and six other localities. It has since then adopted a very cautious strategy for expansion—serving now a total of 15 cities and towns. It made the deliberate choice to focus on localities that had functional water supply and/or sewerage systems, or where investments were to be implemented (i.e., available funding in the short term) and where the service could be enhanced and tariffs could be increased at the same time. Where assets were dysfunctional, the expansion of service area was delayed. BWC also refused to take over

MAP 4.7. Brasov Water Company



Source: Popa and Salvetti 2017b.

all former staff from the municipal services.[29] At the same time, many localities in the Brasov county have their own local operators, and were reluctant to join the ROC as they did not feel pressure to invest in wastewater treatment and incur the associated tariff increases. The result is **a healthy public utility, operated according to commercial principles, sufficiently creditworthy to be able to borrow on commercial terms** (without a sovereign or local governments guarantee) for some of its investments—**but also one that serves only a small portion of the county it was supposed to cover**, since most of the municipalities have not been incorporated (map 4.7).

Another crucial—and parallel—issue to be addressed is the resistance from small rural municipalities to embark on the regionalization process—joining an IDA and delegating their WSS services to a ROC. This has been reinforced by recent decisions of several local governments to leave IDAs. The underlying motives are complex—including lack of attention from some ROC management for rural customers, unwillingness of the local politicians to relinquish control, excessive expectations regarding services improvement, insufficient funding available for investment, and concerns about tariffs. Yet, **it is clear that moving into the next phase of regionalization will require addressing the concerns of rural municipalities and the local rural populations**, and dealing with the underlying political economy and incentives of the various actors. Many valuable lessons can be learned from other European (e.g., Portugal, Italy, Greece, France, The Netherlands, the Slovak Republic, Hungary) and other OECD countries that have embarked on aggregation processes. **To further consolidate the regionalization process it will be critical to look for creative solutions** to serve all types of rural customers and find ways to incentivize the ROCs into serving remote villages.

Closing the potable water access gap—which is both a major poverty inclusion and public health issue—should become a national priority and will require new ambitious policies for rural areas. Even though progress has been made recently, at the current pace, Romania would be able to achieve universal access by 2040 at best—which is clearly unacceptable for an EU member state. Furthermore, it is expected that the EC will soon revise the Drinking Water Policy (DWP), and include possible obligations related to access to potable water—which would make it a legal obligation for the country to close the water access gap, just like with compliance with the UWWTD. While expanding potable water coverage in rural areas is partly linked to fostering the regionalization process, it will also require addressing issues such as identifying potential alternative institutional models for providing WSS services in small and remote rural settlements (possibly with some form of technical support from ROCs), appropriate policies for tariffs and investment financing in rural areas (including subsidies from the national budget), and dealing with the ingrained practices of self-supply through private boreholes.

Introducing social water tariffs targeted at the poor needs to start being considered in Romania. Many other EU countries—namely Spain, Italy, Portugal, France, Belgium, Greece, Malta and England—have started putting in place social water tariffs targeted at the poor over the past decade, in reaction to growing affordability gap for poor households to pay their WSS bill in a context of rising tariffs. These schemes typically involve rebates or the provision of some free baseline volume of water to targeted families.[30] The analysis presented previously outlined that water bills affordability is starting to be a concern for poor households in Romania, the only reason why it has not yet become a major issue being that a large portion of the poor do not have access to piped potable water, and even more have no access to sewerage services. At the same time, affordability is probably the main reason why many households are refusing to connect to newly installed water or sewerage networks—affecting compliance with the UWWTD—and why many rural mayors are resisting joining an IDA and ROC. The current affordability threshold used for tariff setting by the national regulator is based on average disposable income and does not protect the needs of the poor. In a context of future tariff increases and growing pressure to close the rural WSS access gap, the introduction of some form of targeted subsidies to help the poor pay their water bill will become an important topic.

Compliance with the UWWTD must become a priority for the Romanian authorities, and in the face of an impending infringement procedure from the EC, it is to be given full attention. The interim 2013 and 2015 deadlines for agglomerations above 10,000 PE have not been met, and it is clear that the ultimate 2018 deadline for full compliance will not be met either. As a consequence, the country is at risk of an impending infringement procedures from the EC. While much has been done in large urban areas to expand sewerage networks and construct new WWTP (and the compliance rate in agglomerations above 10,000 PE should rise in the next 2 years as many ongoing civil works are completed), very little has been done in smaller agglomerations and rural areas even though they generate about a quarter of the total sewage pollution load. While the challenges of implementing the UWWTD are partly linked to those of the regionalization process (ROCs lacking incentives to expand in rural areas), the specific issues related to agglomerations below 10,000 PE should be addressed, with the development of a national rural sanitation strategy that would *inter alia* optimize the use of IAS and identify appropriate technical and financing solutions for sewerage collection networks and small wastewater treatment plants. The impeding infringement must also be addressed by specific actions including updating the 2004 UWWTD action (with optimization of the cost of compliance) and putting in place a reliable database in order to be able to monitor future progress together with the EC.

Finally, the **most needs to be done to support further improvement of the operational performance of the ROCs—which is still far from matching the performance of water utilities in other EU countries**. The focus over the past decade has been on the implementation of large investments financed by EU funds. While most of them have taken advantage of rising tariffs to be able now to turn some financial profit, it is important that the greatest emphasis be put on improving their operational indicators, especially if further efforts are to be requested from the population with future additional tariff increases. There are considerable variations in performance indicators among regional utilities. Unfortunately, the confidentiality surrounding the national benchmarking exercise does not enhance accountability and limits potential pressure on poor performers. Regarding the high level of NRW—which is probably the single most important performance indicator for a water utility—utility practitioners seem to be hiding behind the excuse that dealing with water leakages is a long-term and costly task, ignoring the fact that a large portion of NRW is due to commercial losses that have a fast payoff and can generate significant financial benefits in the short term. Many new master plans under preparation include activities aimed at improving operational performance—but providing financing for efficiency improvement, albeit a necessary first step, will not be sufficient unless the proper incentives are put in place.

In parallel, **the regulatory framework needs to be nurtured further—continuing to strengthen the capacity of the national regulator ANRSC**. Experience in other countries shows that establishing a credible and solid WSS regulator is a complex and long term process, and the national WSS regulator ANRSC would benefit from further institutional strengthening. This is important as further tariff increases are expected in the future, as the WSS utilities will gradually need to finance a larger portion of their investment needs through revenue collection. As the next tariff period should start including depreciation of existing assets (at least partly) in the calculation of allowable tariff levels, enhanced monitoring and proper incentives will need to be introduced in parallel to ensure that the utilities use these additional resources efficiently.

Notes

1. For instance, there is no framework for setting the "concession fees" paid by ROCs to local authorities for the use of their assets and the right to deliver WSS services in their respective territories.
2. Carried out as part of the 2017 WB study on access in rural areas, based on publicly available information (on websites) and supplemented with interviews. ROCS were requested to provide information on which communes were part of the IDA and which communes were actually served by the ROC under a delegation contract.
3. In January 2017, the Romanian Government issued a document "Instructions regarding the application of the provisions of the law on community utilities #52/2006". These instructions refer to the procedure to be followed if a commune wants to withdraw from an IDA. Among other provisions, it mentions that the request of the commune must be thoroughly justified and that the commune has to pay back all investments made with interest and has to cover all damages caused by its withdrawal.
4. This map is based only on county boundaries which were supposed to correspond to the areas of service of each ROC. In practice, it must be noted that some ROCs are providing WSS services outside of their initially envisaged county boundaries. This is the case for instance for Constanta that serves localities is seven counties.
5. The changes to Law 241 (Law on Water and Sanitation Service) made in 2015 introduced the obligation for the customers to connect to the existing public wastewater networks if they don't have WWTPs that respect the environmental legislation. After 3 months of commissioning a new network in a street, the ROC can start charging the sewerage tariff regardless of whether the households are connected or not. Some have started doing so but it creates problems with local politicians and IDAs.
6. Source: "Impact of regionalization on the financial performances of the operators," BDO Business Advisory, 2017.
7. As per the latest 2016 estimate for the national poverty line, estimated at 122 euros per capita per month for 2016.
8. Commission guidance refers to four percent of household income as a commonly accepted affordability ratio, as per "The new programming period 2007-2013—Guidance on the methodology for carrying out cost-benefit analyses - working document No 4," 8/2006.
9. Even this figure is a rough estimate, considering that the actual size of the population living in the country is unknown with more than 3 million Romanians estimated to have left abroad in search of employment.

10. Although in countries without a national water regulator—including large ones such as Germany, Poland, Spain or France—public access to performance data from utilities is not necessarily easier.

11. Considering the high deterioration of water distribution networks in Romania, the NRW figures below 30-35 percent reported by some ROCs are subject to caution. Furthermore, customers' metering is not yet universal for all utilities, and there are concerns about the quality of reporting by some of them.

12. Apparent losses and real losses respectively, in the International Water Association (IWA) terminology.

13. The NRW situation is even worse in rural areas with systems operated at the local level—but there is no reliable data. Based on the 2017 WB household survey of rural areas, technical management for rural networks is extremely weak among local water operators, as none of the *Communal operators* and only one in five SRL-operators were able to provide NRW figures (likely under-estimated, being usually around 25 percent). Even in the case of ROCs, only half could produce NRW estimates for their stand-alone rural systems.

14. The majority of operators started internal measures to verify the accuracy of the data and implemented procedures for allocation of losses between production, transport and distribution activities.

15. Some of the operators have decided to include extensive water network rehabilitations in the feasibility studies for works to be financed from Large Operational Infrastructure Program (LIOP).

16. In 2015, the ROCs invoiced a total of 573 million m^3.

17. ROC employees have legal limitations regarding the possibility of adjusting the salaries (regional operators are assimilated with public entities and have legal boundaries for salary increases).

18. The current level of the national minimum average gross salary is 1,450 RON/month while the average gross salary in the water sector is close to 3,100 RON/month. The national minimum average gross salary increased from 2013 until 2017 by 45 percent while the average gross salary in the water sector increases by 12 percent between 2013 and 2016. Pressures are expected in the future from unions for the water sector to match the national trend.

19. The legal due time for payment of WSS without penalties is 45 days. After that, the utility has the right to disconnect service following a 5-day prior written notice.

20. Implementation of tariff strategy before the finalization of the investments (and recording the impact of additional operating costs) allowed the operators to accumulate cash resources which were used to solve operational problems.

21. EBITDA: Earnings before Interest, Taxes, Depreciation and Amortization.

22. For instance, it did not have a module for investment implementation from different sources, and some area of analysis was of no interest to the operators but required a lot of work to produce the data (e.g. split of balance sheet for water and sanitation activity, calculate the area of supply in km^2).

23. For instance, indicators related to SOP financed investment implementation, and different definition for EBITDA considering the MRD mechanism.

24. DWD court of auditors.

25. The management of the two large investment programs for water and sanitation infrastructure—LIOP and PNDL—has just been consolidated through the creation in January 2017 of the Ministry of Regional Development, Public Administration and European Funds (MRDPAEF) through the merger of the former Ministry of Regional Development and Public Administration with the Ministry of European Funds.

26. with thus far 134 projects equivalent to 0.2 billion euros under construction.

27. with two loans for the new Crivina WWTP from EBRD (55.4 million Euros) and German DEG (18.5 million Euros).

28. The total grant amount was split among financing sources the following way: 85-88.16 percent from the EU, 10.16-13 percent from the state budget and 1-2 percent from the local budgets.

29. Although the model of delegation contract prepared by the Environment Ministry advocated for transferring all staff to the incumbent, BWC managed to transfer only a small number of operational staff in each case. Administrative tasks were absorbed into the existing organizational chart of the company.

30. As opposed to the provision of some free or discounted volume of water per connection to all domestic customers regardless of income level or vulnerability—which is common is some countries and sometimes wrongly called "social tariffs."

Chapter 5 Water for Irrigation: In Need of a National Strategy

This chapter looks at the situation and perspective of irrigation services in Romania. It presents the large (about 3 million hectares) irrigation perimeters developed before the 1990s to serve a large state farms infrastructure. Mostly located on the rich arable lands of the lower Danube area, they are the largest irrigation perimeters in the Central and Eastern European countries. This chapter discusses the major structural reforms that have been implemented over the last 25 years—in particular, the fragmentation into small farms and switch to cost recovery tariffs (for O&M)—and that have led to a drastic (almost eightfold) fall in demand for irrigation water. It analyzes what has been driving the economic viability of irrigation schemes in recent years, leading to many irrigation perimeters being abandoned (for lack of viable demand) and their subsequent deterioration. Finally, it discusses the future of irrigated agriculture in Romania in a context of climate change—with increased drought risk and the establishment of a semi-arid climate in the lower Danube area—and presents current figures on the investments needed to rehabilitate the most viable infrastructure.

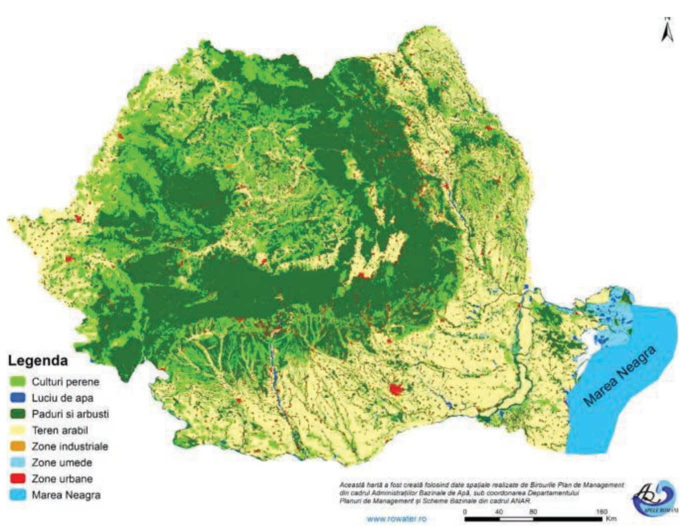
5.1. A Legacy of Large Irrigation Infrastructure Built Before 1990

5.1.1. Irrigation Plays a Major role in Some Parts of Romania

Agriculture is an important economic sector for Romania. Romania has a total of 15 million hectares of agricultural land, two thirds of which are arable, giving the agricultural sector considerable potential to produce a commercially viable and diverse mix of temperate crop and livestock products. Historically, agriculture was the basis of the country's economic growth and prosperity in the early 20th century, and during the communist regime Romania was a key food producer within the Eastern bloc. Map 5.1 shows the repartition across the country of arable lands (major crops including cereals, vegetables, and forages), perennial cultures (fruit trees) and forests. At the end of the 1980s, Romania had the third largest irrigation surface in Europe, coming close behind Spain and Italy.

During the early 1990s, the land reform dismantled about 5,000 state and collective farms and restituted the land to the

MAP 5.1. Map with Locations of Arable Lands (Yellow), Perennial Cultures (Green) and Forests (Dark Green)



Source: ANAR 2015.

PHOTOGRAPH 5.1. Irrigation in Romania: Sprinkler Irrigation and Open Canal

Source: Gabriel Ionita.

original owners—resulting in an extreme fragmentation of the agricultural sector. As a result, about 4 million small private farms, with an average size of 2.3 hectares, emerged. Since then, a slow but steady process of farm consolidation took place resulting in a transfer of about 70 percent of arable land to large and mid-size farms, commercially oriented and managed by professionals and having access to financial resources. These farms have also gradually accessed the financial resources made available under the National Program for Rural Development, investing in new farm technology and machinery. However, a large number (over 2.6 million) of small, subsistence or semi-subsistence farms continue to exist, with low productivity and aiming mostly at self-consumption. With this farming pattern, **Romania has the largest number of farms in the EU, accounting for about 45 percent of the total number of farms in all 28 EU member states**.

Irrigation is vital to Romanian agriculture (photograph 5.1). First, it is necessity in order to offset rain deficits in the country's semi-arid southern and eastern regions of the lower Danube plains. While average annual rainfall for the country is 750 mm, the average rainfall in the southern and eastern regions is less than 500 mm (the typical upper bound of semi-aridity), with uneven seasonal distributions (less than 20 percent of rainfall in summer). The water demands of crops in July-August are 300-500 mm, leaving a crop water deficit of some 200-350 mm—making irrigation a must for most summer crops, such as maize, vegetables, sugar beet, sunflowers, potatoes, and alfalfa. Irrigation also minimizes the climatic risks affecting agriculture, ensuring the stability in production necessary for commercial farming. It can also encourage private farmers in certain areas to convert to higher value crops, such as vegetables.

Drainage is also important to Romanian agriculture because the arable lands in flood plains along the Danube River and other rivers can become waterlogged, especially in the spring, when river flows are at high levels. Along the Danube, the embankment works along 1,200 km of Romania's northern riverbanks allow over 450,000 hectares of low-lying land to be sustainably cultivated. Also, drainage is critical for the flat lands located in the Western Romania, where heavy clay soils prevent natural drainage of excess water from rain and snow.

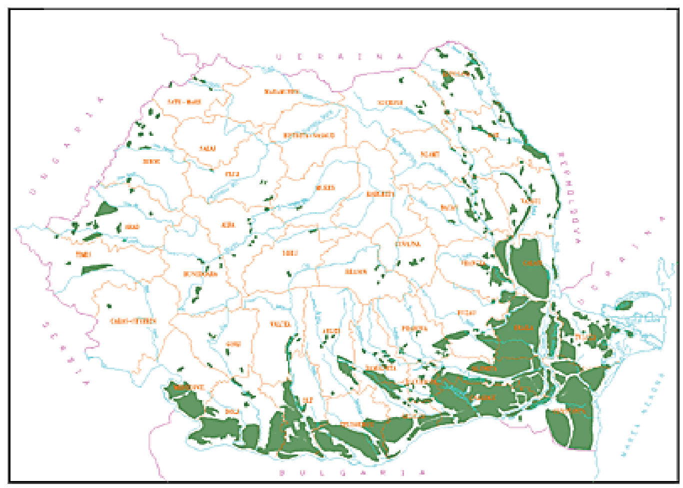
A considerable number of irrigation schemes were developed in the past—mostly concentrated on the lower Danube in the Southeast of the country. During the socialist regime

PHOTOGRAPH 5.2. **Views of Irrigation Canals in Romania**

Source: Wikimedia and Romania Insider.

irrigation facilities consisting of 247 large schemes and 125 small, local (under 1,000 ha each) schemes covering just over **3 million hectares (about 30 percent of arable land)** and worth around US$10 billion (if converted to current values) have been developed, located mainly in the south and east (map 5.2). Typical views of these canals are shown in photograph 5.2. The large schemes cover a total area of 2.96 million ha, while the small schemes have a total area of 59,500 ha. Most of these facilities were developed during the 1960s and 1980s, when irrigation was centrally planned and supply-driven, and economic[1] and environmental implications were often ignored. **The overwhelming majority of these schemes relied on pumping water** to high terraces of the Danube and other internal rivers in the southern and eastern regions, many with high pumping heads, and operated using subsidized electricity, with little regard for cost efficiency. However, **an area of about 245,000 ha is supplied by gravity**, either in independent schemes or in the lower parts of pumped schemes. As for the small schemes, they are fed both by gravity and low pumping in equal shares.

MAP 5.2. **Spatial Distribution of Irrigation Schemes in Romania**



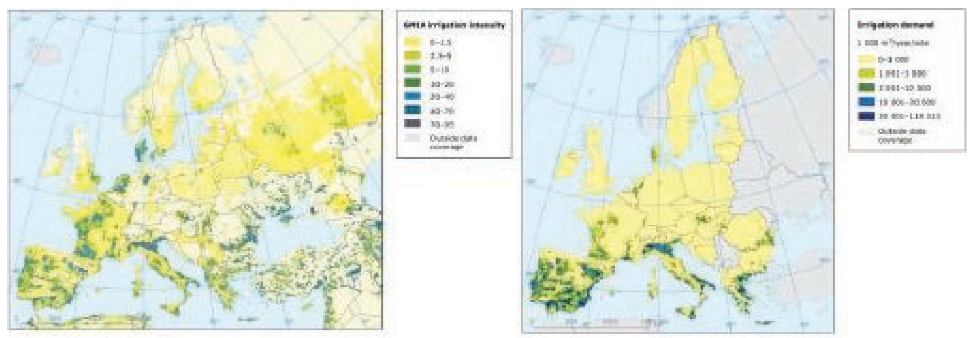
Source: ANIF.

Romania has by far the largest irrigation infrastructure amongst EU-13 countries (map 5.3). The extent of irrigation infrastructure that was developed in the past in the lower Danube area is close to those in place in the large irrigated regions of Italy (plain of the Po River), France (plains of the Rhone, Garonne and Loire Rivers), Spain (Guadalquivir), Portugal and Greece. It is also larger than the total irrigated area in the neighboring Ukraine. Irrigation management in Romania is therefore of special importance not just nationally but also in the overall European context.

5.1.2. The Economics of Irrigation Changed Drastically After 1991

The economics of irrigation depend on a number of factors, such as pumping height, irrigation intensity (percentage of total area), and cropping patterns. When the communist regime ended,

MAP 5.3. Percentage of Areas Equipped with Irrigation (Left) and Irrigation Demand across Europe (Right)



Source: EEA 2009.

this was affected in many ways. For example, the existing irrigation schemes that had been designed to serve large state farms needed to be adapted to serve a large number of small farms. However, when the large state and cooperative farms were dismantled, much of the irrigation equipment was damaged, vandalized, or simply disappeared. In addition, the liberalization of electricity prices led to huge increases in pumping costs, and the collapse of state and collective farms and the subsequent emergence of small private farms resulted in a loss of scale for commodity crops. Consequently, after 1990, when the largest area ever was irrigated (about 2.1 million ha), because irrigation was free, **the irrigation area declined sharply and never returned to more than 30 percent of the total equipped area**. Nevertheless, the main and secondary irrigation infrastructure (pumps and canals) serving the respective areas had to be maintained and operated, as there was still irrigation demand (though much lower) from scattered farms.

The economics of irrigation was radically changed after Romania moved towards a market economy. Subsidization of agricultural inputs—including water for irrigation—ceased, and irrigation services became based on cost-recovery principles. As a result, a large portion of the existing irrigation infrastructure became economically non-viable, essentially because of excessive pumping costs which could not be passed to farmers. Technical and economic studies prepared in the past decade by local and international consultants (under the WB Irrigation Rehabilitation and Reform Project) documented that about 1.1 million hectares are currently economically viable and marginally viable (considering the actual prices and market demand) of the total area of about 3 million hectares historically equipped for irrigation. With rehabilitation and modernization, and with significant changes in the cropping patterns (through increasing the share of cash crops) this area could be increased to about 1.54 million hectares (considering also adequate changes in cropping patterns), as shown in table 5.1 and map 5.4.

The majority of the viable and marginally viable areas are located in the southern counties along the Danube, with very small areas located along the Prut and the Mures Rivers. However, it is important to discuss the share of viable and marginally viable areas in the total area equipped. There are counties where (very) large areas have been equipped, such as Constanta, Giurgiu,

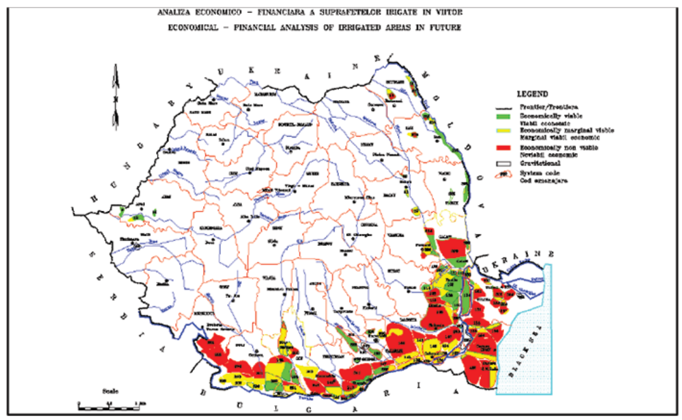
TABLE 5.1. **Viability of Irrigation Schemes (ha)**

	Current	Future (with rehabilitation)	Change
Viable	504,814	709,161	+204,347
Marginally viable	597,203	827,376	+230,173
Unviable	1,863,392	1,428,872	−435,520
Total large schemes	2,965,409	2,965,409	0
Small schemes	59,506	59,506	0
Grand total	3,024,915	3,024,915	0

Source: Technical and Economic Viability Analysis, DHV, 2009.

Teleorman, and Tulcea but **less than 30 percent of these are viable or marginally viable**. In contrast, in other counties the viable and marginally viable areas' share in total equipped areas exceeds 65 percent, such as Arges, Buzau, Braila, Dambovita, Valcea. A special mention for Buzau and Dambovita, where the entire area equipped is gravity fed and, hence, viable. The detailed information is mapped in map 5.5. The few rehabilitation works carried out in the past two decades were concentrated in the irrigation schemes classified as either viable or moderately viable.

MAP 5.4. **Territorial Distribution of Viable and Unviable Irrigation Schemes**



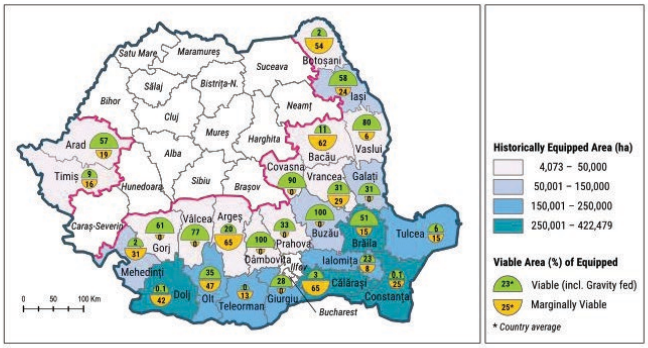
Source: DHV 2009.

5.1.3. Major Reforms of Irrigation Services in the Last Two Decades

Significant institutional reforms were undertaken after 1990 to adapt to the new economic and social conditions. The county-based state enterprises in charge of construction, operation and maintenance (O&M) of irrigation sector have been restructured to separate the construction activities, and the resulting entities have been registered as state-owned commercial companies. Further, the construction activities were gradually transferred to the private sector, while the O&M companies (with a declining scope of activity) remained state-owned until their incorporation, in 1994, into the state-owned "Autonomous Agency of Land Reclamation" (RAIF, in Romanian abbreviation).

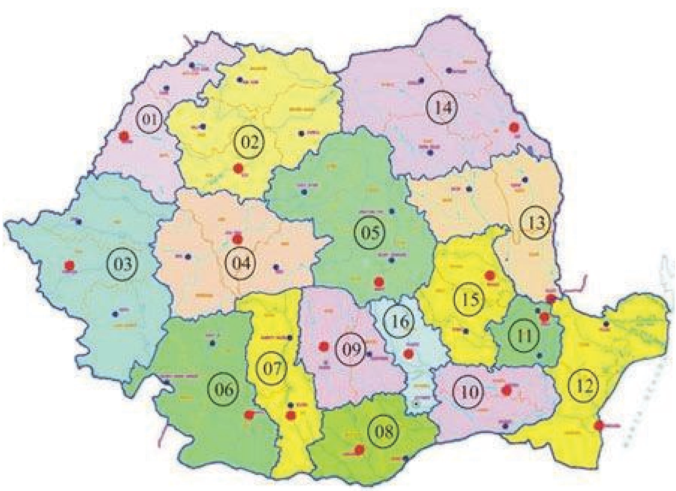
The establishment of RAIF intended to restore the irrigation activity, but it failed to set sound principles for recovering costs from users. Under political pressure, substantial subsidies were allocated every year, while the tariffs for services paid by farmers were set very low, at 10-12 percent of actual costs. The subsidy covered all costs for maintenance and electricity for water delivery to the end field, while the farmers contributed only to the salaries of the National Agency of Land Reclamation (ANIF) field and HQ staff. Even so, the irrigated area only reached a maximum of 622,000 ha in 1996 and 570,000 ha in 2003. In year 2000, the transformation of RAIF into a national company (commercial company of national interest),

MAP 5.5. Viable Areas as Share of Historically Equipped Area, by County



Source: World Bank's own computation based on the data of Technical and Economic Viability Analysis, DHV, 2009.

MAP 5.6. The Structure of ANIF



Source: Ministry of Agriculture and Rural Development—ANIF website.

SNIF, enabled the latter to expand to commercial activities to increase the revenues, including, again construction activities. However, in the absence of clear separation of financial records, the use of state subsidy became difficult to track, leaving room to abuse.

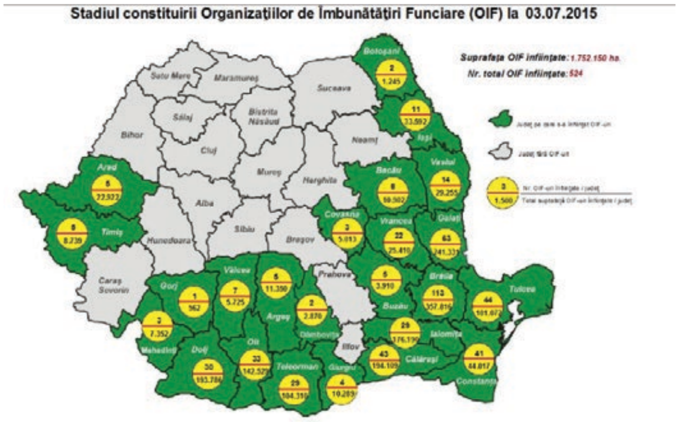
A new and more drastic reform was implemented after 2004, with the establishment of the new National Administration of Land Reclamation (ANIF). As the parliament approved a new law governing the entire institutional organization and function of land reclamation sector (Land Reclamation Law) so as to separate from SNIF the activities of public interest—i.e., management, O&M of irrigation, drainage, flood protection and soil erosion control infrastructure—and transfer them to the newly created National Administration of Land Reclamation (ANIF in Romanian abbreviation). The structure of ANIF included a head office, 12 regional branches and 54 Scheme Administrative Units (SAU) in charge of direct relations with customers. Since then, the ANIF structure and status have changed, it became an "agency" subordinated to the Ministry of Agriculture and Rural Development (MARD). Also, the number of branches and SAU and their coverage changed but, in general, the organizational principles remained the same. Currently, ANIF structure includes 16 branches (with 34 SAUs), as shown in map 5.6.

In parallel with the reform of the public sector, farmers started organizing themselves into entities that could enable better access to irrigation facilities and improved voice in relations with the "irrigation agency." Hence, learning from the experience of other countries with a large sector of small farmers willing to irrigate, private farmers started forming water users' associations (WUAs) based on the specific legislation developed with the World Bank support, in 1999. Further, the provisions for establishment, function, rights and obligations of WUAs and federations of WUAs (FWUAs) have been included in the Land Reclamation Law.

The Water Users Association became able to own and operate the tertiary irrigation networks. A critical change brought by this law consisted in giving to the WUAs a legally established right to get the ownership, free of charge, of the tertiary irrigation infrastructure located on their respective territories: small pump stations, buried pipelines, hydraulic equipment appurtenant to pump stations and pipe network, and field irrigation equipment. With this right, the WUAs became also responsible for maintenance, operation and securing the respective infrastructure. After a slow start, the consolidation process gained momentum after 2005, when the mechanism for distribution of state subsidies changed to target exclusively the WUAs, and more and more farmers were forming WUAs to get access to state financing. Gradually, WUAs obtained exclusive access to other forms of financial support, including the EU funds available under the National Rural Development Program (NRDP) (after EU accession in 2007) for investment in irrigation equipment and rehabilitation or modernization of the infrastructure owned or managed by WUA. In addition, federations of WUAs have been established with the aim to take over the management of parts of irrigation schemes or even entire small schemes.

The establishment of farmers' associations for drainage, flood protection and soil erosion control, called generally land reclamation organizations (LROs), was further permitted (through Law amendment) but only a few LROs have been established for drainage and none for soil erosion control and flood protection. By July 2015, 524 LROs had been established with a total coverage of 1.75 million ha, of which 475 WUAs (1.08 mill. ha), 25 drainage LROs (213,000 ha) and 24 FWUAs (385,000 ha) located as shown in map 5.7.

MAP 5.7. Status of Establishment of Land Reclamation Organizations



Source: Ministry of Agriculture and Rural Development—ANIF site.

5.2. What Is Driving the Viability of Irrigation Services

5.2.1. Financing of Irrigation Services: Establishing Cost-Covering Tariffs

Financing proved to be the most critical factor in determining the demand for irrigation, i.e., crops to irrigate and intensity of irrigation, in terms of volume of water delivered per hectare during a growing season. For pumped systems, the electricity cost to deliver water to fields would be the main component of the total cost of water and its share in total cost would also depend on the energy efficiency of the system. This is the case in Romania where the old schemes have an energy efficiency of about 55 percent and a hydraulic efficiency around 40 percent (because of high water losses in the main water transport network.

During the communist era (until 1989), all farms (both state-owned and state-controlled collective farms—cooperatives) were required, by law, to pay the full cost of irrigation. In reality, only the majority of state farms, having a higher productivity (and guaranteed markets, including export), managed to pay in full the irrigation costs, whereas many (or the majority of) collective farms defaulted regularly and cumulated debt to the local irrigation enterprises. Then, once every five years, the state used to write-off these debts, and the process would resume.

In 1990, the new government decided initially to make the irrigation services free of charge for all farming systems. The underlying rationale was to give the rural population a sense of the "changing society," but this decision proved unfortunate as it instilled a sense of entitlement to free irrigation water. Two years later, after the land reform started with restitution of agricultural land to previous private owners, the state irrigation enterprises had been restructured into commercial companies, and the government ceased the irrigation subsidization. Thus, the irrigation demand dropped abruptly (stimulated additionally by the liberalization of electricity price), the irrigation companies deferred infrastructure maintenance, which started depreciating, and the perspective of a fast sector disarray arose.

Uniform irrigation tariffs across the country prevented a focus on the most economically viable areas. With the establishment of the state-owned RAIF, in 1994, the subsidization of irrigation resumed, in absence, though, of rules to promote efficient use of financial resources. Irrigation tariffs were set up for each county regardless of the actual costs to deliver water from the source to the field, which are determined mainly by the location of farms (i.e., irrigation scheme and pumping heights). This means that subsidies had to be used to finance the entire costs (except the staff salaries) and that less efficient schemes in the higher terraces required higher subsidies for operation. These enabled farmers to continue uneconomic irrigation both in the higher terraces, which required more energy due to higher pumping heads, and in schemes with high water losses. Indeed, these areas absorbed the greater part of the state subsidy without bringing a return to Romania's economy. During 1996–2004, about US$300 million, was spent to subsidize irrigation at an average annual rate of about €40 million, but only 280,000 hectares were actually irrigated, on average, annually (about 10 to 16 percent of the total area covered by irrigation facilities), with peaks of 622,000 ha in 1996 and 569,000 ha in 2003. The farmers were charged a small fee to cover only a fraction of the man power required to operate the infrastructure (pump stations mechanics and water masters).

It was vital to reform the irrigation pricing and subsidy policies. The reform, enforced through the Land Reclamation Law (Law 138), enacted in 2004, provided for the introduction of a binomial tariff and flat subsidy; the new tariff system included an annual tariff per hectare and a volumetric tariff for water consumption. The annual tariff was supposed to cover the annual maintenance and repair costs. The irrigation agency (ANIF) was mandated to calculate the tariff for each scheme and, within the scheme, for each delivery point (usually, pressure pump station-SPP): the volumetric tariff was, practically, uniform for each pumping step (terrace) while the annual tariff could vary even within the step if long distribution (secondary) canals required different maintenance costs. The tariffs' structure of costs, developed by ANIF and agreed with the WUAs representatives, was approved by MARD. Then, annually updated tariffs have been calculated, discussed with the WUAs and published in the Official Gazette. From 2015, the tariffs published did not include annual tariffs, as they were replaced by the service subscription, mandatory for all farmers within each operational scheme, approved through an amendment to Law 138/2004. Though, the implementation mechanism is yet to be developed.

The current tariffs, both annual and volumetric, are differentiated and based on local costs, and show major discrepancies across the country, as they depend upon the features of each scheme, particularly upon the pumping height from the water source to each terrace (pumping step), number of steps, length of canals, water losses, energy efficiency of pump stations (years of service), status of infrastructure, and, not least, the prospective demand for irrigation for the following year. Nevertheless, as mentioned, tariffs vary by pump step, mainly because of the electricity costs. A review of tariffs calculated for year 2015 (last year with annual tariffs) showed that the annual tariff varied between 0.22 and 120 €/ha and the water tariff varied between 0.005 and 0.201 €/m³. For the four counties which accounted for 84 percent of the irrigated area that year, the tariffs were as shown in table 5.2.

In comparison with southern EU countries,[2] Romania has a greater range of values for both annual (flat) tariff and volumetric tariff, while the maximum annual tariff in Romania is lower than in all countries used as comparator (except Portugal where the tariff is about the same). For the volumetric tariff, the lowest value in Romania is outset in Portugal while the highest value is exceeded only in Greece and (slightly) in Italy. No annual tariff is charged in Cyprus, where only volumetric tariffs are used, so as *inter alia* to further incentives for demand management by farmers. A summary of tariffs in the selected countries is presented in table 5.3.

Although it was considered unrealistic to entirely eliminate subsidies for irrigation, given the depressed economic situation in rural areas and the weakness of the agriculture sector, in order to economize the use of state subsidies and encourage only economic irrigation the Law 138/2004 also included provisions for reforming the irrigation financing system through state subsidy, consisting in the following main principles: (1) the subsidy be granted in a fix amount per hectare regardless of the location and elevation above the water

TABLE 5.2. Selected Irrigation County Tariffs (Average)

	Annual tariff (€/ha)(min-max)		Volumetric tariff (€/m³) (min-max)		Irrigated area (ha)	% of total
Country	0.22	120	0.005	0.201	173,185	
Brăila	2.20	29.00	0.007	0.130	98,862	57%
Călărasi	1.38	3.11	0.008	0.03	12,430	7%
Galați	0.22	0.43	0.007	0.068	15,798	9%
Ialomița	6.63	8.70	0.047	0.201	17,786	10%

Source: WB team computation.

TABLE 5.3. Summary of Irrigation Tariffs in Selected EU Countries

Country	Annual tariff (€/ha)		Volumetric tariff (€/m³)		Year
France	81	157	0.06	0.082	2003; 2012
Portugal	120		0.002		2012
Greece	73	210	0.02	0.70	2012
Cyprus	–	–	0.15	0.17	2012
Italy	30	150	0.04	0.25	2012

Source: EEA Technical Report 16/2013.

source (thus, favoring irrigation in schemes and parts of schemes (terraces) requiring less pumping head); (2) cost-sharing of irrigation costs: the subsidy covered only a portion of total cost of irrigation, namely 80 percent of the maintenance costs and 90 percent of water delivery costs, while the farmers (users) covered the balance; (3) the exclusive access to subsidy was granted to WUAs.

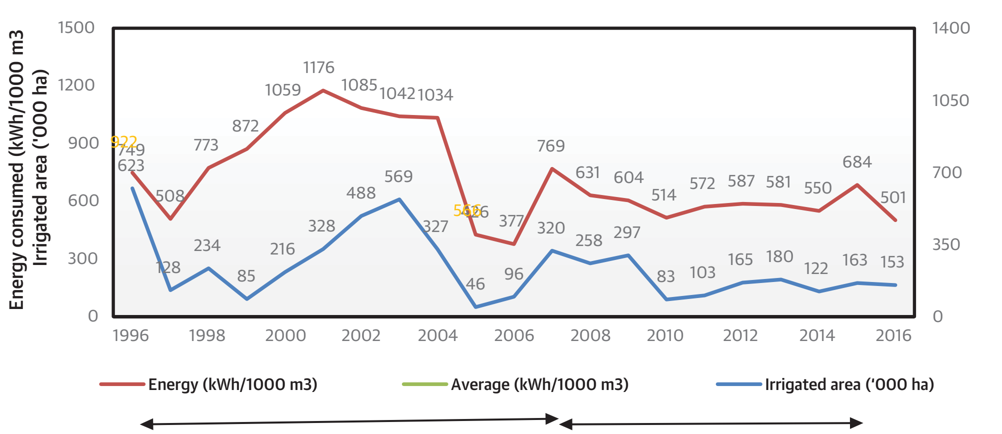
The new subsidy system, applied since 2005, has been aligned with the EC subsidies for direct area payments to farmers applied through the Common Agriculture Policy, preparing the farmers for what was to come after EU accession (in 2007). The new financing system was applied until January 1, 2010 when the "transition period" ended and Romania had to cease all state aid, including the irrigation subsidies. After that, the farmers were charged the full cost of irrigation, calculated using the same tariff system developed and applied since 2005. However, a new amendment to Law 138/2004 passed in 2016 provided for free of charge water delivery to all delivery points, in 2016 and 2017, with the costs covered by the state budget. The way this decision was reconciled with the state aid principles is unclear.

The implementation of the reformed subsidy system has resulted in a clear consolidation of irrigation area in locations that required less pumping, leading also to a substantial reduction, by 40 percent, in electricity consumption for irrigation (from 922 kWh/1000 m^3 delivered during 1996-2004 to 566 kWh/1000 m^3 during 2005-09) as shown in figure 5.1.

However, the new subsidy system has shown some weaknesses and is exposed to abuse. Much funds have been used for maintenance and repair of public and WUO infrastructure only based on preliminary commitment of farmers to irrigate a much larger area than what was actually irrigated further in the year. In general, the subsidy for maintenance and repair covered an area three times larger than the irrigated one.

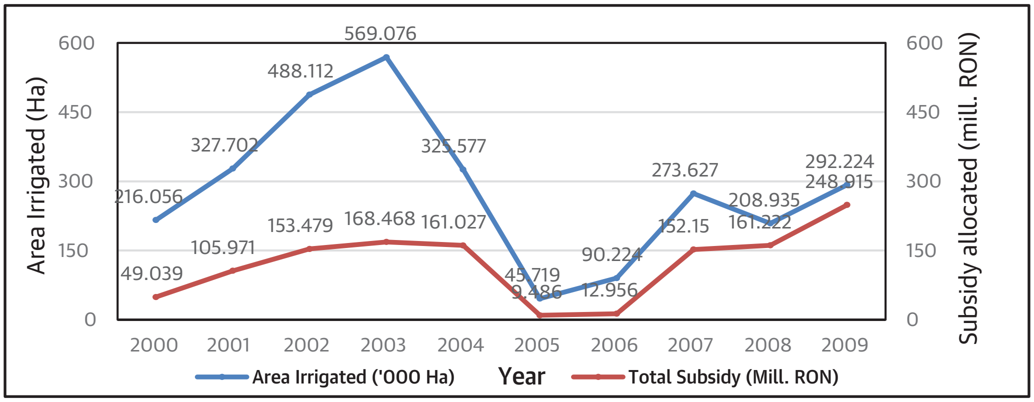
While the government tried to provide as much support as possible to farmers to get them prepared to cope with the subsidy cut in 2010 through increasing the funds available for

FIGURE 5.1. Correlation of Irrigated Area (Ha) with Energy Consumption (kWh/1,000 m³)



Source: WB team computation based on the statistical data.

FIGURE 5.2. Variation of Irrigated Area and Subsidy Allocation



Source: World Bank computation based on the statistical data.

rehabilitation and modernization of tertiary infrastructure, the support did not result in increasing the irrigated area, as documented in a consultant report[3] prepared under the World Bank-funded Irrigation Rehabilitation and Reform Project (IRRP). The report showed that instead of proceeding to a gradual reduction of the subsidy over time to prepare the farmers for the sharp cut, the government decided, on the contrary, to increase the state funds available from 135 RON/ha in 2006 to 852 RON/ha in 2009. The report revealed cases of WUOs which received huge funding for investment and O&M in 2009 (over €1 million), just before the subsidy was cut, but their irrigation activity in the following years did not justify the financial effort. The variation of subsidies and correlation with the area irrigated for the period 2000–09 is illustrated in figure 5.2, which shows that the increase of subsidy did not promote an increase of the irrigated area. A review of state subsidy on irrigation performance is presented further.

The irrigation reform was supported by technical and financial assistance of the World Bank provided under the IRRP, implemented during 2004–12. The IRRP total budget was US$103 million, of which US$20.6 million from the state budget, US$2.4 million WUAs contribution and $80 million World Bank loan. Almost 90 percent of IRRP budget was used for investment in rehabilitation of (public) primary and secondary irrigation infrastructure covering 93,000 ha, including 290 km of canals and nine main pump stations located in five schemes. The IRRP also financed rehabilitation and modernization of tertiary infrastructure (pressure pump stations, pipes and irrigation equipment) owned by 309 WUOs and covering a total area of 308,000 ha; procurement of equipment for field irrigation, water scheduling, water metering at field pump stations (SPPs), motorcycles for irrigation monitoring, as well as office equipment for WUOs. The project also financed several studies that have been further used by MARD in preparation of sector development plans, referred to elsewhere in this report.

After its accession to EU, Romania applied, in parallel with IRRP implementation, for EC financing to scale up the process of upgrading the tertiary infrastructure owned or managed by

WUAs, under the NRDP. During the first financing period, 2007-13, funds in amount of over €150 million have been earmarked for rehabilitation and modernization of on-farm irrigation infrastructure; this amount could finance eligible projects in amount of maximum €1 million submitted by WUAs or Federation of WUAs (FWUAs). Until the end of the implementation period, 135 projects submitted by 128 WUAs and seven FWUAs have been accepted for financing amounting to over €127.4 million. The projects submitted came from 17 counties; the largest number came from Braila and Galati counties (22 percent—30 projects and 13 percent—18 projects, respectively), which was also reflected in their leading positions in irrigation activity, as shown earlier.

Financing with EU funding is expected to continue under the current financing period (2014-20) as part of the new NRDP, with a budget allocated of €435 million; applications for financing are being submitted. In addition, the government approved in 2014 the Program for Rehabilitation and Modernization of Irrigation Infrastructure aiming at financing rehabilitation and modernization of the primary and secondary infrastructure (main pump stations, main and distribution canals, and appurtenant structures) in all viable schemes, to be further discussed later in this report.

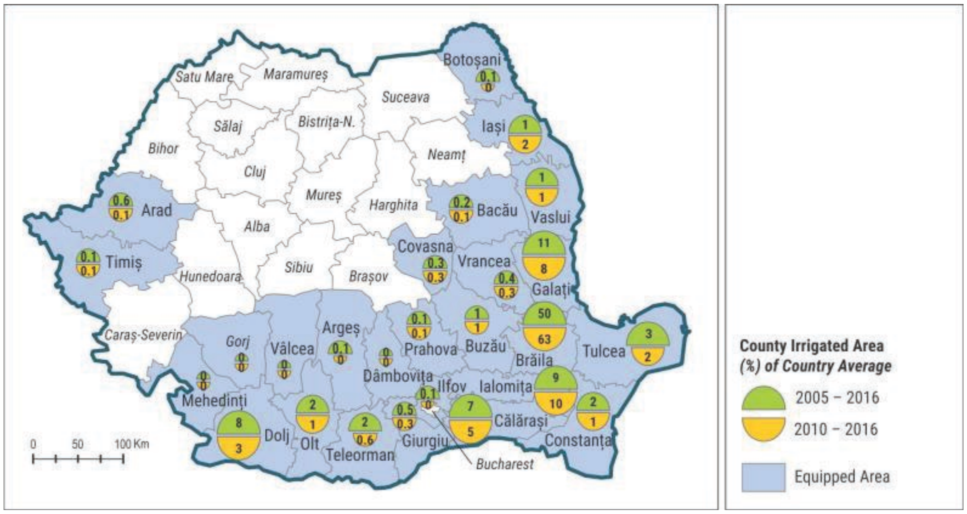
5.2.2. Only a Portion of Irrigation Infrastructure is Economically Viable

The supplementary feature of irrigation in Romania leads to significant annual variation of water deficit of crops according to weather conditions, temperature and rainfall during the growing period. However, the years with favorable weather are very rare, and their occurrence diminished with the more obvious climate change. The areas located in the southern and eastern Romania are the most prone to dry summers and frequent droughts, which affect field crops, particularly the spring ones, which cannot benefit much from the winter and spring rain. Also, the drought incidence increased in the past two decades, with 8 years of severe droughts between 1992 and 2015 (in 1992, 1993, 1997, 2000, 2003, 2007, 2012, 2015) and only three rainy years (1998, 2001, 2004).

The territorial distribution of irrigated areas also shows large discrepancies even amongst counties with similar climate conditions located in the southern part of the country. Data available for the period 2005-16 (mapped in map 5.8) show that about **61 percent of the total area irrigated was in two neighboring counties located in the south-eastern region: Brăila (with 50 percent) and Galați (with 11 percent)**. In the southern region, the area irrigated on average accounted, in two counties (Călarasi and Ialomița), for 19 percent of country average and 10.5 percent of the equipped area, while in Dolj and Olt counties located in south-west region, the area irrigated was slightly over 10 percent of the country average and represented only 6.5 percent of the equipped area.

The irrigation performance changed after 2010. The period 2005-16 can be split into two sub-periods, one between the change of tariff and subsidy, and the subsidy cease (2005-09) and the other after the subsidy cease (2010-16). One can note substantial change in the irrigation activity: in all but two counties the area irrigated dropped substantially once the

MAP 5.8. County Irrigated Area as % of Country Average



Source: World Bank computation based on the statistical data.

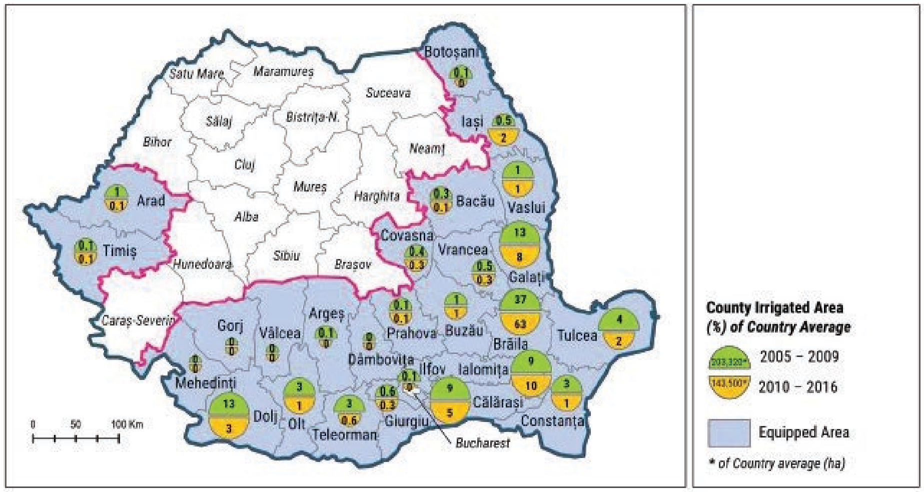
subsidization ended, because the farmers had to, suddenly, increase their payments four times and many of them could not afford this. The two exceptions were Braila and Iasi counties, where irrigation picked up. The explanation is different for each one: In Braila, the process of the establishment of WUAs was slow, because the majority of users were farms large enough to allow good water management; therefore, once the access to subsidy was restricted to WUAs only, these farms lost their access to state financial support. Because the procedures for WUAs' establishment were pretty cumbersome and lengthy, many farms ceased or reduced irrigation for a while but picked up later. In Iasi county, the process of consolidation of large farms into viable units was slower and visibly came to fruition after 2012. Map 5.9 compares the two periods.

The substantial differences among counties regarding the situation in irrigation can be explained by two factors: the **structure of land management** and the **cost of irrigation.**

The farms structure in Braila and Galati counties includes a substantial share of large, commercial farms with good access to markets, either for vegetables or field crops, using high input—high output practice. Also, the irrigation schemes in Braila county depend upon low pumping head (10-40 m) from the Danube River (the main water source), which leads to low electricity consumption and, implicitly, low electricity bill. This is the case for some areas also in Galați county. A special note on the organization and activity of water users' organizations (WUOs): the establishment of WUOs in these counties started later than in other counties but resulted in more solid and active entities, most probably due to the substantial presence of larger farms with solid interest in functional irrigation; the largest number of WUOs in Romania have been established in these two counties.

In contrast, the schemes in Călărasi, Ialomița, Dolj and Olt counties have large areas located on higher terraces with pumping heads exceeding 50 m (going up to 110 m), which makes irrigation

MAP 5.9. County Irrigated Area as % of Country Average, by Period



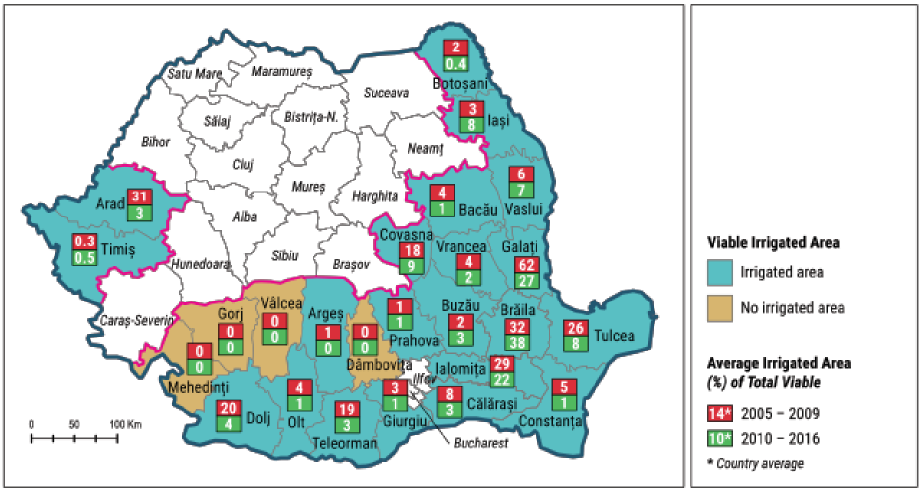
Source: World Bank computation based on the statistical data.

water more expensive, sometimes unaffordable. In addition, the farms structure still includes a large share of small semi-subsistence farms with low productivity and limited access to markets. So, the combination of high costs and limited availability of cash led to a steady reduction of irrigation activity in these areas, even though one of the schemes selected for rehabilitation under IRRP was located there. The establishment of WUOs started much earlier in Dolj county just to enable small farmers' access to irrigation facilities. The concept of WUAs was piloted here starting in 1999 and the WUAs (transformed later in WUOs) strengthening received support under the IRRP until 2012 (at project closure).

A new perspective on the irrigation activity is gained by examining it in viable and marginally viable areas, as mapped in map 5.10. Country wise, the average irrigated area during 2005-16 represented 12 percent of the total viable economic area, while for 2010-16, the share dropped to 10 percent. The same trend occurred in almost all counties that irrigated, except in Buzau and Prahova, where the values remained at the same low levels, and Braila, where the share increased. Moreover, it is interesting to note not only that the same two counties (Brăila and Galati) are in leading positions but also that other counties, like Ialomita and Tulcea are doing better that the rest of the counties. This information could be useful, beyond the statistical value, as a significant planning factor for priority setting for the implementation of the new Strategic Investment Program.

The irrigation activity only partially followed the weather pattern during the past 20 years: the area irrigated in the drought years varied substantially, as did the irrigation intensity. In some years, a large area was irrigated physically but with a low intensity while in other similar years the irrigation intensity prevailed. More detailed information on irrigation activity in the past 20 years (1996-16), including the use of resources (water and energy), is presented in appendix E. One can note the variability of irrigation application (total volume of water

MAP 5.10. Average Irrigated Area as Share of Total Economically Viable Area



Source: World Bank computation based on the statistical data.

used for irrigation during a season) which, in the drought years listed above, varied from 887 m^3/ha in 2003 to 2,043 m^3/ha in 2012, while the irrigation intensity (number of applications per ha) varied from 1.75 in 2003 to 2.55 in 2015. In general, on average, the irrigation activity was pretty weak and, in many cases, irrigation was used rather to salvage the crops than to secure a certain yield and quality of crops.

The change in the subsidy mechanism promoted concentration of irrigation in areas with low pumping (in 2012, 96 percent of the area irrigated was located below 70 m pumping head) but the substantial increase of subsidies for O&M of irrigation facilities did not enhance performance of irrigation through expansion of irrigation on areas with low pumping, as expected. On the contrary, high subsidies encouraged irrigation on higher terraces, at higher costs, and with lower performance: about 47 percent of the subsidies paid in 2009 went to WUOs located in unviable schemes or areas to irrigate 37 percent of the total area with an irrigation intensity of 60 percent of the viable areas. In addition, while the irrigation subsidy rose from 135 RON/ha in 2006 to 852 RON/ha in 2009, the area irrigated remained generally the same, around 300,000 ha. It would appear that much of the 249 million lei budgeted and spent for this purpose was wasted, since areas hopelessly inefficient for irrigation benefitted of these subsidies, and infrastructure was repaired in areas that had ceased irrigation.

After the subsidy cut, the irrigated area dropped but the performance increased: while the average area irrigated in 2010-16 dropped at 50 percent of the average area irrigated in 2000-09, the performance of irrigation improved in economic terms: most of the irrigated areas remained at low elevations (below 60 m pumping head), the average irrigation intensity remained over 2 applications/ha and the annual irrigation application exceeded 2,000 m^3/ha.

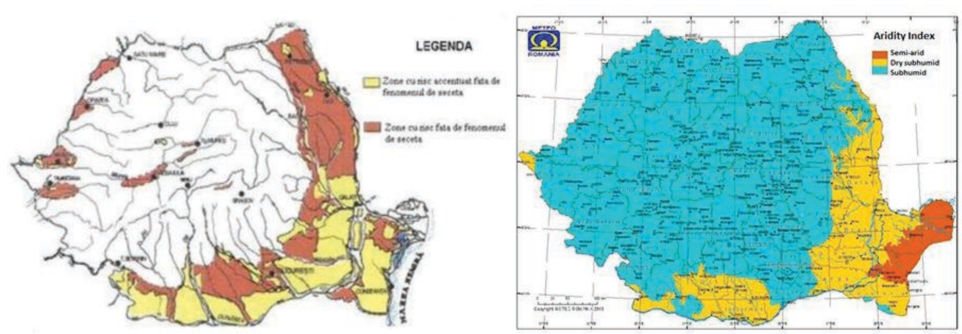
5.3. Looking Forward: What Is the Future of Irrigated Agriculture?

5.3.1. Adapting to Increasing Droughts, Due to Climate Change

All climate projections point to a notable increase in frequency and intensity of droughts in Romania, with dire consequences for the agricultural sector, causing significant volatility in crop yields from year to year. A study[4] conducted by the EU Joint Research Center (2014) showcases that Central and Southern Europe (including France, Austria, the Czech Republic, the Slovak Republic, Hungary, Slovenia, and Romania) will be the second most affected regions in the European Union, pursuant to the decrease in precipitation by approximately 24.4 percent during the summer season, thus increasing exposure to drought with losses rising to 3 percent of annual regional gross domestic product (GDP). For Romania, the 2001–12 interval was particularly droughty and agricultural productivity suffered, while the mean yield by ha decreased by more than 50 percent on non-irrigated land. The most affected crops included corn, wheat, barley, sunflower, rapeseed and soybean. In 2007, when the drought reached a significantly high level, gross added value in the agricultural sector recorded a downfall of 15.3 percent, and in 2012, the downfall was of 21.2 percent, with drought being one of the major factors that led to a decrease in GDP.

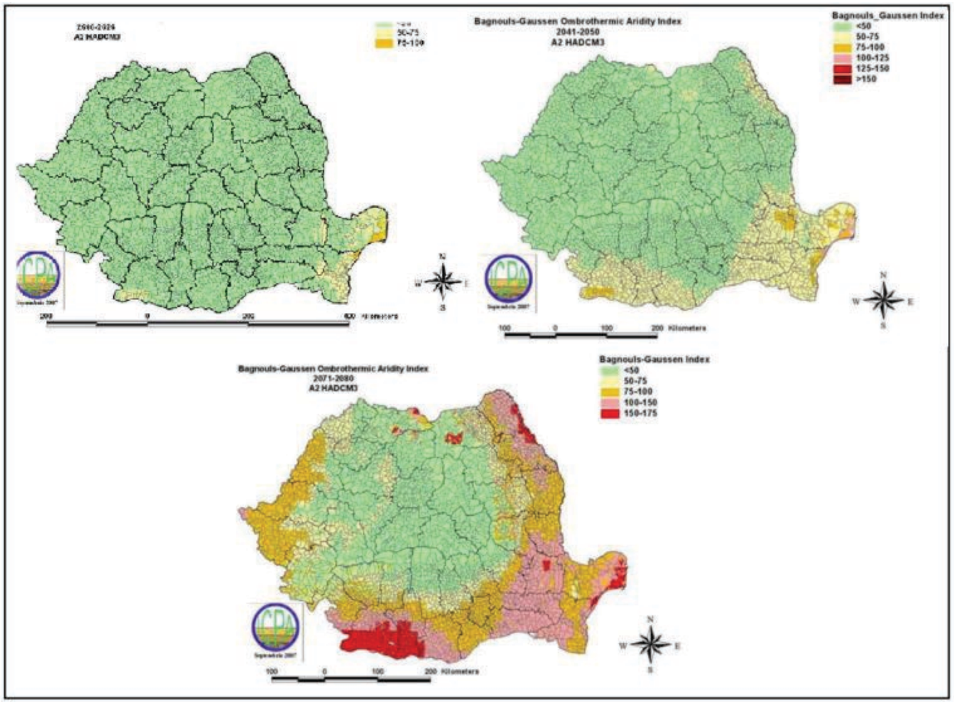
The assessment of the map of drought risk areas, comprised in the 2nd national RBMP, highlights the south (the Romanian Plain, Getic Plateau), southeast (Dobrogea) and east (Moldavian Plateau) as highly vulnerable to droughts (map 5.11, left side). Map 5.11 (right side) also shows the territorial distribution of the aridity index (AI) on the territory of Romania for the period 1961–2014. The AI (as defined by UNDP) falls below 0.7, characteristic of a dry sub-humid region, in areas with poor precipitation and favorable conditions for a strong evaporation; this situation is met in the southern part of the country, the eastern part of the Romanian Plain, the Danube meadow and Dobrogea. In the eastern part of the Danube Delta, the AI reaches values of less than 0.50, which indicate semi-arid conditions in the area.

MAP 5.11. Map of Drought-Risk Areas from the 2nd National RBMP (Left) and Map of Territorial Distribution of the Aridity Index for Romania for the Period 1961–2014



Source: ANAR 2016.

MAP 5.12. Forecast of the Intensity of Agricultural Drought (2010–80)



Source: ANAR 2016, based on ICPA.

Additional forecasts for the 2010–80 indicate increased intensities of the drought phenomenon in Romania (map 5.12), with the main hotspot (in red) located in the two counties of Doli and Olt in the lower Danube, together with a few other hotspots in the Tulcea county (Danube delta) and the Botosani and Iasi counties (Prut-Barlad basin, on the border with Moldova).

As a result of the decrease in precipitation, more and more crops will be under water stress and will need to be irrigated in order to diminish the risk of yield variability. Within the above-mentioned World Bank climate change project, a modeling exercise on the impact of climate change on water demand for irrigation and agricultural production has evaluated the potential impacts of three different climate change scenarios (low, medium, and high) on the yields for different types of crops at the 2040 horizon. The model was run for 12 Romanian River Basins, with data provided by the National Institute of Hydrology and Water Management and the National Meteorological Administration, and evaluated the potential influence of the decrease in precipitation under the medium climatic scenarios on the yields of several rain-fed crops. The results show that most rain-fed crops yields are expected to decrease in all river basins. For some river basins where water demand could grow significantly, it could have an impact in terms of water scarcity and could lead to a conflict between some priority uses, such as environmental flows and domestic demand.

Adaptation policies would be necessary in order to avoid overexploitation of water resources and conflicts with other uses and users, and potentially adjust to new crop patterns, with higher

economic value and development potential. The above-mentioned modeling exercise also allowed tests of several adaptation measures and evaluation of their respective impacts on yields improvement and water demand. From the yield perspective, the major improvements would be expected with expanding the use of irrigation (including turning from rainfed to irrigated agriculture) and increasing fertilizer application, but at the same time this will require more water (as there is a strong correlation between these two production factors). If the goal is to limit the increase in water demand, the most efficient measures would be improving water use efficiency at farmers' level (sprinklers or drip irrigation), selection of crop variety (resilient crops) and improving soil aeration. Overall, the combination of adaptation measures will have to strike a right balance between agricultural productivity and sustainable water management.

5.3.2. Lack of Clear Policy for the Future of Irrigated Agriculture

The irrigation sector in Romania presents significant challenges. Large areas historically equipped for irrigation have fallen in disrepair, are considered unviable or are only partially utilized. With few exceptions, most of the large-scale infrastructure is either non-functional or highly inefficient in terms of water use and energy consumption. This is associated with high operational costs and water tariffs that are unaffordable to the farmer—especially in high elevation areas. Yet, the effects of climate change and more frequent extreme weather events will increasingly affect the agriculture sector in Romania. While in years with good precipitation agriculture has made an important contribution to GDP and trade balance, in dry years the output decreased by more than 40 percent (up to 60 percent at times). Revitalization of the irrigation sector is required to stabilize production, enable commercialization and diversification, and generally support the agricultural development agenda in Romania. This will need to be done also to make the sector more robust and sustainable in managing energy and water use, creating more efficiency and reduce production cost. To achieve the above goals, Romania needs to address four main sector issues: (1) the legacy of over-investment in irrigation infrastructure, (2) the lack of a strategic "exit strategy" to formally abandon the unviable schemes, (3) the absence of legal, regulatory and institutional stability, and (4) the lack of a clear vision for the long-term development of the irrigation sector.

There is a huge legacy of over-investment in irrigation infrastructure. The area covered with the irrigation infrastructure developed in 1960-89 reflected the reality of a different society with a centrally planned economy and cross subsidization of costs. The structural socioeconomic turn towards a market economy required reconsideration of economic dimensions of all activities and development of cost-recovery mechanisms to secure profitability and healthy businesses. The technical and economic studies developed in the past decade, as mentioned earlier, demonstrated that about 50 percent of the irrigation schemes cannot be profitable either under the current farming practice and cropping pattern or even in case of substantial change towards high value crops. As recommended, activity in the respective schemes would need to be closed down if there is no more demand from farmers willing to pay the full costs. However, the large size of the irrigation sector and its benefits to agriculture have deep roots in the collective mind in Romania, and making a sharp decision to close down irrigation activity on large areas may create political discontent; hence, although the impossibility to recover the irrigation sector at its past size is widely accepted, no political force has had the courage to take difficult action. In practice, many large schemes or parts of schemes have been abandoned *de facto,* but their historical assets are still present in ANIF books. Once irrigation demand ceased, O&M activities stopped, and the condition of assets depreciated, the dismantling and theft of unguarded assets started and now, many wrecks of old pump stations can be seen on high terraces where irrigation is not economic. These wrecks not only form a depressing image but also maintain the sentiment of loss of national treasure, and should be demolished.

There is a lack of exit strategy to write off the unviable irrigation schemes. Despite the difficulty of making the decision to formally close down the unviable schemes and remove all of them from ANIF books, this should be part of a clear strategy to consolidate the viable parts of the irrigation infrastructure and make it functional at higher technical parameters. This strategy should be prepared by the MARD in a form that highlights the benefits of restraining the irrigation sector to a smaller size than in the past and justifies the action through better ways to use the scarce budgetary funds available for the sector. The exit strategy should also be linked with the investment program for modernization and rehabilitation of the public irrigation infrastructure in order to demonstrate the willingness to develop and strengthen the viable part of the sector through a coherent approach rather than patching up the damages. Last but not least, the exit strategy should be accepted and supported by all major political forces active in parliament to secure its long-term implementation.

There is still some lack of regulatory and institutional stability. The irrigation sector was subject to many and substantial changes since 1990 following the pattern of the general reform and restructuring of the society, economic, social and educational. Different institutional and financial arrangements have been tested and abandoned once they did not generate the expected results. It was believed that all lessons learned from more than a decade of experiences together with the possible adaptation of experiences of other countries with similar conditions could be reflected in a new legal and regulatory framework of the sector. However, the Land Reclamation Law 137/2004 that was adopted in 2004, and which defines the implementation norms and the new Regulation for Organization and Functioning of ANIF, has still not been revised.

The new legal and institutional framework created in 2004 shook the system and generated a large opposition among the "old guard" that was still active; unhappy with the new financial and functional framework, they started to undermine its implementation through small steps. As a result, instead of allowing the reforms to produce results (and demonstrate any shortfalls), amendments to the Law 134/2004 have been enacted once, or even twice, every year (in most case for small changes) creating a sense of instability and discouraging the system operatives from making decisions.

The major reorganization at ANIF have had a destabilizing effect. The 12 regional branches established in 2004 to replace the 42 county-based subsidiaries, were dissolved in 2011 and replaced by 42 branches (restoring the situation of before 2004); in 2014, the 42 branches were reformed again to form 16 regional branches. In the same time, ANIF's technical capability deteriorated after the staff downsizing by 3,500 operatives in 2011 following the MARD decision to outsource the O&M of main irrigation infrastructure. In 2016, ANIF staff increased again by about 1,000 to partially restore the technical capacity.

The legal, regulatory and institutional instability acted as an aggravating factor in the general downward spiral of irrigation activity diminishing the farmers' trust in ANIF's capacity to manage the irrigation systems. Therefore, urgent actions need to be taken to restore the confidence of clients in ANIF staff's capacity and willingness to improve its performance.

The lack of a clear vision for the development of the irrigation sub-sector for the next 20 years. It is obvious that the current apparent stalemate in the irrigation activity cannot continue any longer and there is a need for a new, long-term vision for sector development, a vision to set the reasonable targets in conjunction with the country and farmers' economic interests but also to set the scene for development and implementation of a sustainable investment strategy in rehabilitating and modernizing irrigation assets.

Romania has set a number of strategic objectives in agriculture, namely, development and strengthening of the market-oriented farming sector, enhancing the share of high value crops in the general cropping patterns, and **addressing the climate risks and irrigation can play a key role in meeting these objectives.** With the more and more obvious effects of climate change and variability of weather events, the effective use of irrigation infrastructure is a matter of national security, because it can affect food safety in Romania. Given the ever-increasing food demand coming from the countries with high rates of population growth, irrigation provides yields stability, in volume and quality as well as for export margins.

5.4. Investment Needs for the Rehabilitation of Irrigation Infrastructure

A Strategic Investment Program to rehabilitate irrigation infrastructure was approved in 2013, covering 820,000 hectares for a total cost of about 1 million euros. This rehabilitation program drew on the technical and economic studies prepared by international and local consultants in the past decade (referred to earlier), and was prepared by the MARD. This Strategic Investment Program for Rehabilitation and Modernization of Irrigation Infrastructure (SIPRMII) was to cover a total of 820,000 ha, or about half of the area assessed as economically viable and marginally viable (under current prices and market demand).

The irrigation rehabilitation program was revised by MARD in 2016, keeping the same total budget of 1 billion euros but expanding the area to be rehabilitated to 1.9 million hectares. This represents more than doubling the total acreage initially envisaged to be rehabilitated (+130 percent), while maintaining the same budget. This program is to be supported from the state budget, with an implementation timeframe in 2017-20. The expansion of the program was mainly done by including a significant number of marginally viable schemes with unconfirmed commitment of farmers to use the rehabilitated schemes, together with some unviable schemes (or parts of schemes), where the future use of irrigation infrastructure is even more uncertain. A breakdown of the schemes included in the Program, initially and after extension, with county location and area, proposed for rehabilitation is shown in appendix F.

In its current state, the proposed 2017–20 irrigation rehabilitation program raises a series of questions regarding both budget and timing. The fact that it intends to rehabilitate a much larger area with the same budget as initially envisaged creates risks that the budget would be insufficient to achieve the rehabilitation objectives. The average expenditure for irrigation rehabilitation under the previous WB irrigation program (IRRP) stood at 1,100 US$/ha, or about 1,000 euros per hectare. This is in line with the unit rehabilitation cost that was budgeted initially for the new program, at about 1,220 euros per hectare. However, the unit rehabilitation cost for the revised program was dropped to 525 euros per hectare—a figure which seems too low for achieving satisfactory quality and operational performance after completion. Moreover, there are serious concerns, whether such amount of rehabilitation civil works could realistically be carried out by the construction industry over the proposed 4-year timespan, since the extended program would aim to cover as much as about two-thirds of the irrigation area historically equipped, which had taken over 25 years to build. Finally, the tight schedule proposed in this program seems overly ambitious, given that engineering designs are ready only for a few schemes (prepared during IRRP but subject to update), while for the majority of civil works the full process of design preparation is to be completed. The implementation plan of the program needs a thorough and realistic revision to align it with the country's construction and financial capacity.

Climate change effects may justify a revision of the economic viability of irrigation considering a possible increase of demand for irrigation services—since the existing infrastructure is concentrated in the south-eastern part of the country, where the impact of climate change is expected to be higher, with the establishment of a semi-arid climate with increased evapotranspiration and drought risks. This would need to be part of a broader strategy for promoting irrigated agriculture, with *inter alia* further consolidation of land into market-oriented farms, and based on realistic estimates of increase in irrigation demand from farmers.

Notes

1. Many irrigated crops enjoyed guaranteed exports to other Eastern Bloc countries.
2. Assessment of Cost Recovery through Water Pricing, EEA Technical Report 16/2013, ISSN 1725.
3. WUOs Capacity to Pay Full Cost of Irrigation, Fidman Merk, 2010.
4. Climate Impacts in Europe. The JRC PESETA II Project, Joint Research Center, 2014.

Chapter 6 Spatial Analysis of Water Security by River Basin

This chapter combines the key findings from the analysis in the previous chapters—most of which is supported by detailed maps—to carry out a spatial analysis of water security for each of the 11 river basins in Romania. New projections for the water balance in each river basin based on data from the River Basin Management Plans (RBMPs) that have been adjusted to account for the impact of climate change, were developed to be able to assess which river basin may be subject to water availability stress (with demand close to or exceeding available resources) by 2030. A review of the water security situation for each Romanian River Basin is based on nine dimensions of water security, including poverty and WSS access, UWWTD compliance, quality and quantity of water resources, droughts and floods risks, and expected impact of climate change. Finally, a typology of Romanian River Basins is proposed, identifying the hotspots (river basins and counties) that are most vulnerable for water security.

6.1. Methodology for Spatial Analysis of Water Security

6.1.1. Projection of Future water Demand and Balance

Specific projections of water demand by river basin were developed as part of this study, in order to assess whether some river basins would face difficulties for meeting demand over the next two decades. As explained in the Water Resources Management (WRM) chapter, Romania is close to the water-stress threshold in terms of water availability per capita, but the drastic fall in water demand and abstraction following the structural economic reforms of the 1990s—the largest fall amongst all EU-13 countries—has provided a strong buffer that may have led to a false sense of water security. The water availability per capita by river basin was previously discussed in the WRM chapter, but such comparison can be misleading for assessing potential water stress and quantitative shortage, as there can be considerable variations in the demand pattern between river basins, which are not driven by the population size (for instance with irrigation demand).

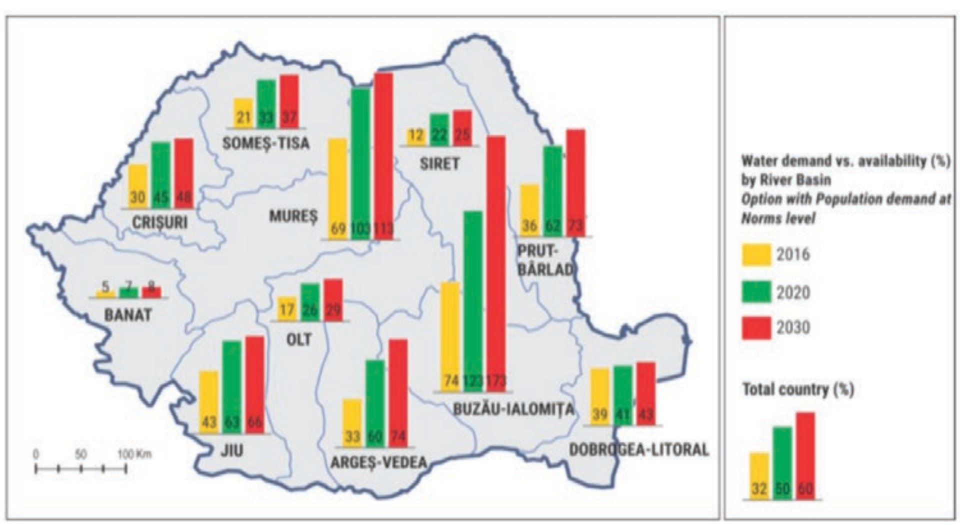
This analysis is not only an update of the previous water demand projection exercises carried out by National Administration "Romanian Waters" (ANAR), but also includes **a different approach to the estimation of future demand from various users, and includes estimates of the impact of climate change**. The methodology was developed starting from the approach used by MWF-ANAR in undertaking a similar exercise for the Danube River Basin Management Plan (RBMP), based on statistical data valid from 2011 to 2013. Most of the information used was collected from the official statistics available on the website of the National Institute of Statistics (NSI); only sporadical use of data available from MWF-ANAR was made. For conversion of county-referenced data (as in NSI databases) to river basin, the same RBMP methodology was used, for consistency. The specific hypothesis for estimating water demand projection from domestic, industrial and agriculture uses are outlined in appendix G.

Water demand estimates by river basin (using the year 2016 as reference) were compared with estimated water availability (taking into account climate change) to assess the water security situation in each river basin. For future change in water stock in each river basin, as a result of climate change, the results of the National Institute of Hydrology and Water Management (INHGA) study conducted on 11 important rivers in seven basins have been incorporated. Water availability forecasts for 2050 horizon have been developed by INHGA for seven river basins and show that most river basins in Romania would have a diminished water stock by about 10 percent in 30 years, except the Somes-Tisa River Basin, where a slight increase (+2.5 percent) was compounded by the report from the forecasted changes for three main rivers of the basin. For the remaining four river basins, a similar reduction of the water availability by 10 percent was assumed. Moreover, in absence of any reliable forecasts for the Danube River, it was assumed that its volume would not be affected in the lower section of the basin nor its share utilizable by Romania would diminish.

The result of this updated water balance projection analysis is summarized in map 6.1, which presents the projected ratio of water demand to availability for 2020 and 2030. Despite the inherent limitation of such analysis (especially with regards to climate change projections),[1] it brings useful insight in terms of the expected situation of water security of the various Romanian River Basins over the next 15 years—as it is, so far, the only available projection of water balance by river basins that takes into account the impact of climate change. The main findings of this analysis by river basin are outlined below.

The two river basins most at risks in terms of water availability are those of the Mures and Buzau-Ialomita. In these two basins, water demand is already equaling (Mures) or exceeding

MAP 6.1. Comparison of Demand versus Water Resources by Romanian River Basin (2016, 2020 and 2030)



Source: World bank's elaboration.

(Buzau-Ialomita) available resources by 2020—up from the demand reaching 69 and 74 percent of the utilizable resource in 2016. In all other river basins, demand was below 45 percent of utilizable resource in 2016 and would still be well below available resources by 2030. As a reminder, the utilizable share of total water stock in Romania does not exceed one-third of the potential natural resource.

The Buzau-Ialomita River Basin is by far the most at risk, with projected demand in 2030 to exceed the projected availability by 44 percent. It is also the river basin with by far the largest existing irrigation infrastructure, and the one which will be most impacted by climate change with increased drought events.

Other river basins that may become subject to water stress are those of the Prut-Barlad, Arges-Vedea and Jiu. In these three river basins, the ratio of demand to available resources would exceed 50 percent by 2030—it would be 64 percent in Jiu, 59 percent in Prut-Barlad and 67 percent in Arges-Vedea. Given the territorial discrepancies within each river basin in terms of demand and available resources at the local level, it is likely that several counties in each of these three river basins will be affected by water scarcity by 2030.

The water availability in the Dobrogea-Litoral River Basin is extremely low based on internal rivers and aquifers only, which can satisfy only a limited demand. Thus, it is very likely that almost all water demand will need to be satisfied from the Danube River. This assumption was used further, explaining why the ratio of demand to available resources stood at less than 50 percent (43 percent) by 2030.

For the reference, comparing the results of our analysis with the water demand estimated for the Danube River Basin Management Plan (average scenario), one can note that the demand estimated in our analysis is more conservative than the RBMP. One source of the difference may come from the changed forecasts for population trends towards 2020-30. The overestimated demand for industrial water in Dobrogea would be a second factor. The third factor would be the much larger area assumed to be irrigated in 2020 and 2030 and used in the RBMP estimates (which this analysis has considered unlikely). A fourth element would be the inconsistency in calculating the water demand for livestock, which deviated from the initial principles (or methodology), because the calculation was based on proxy (population) and not on the actual livestock population and unit water consumption. Comparing the RBMP values for water demand by river basin with the availability of utilizable resource, one would note that the pressure on all river basins would be much higher and require stronger actions to mitigate the risk of severe water restrictions.

6.1.2. Framework for Assessing Water Security at River Basin Level

As previously indicated, **water security is a broad-reaching concept that encompasses (a) ensuring sustainable use of water resources to meet all needs, (b) delivering affordable services to all, and (c) mitigating water-related risks.** It follows that, while the issues of compliance and inclusion are crucial factors for water security, achieving it also requires dealing with a number of other factors. This includes also looking at possible imbalance between demand

and supply—as presented in the analysis of the previous sub-chapter, as well as dealing with *inter alia* climate resilience to increased frequency and magnitude of floods and droughts.

An analysis of water security for each Romanian River Basin has been carried out as part of this study. It seeks to identify the opportunities and major threats for further economic, social and human development in each river basin, using and comparing the many maps that were gathered (mostly from the RBMPs). The analysis takes stock of the findings presented earlier in this report, focusing on the following dimensions of water security: quantitative (demand vs. available resources), ecological and chemical status of surface water bodies, quantitative and qualitative status of subsurface water bodies (deep and shallow aquifers), access to piped water supply and sewerage networks (with treatment of wastewater), current drought risk, current flood risk, expected impact of climate change over drought and floods, poverty index and proportion of rural population (itself a proxy for poverty).

To summarize the status of each river basin, and facilitate comparisons, a table 6.1 will be presented with each basin rated from 1 (no issue) to 5 (acute problem) on the nine dimensions of water security. Despite the inherent limitation of such approach, it allows nonetheless to capture in a synthetic manner the intensity of the pressures in each basin.

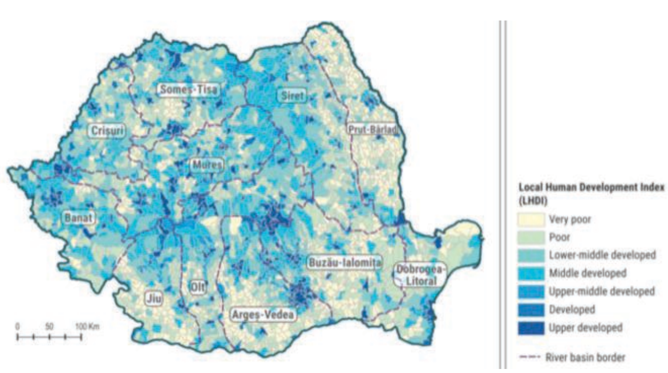
For the sake of facilitating the cross-analysis of a large number of maps, **the main maps being used for this spatial analysis have been grouped below**, copied or adapted from the previous parts of this report (maps 6.2–6.13).

TABLE 6.1. Example of Table Heading for Basin Analysis

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact

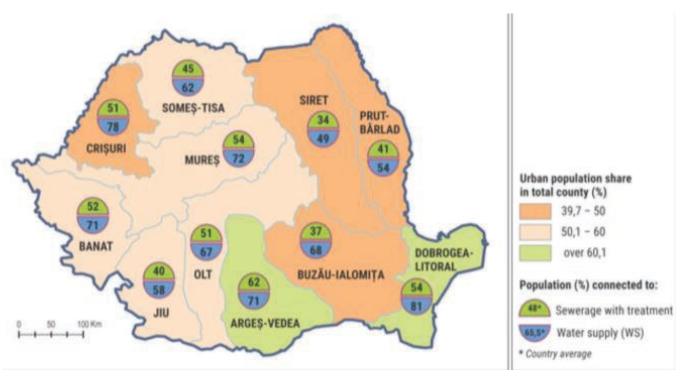
Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.

MAP 6.2. Poverty Index (Local Human Development Index) at Commune Level



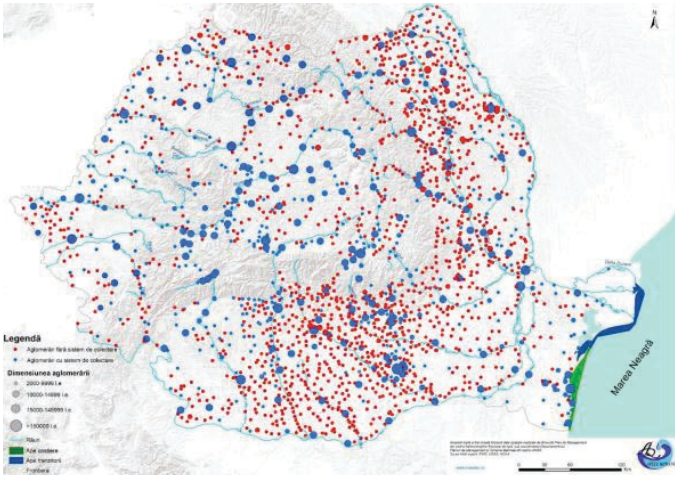
Source: World Bank.

MAP 6.3. Share of Urban Population and WSS Access by River Basin



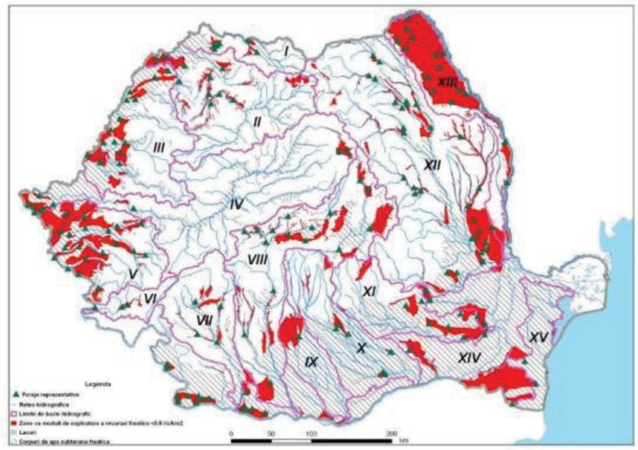
Source: World Bank's elaboration.
Note: WSS = Water Supply and Sanitation.

MAP 6.4. Sewerage Collection in Agglomerations above 2,000 PE



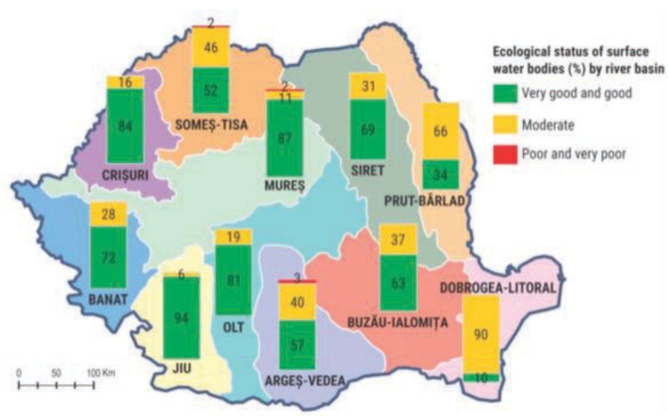
Source: ANAR 2016.

MAP 6.5. Location of Phreatic Water Bodies with Reduced Resources (in Red)



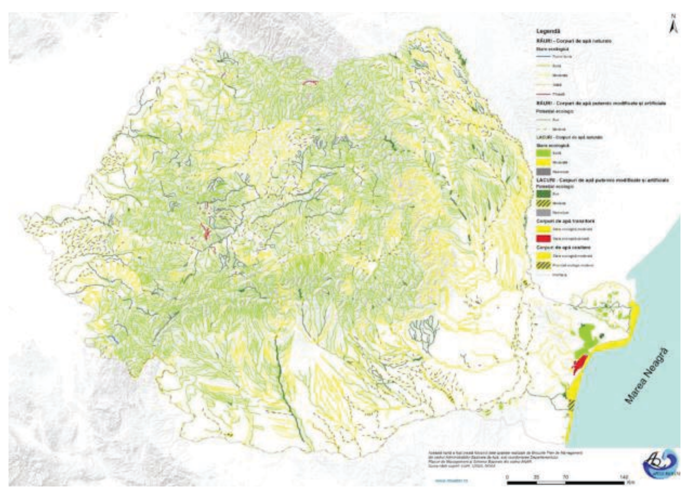
Source: ANAR 2016.

MAP 6.6. Ecological Status of Surface Water Bodies—Rivers



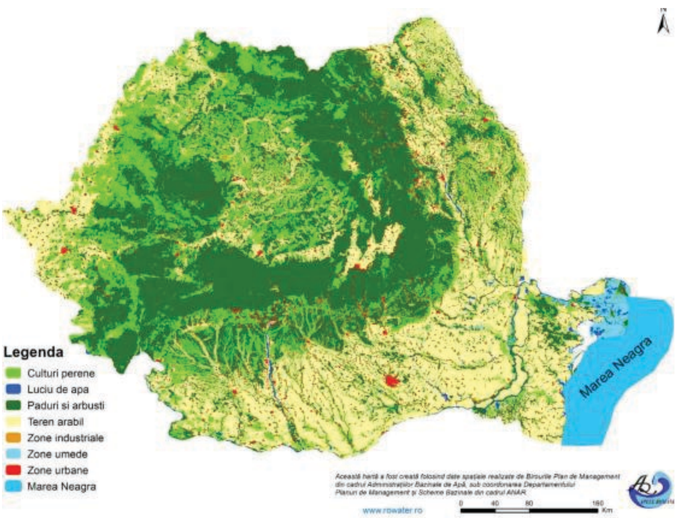
Source: World Bank's elaboration based on ANAR.

MAP 6.7. Map of the Ecological Status of Water Bodies in Romania



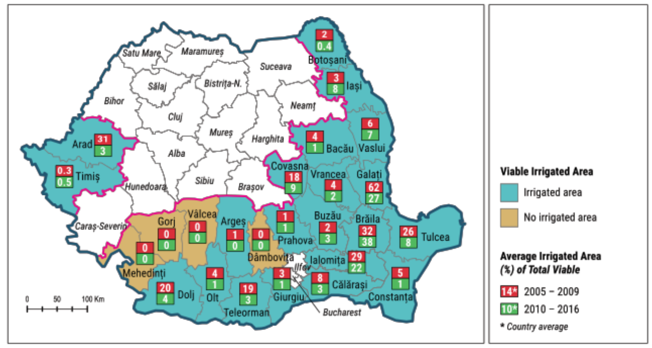
source: ANAR 2016.

MAP 6.8. **Map with Location of Arable Lands (Yellow), Perennial Cultures (Green) and Forests (Dark Green)**



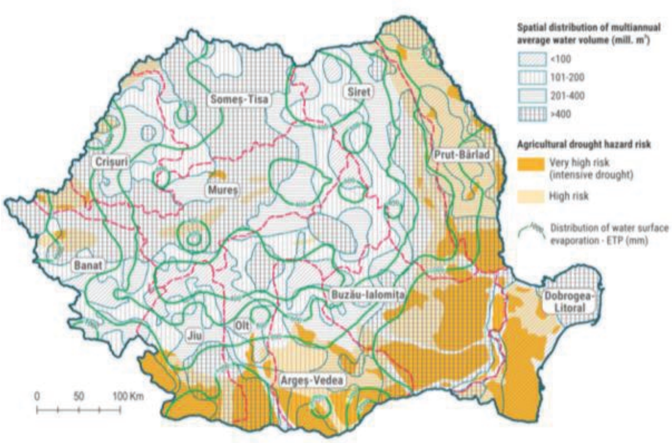
source: ANAR 2016.

MAP 6.9. **Average Irrigated Area as Share of Total Economically Viable Area**



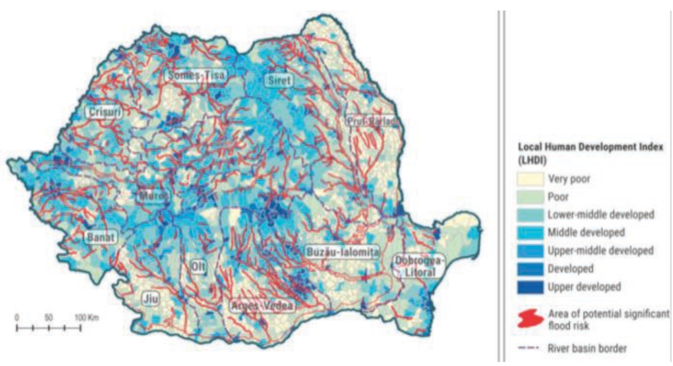
Source: World Bank's elaboration.

MAP 6.10. **Drought Hazard Risks**



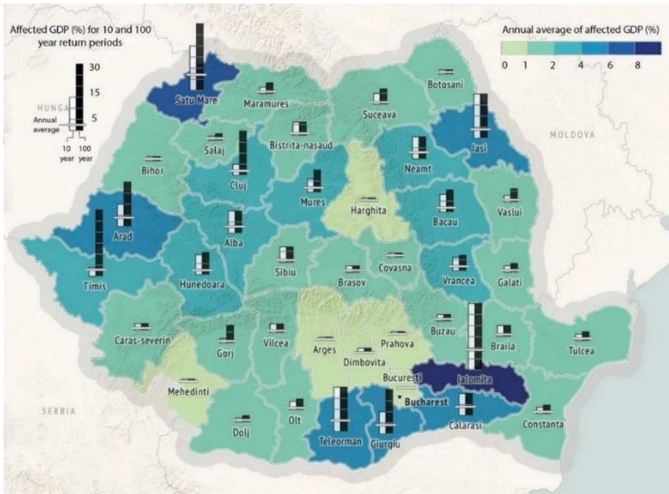
Source: World Bank's elaboration.

MAP 6.11. **Floods Risks Based on FRMPs**



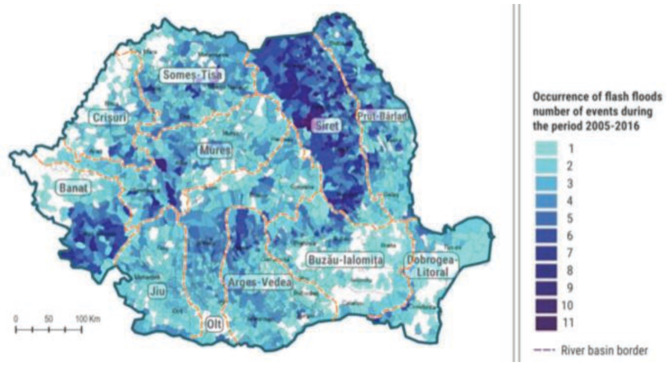
Source: World Bank's elaboration.
Note: FRMP = Flood Risk Management Plan.

MAP 6.12. **Romania's Regions Most Affected by Large Floods in the Past**



Source: World Bank's elaboration.

MAP 6.13. **Locations with High Incidence or Risk of Flash Floods**



Source: World Bank's elaboration based on ANAR data.

6.2. Water Security Assessment at River Basins Level

The Banat River Basin is endowed with large water resources. It has 3.13 billion m^3 from surface water bodies, of which only 19 percent (608 million m^3) is utilizable, complemented by 1.1 billion m^3 utilizable from subsurface water. This basin consists of many independent rivers that flow across the western border with Serbia: the Timis, Bega, Barzava, Aranca, Caras, and Nera Rivers; another important river, the Cerna, flows southwards and discharges directly in the Danube. The ecological status of surface water bodies (rivers) is good, with 72 percent of surface water bodies with good and high status, matching the national average. The chemical status of surface water is good, in general, except the upper and median sector of the Timis River, which is subject to industrial pollution, the upper Bega River subject to nutrients pollution from agriculture, and the median sector of the Nera River polluted by the iron mining industry. Heavy metals can be found locally in the proximity of industrial plants.

The subsurface water availability varies much with location. The Banat basin has 20 subsurface water bodies, the majority of them (17) of good chemical quality. The total subsurface water available is divided between 700 million m^3 in phreatic and 400 million m^3 in deep aquifers. While the aquifers located in the eastern part of the basin have substantial volumes that can be tapped, the aquifers located in the western flat plain are located in thin coarse deposits with limited storage capacity, covered with thick layers of heavy clay soils that do not allow much water to percolate through for recharging. These thin aquifers are in most cases suspended between two layers of heavy clay and exposed to chemical pollution from agriculture or industrial activities, and show poor chemical status.

TABLE 6.2. The Banat River Basin: High Floods Risk Exposure

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
4	2	3	3	1[a]	3	3	5	4

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.
a. 3 for Western aquifers.

Over 59 percent of the total population in the Banat basin lives in urban localities, more than the national average. This is expected to increase, given that Timisoara, the largest city in the region, has a dynamic economy and acts as a magnet for population migration (seeking jobs and changing residence). The map of local human development index (LHDI) shows not only that the Banat basin can be rated as developed (on average) but also that it has the most balanced level of development among all river basins. The share of total population connected to piped water supply stands at 71.2 percent, well above the country average of 65 percent. Similarly, the population connected to sewerage networks is at 52.4 percent, above the country average of 48 percent.

The Banat basin was badly hit by catastrophic floods in the past and remains highly exposed to floods risk, despite the many protection works that have been built on some of its rivers. The value of damages by a 100-year return period flood is estimated to be 30 percent of the basin gross domestic product (GDP), while the average annual damage is 2–4 percent of GDP.[2] The most recent catastrophic floods occurred in 2005 when the Timis River overtopped, eroded and destroyed the dykes in several sections and flooded seven localities, and an area of over 100,000 hectares of land remained under water for several months in the western part of the basin. The same flood also affected a large area in neighboring Serbia. The Barzava River also has a long history of floods, and the most recent occurred in 2017. This river receives water from many mountain streams, which are exposed to flash floods and, because of its longitudinal natural slope of the river bed, has fast flow and creates fast floods with high damaging potential. Embankments and a few side polders protect the population and its socio-economic activities. Flood protection of Timisoara has benefited for a long time from a complex hydro-technical system that allows water transfer between the Bega and the Timis Rivers in case of too much (floods) or too little (drought) water in the Bega River.

The Banat basin is expected to face notable climate change effects, including a drop in the annual stock of rivers, drought, and high incidence of high intensity heavy rainfalls. The INHGA studies of 2015 showed that the rivers in this basin would experience a drop in annual water stock by about 10 percent (basin average), by year 2050. In addition, the high intensity rain storms in the upper basins of the Timis, Barzava, Cerna and Caras Rivers would enable more frequent flash floods which, particularly on the Barzava River, would turn into rapid floods in the lower basin. Same effects may be seen on the Timis River. The climate change would also impact dry farming agriculture given that the potential evapotranspiration (ETP) largely accounts for 600-800 mm in the mid and lower parts of the basin, with small areas reaching 1,000 mm and being exposed to a very high risk of drought. Under such conditions, it is of paramount importance that the existing irrigation and drainage systems be in a functional condition and operated properly.

The estimated changes in population would follow the general trend described for all other river basins, with a general decrease by 1.3 percent until 2020 and further by 6 percent until 2030. The urbanization trend would go opposite but at a much slower pace: the urban population is expected to increase by 0.2 percent until 2020 and 0.7 percent until 2030, at an annual rate of 0.05 percent. The result of these divergent trends would be a drop of 1.1 percent in urban and 1.6 percent in rural population by 2020, and of 5.3 percent in urban and 7.1 percent in rural population by 2030. If this change is complemented by the estimated increase of connections to water supply and sewerage networks to at least 80 percent by 2020 and 90 percent by 2030, the demand for water would increase substantially. The second trend is the increase of the water available to the population to the annual norm of 95 m^3/capita in urban and 128 m^3/capita in rural settlements, which would exert further pressure on the water resource. Under these conditions, the water demand for population would increase by 92 percent in 2020 and by 106 percent in 2030, to 83.6 million m^3 and 89.4 million m^3, respectively, compared with 43.4 million m^3 in 2016; the **average annual water consumption would also increase from 62.5 m3/capita to 108.4 m3/capita**. As mentioned earlier, doubling the volume of water available for population in a short time would lead to overinvestment in both water supply and sewerage plus wastewater treatment facilities which would subsequently work at a lower and uneconomic capacity.

The demand of industrial water in Banat basin is the lowest among all basins, mainly because of the massive downsizing of heavy industry (steel plants, motors plants, crane manufacturers, etc.) that took place in the 1990s. However, the new trend in economic development including industrial sectors would demand increasing volumes of water by 27 percent until 2020 and 37 percent until 2030 (compared to 2016 demand). Even so, the Banat basin would remain the smallest consumer of water for industry in the country.

The water demand for livestock would show a general drop by 6 percent until 2020 (mainly because of the negative trend in chicken population) and would return close to the current (2016) level of demand, by 2030. Unlike the other basins, in Banat the population of pigs, cattle and sheep would keep increasing slowly, given the long local tradition in cattle breeding. With increasing drought effects, it is expected that more water would be demanded for irrigation provided that the existing schemes would be used at the level of 2012 when about 3.5 million m^3 were abstracted. **Of the total area of 11,461 hectares equipped for irrigation only about 2,360 hectares are expected to be rehabilitated beyond 2030**, while the degree of utilization may be increasing over time.

To conclude, **the overall water demand in the Banat basin would increase from 128 million m^3 in 2016 to 174 million m^3 in 2020 and 185 million m^3 in 2030** changing the current demand to availability ratio of 21-32 percent and 34 percent in 2020 and 2030, respectively. Even with this increase in demand and considering that the expected drop in water stock forecasted for

2050 would happen in 2020, the elasticity of availability would be maintained. The main issues are related to high vulnerability to floods—with significant negative impact on the national economy due to the relatively high level of development of the Timisoara region—as well as adapting to climate change (droughts) in some areas which could lead to opportunities for pilot projects on wastewater reuse.

This Crisuri River Basin has limited overall water resources, but they are of good quality and there is little pressure from demand. With 1.6 billion m^3, it is the third lowest river basin in Romania on water resource potential; consequently, the utilizable resource is also scarce, with only 400 million m^3, representing 25 percent of the utilizable resource. All rivers that make this basin flow across the border to Hungary and discharge into the Tisa River. The ecological status of surface water bodies (rivers) is high: 84 percent of surface water bodies with good and high status and 16 percent with moderate status; also, the chemical status of surface water is good, in general, except for the lower sectors of the Black Cris and the White Cris, towards the border with Hungary, where the water has a poor chemical status mainly because of the intensive agricultural activity in the area, where several large farms are operating. The Crisuri Rivers Basin has 9 bodies of subsurface water, and all are with a good quality and quantity status; however, some phreatic water bodies located in the low plain tend to reduce their availability during the summer.

Despite being largely rural, the Crisuri River Basin achieves a higher level of WSS access than the national average. The proportion of rural population in the basin standing at 57 percent, well above the national average, with most localities in the lower-middle developed level of local human development. However, the share of total population connected to piped water supply stands at 77.7 percent, significantly above the country average (65.4 percent). A similar situation for connection to sewerage with treatment, that stands at 50.7 percent compared to 48 percent nationwide. This situation deviates substantially from the national pattern of low access in rural areas, and shows the strong interest of the local population to reach good living standards regardless of the type of community they live in, and readiness to pay for it.

The vulnerability to floods is moderate compared to other parts of Romania. The most exposed areas are located in the downstream sections of the Black Cris, the White Cris and the Barcau Rivers. Three significant floods occurred between 2000 and 2016 (in 2000, 2001 and 2005), mainly on the White Cris and the Barcau Rivers which continue to be at risk of

TABLE 6.3. The Crisuri River Basin: A Rural Basin with High Access Level

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
3	2	2	1	1	2	3	3	2

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.

further floods. Seven dams and reservoirs located in the basin contribute to flood protection and water security, though the Lesu Dam is one of the dams on which operational restrictions were imposed in 2004 because of safety issues. This dam should be subject to retrofitting and rehabilitation so that it can return to its initial storage capacity and be able to respond to new water demands.

The expected effects of climate change will be significant, but not enough to cause stress on the water balance. The INHGA studies of 2015 showed that the rivers in this basin would experience a drop in annual water stock by about 10 percent (basin average), by year 2050. The effects of climate change would be more harmful through the increasing incidence of high intensity rainfalls resulting in river floods as well as flash floods, although the past records do not indicate a high incidence of flash floods. The climate change would also impact dry farming agriculture given that the ETP accounts for 600-800 mm in the mid and lower parts of the basin, with some small areas reaching 1,000 mm.

The prospects for population change would follow the general decreasing pattern of total population living within the river basin by 1.3 percent by 2020 and 6 percent by 2030, accompanied by an increase of urban population by 0.2 percent until 2020 and 0.7 percent until 2030 (compared with 2016 figures), at annual pace of 0.05 percent, would lead to a drop with 1.1 percent for urban and 1.4 percent for rural population by 2020 and with 5.3 percent for urban and 6.5 percent for rural population, by 2030. The change trends in population numbers complemented by the expected steady increase of connection to water supply and sanitation to at least 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. It is estimated that to reach the annual norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas (reaching these targets would also double the average water consumption per capita from 56.9 m^3/year to 113.7 m^3/year), the water demand for population supply would also double in 2020 and increase by 113 percent in 2030, to 72 million m^3 and 77 million m^3, respectively, compared with 35 million m^3 in 2016. However, it is difficult to expect that sharp an increase in water consumption per capita considering the conservative attitude or rural population towards paying high water bills.

The dominant rural economies in the Crisuri Rivers Basin do not indicate a significant upward trend in water demand for industrial use and just 17 and 21 percent increases are expected by 2020 and 2030, respectively. In contrast, the water demand from agriculture would show a drop by 7.4 percent in 2020 and increase again by 2030 towards the volume consumed in 2016, 41 million. m^3. The drop until 2020 is expected because the current negative trend in pig and chicken population is expected to continue followed by a gradual reverse until 2030. It is also expected that the current slight upward trend in cattle and sheep population would continue at 1 percent annual pace. There is no irrigation activity in this river basin as no scheme had been built in the past, although the large areas with light (sandy) soils and high evapotranspiration demand irrigation and the expected effects of climate change would escalate the demand.

TABLE 6.4. The Somes-Tisa River Basin: Poor Water Quality, Floods Risk and WSS Access Gap

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
3	4	3	2	1	4	2	4	2

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.

To summarize, the overall water demand would increase from 119 million m^3 in 2016 to about 160 million m^3 by 2020 and to 169 million m^3 by 2030, which **would increase the demand-availability ratio to 45 percent in 2020 and 48 percent in 2030**—still providing a significant buffer against water stress. While there appear to be no risk of water scarcity in the near future, attention needs to be given to mitigating flood risks locally and improving the chemical and ecological status of the water bodies that still have problems.

The resource utilizable represents 22 percent of potential, while total demand in 2016 was only 21 percent of water utilizable, showing significant buffer in water resources to meet demand. The Somes River flows through the border with Hungary and discharges into the Tisa River. The ecological status of surface water bodies (rivers) is, with 52 percent good and high status, significantly below the country average of 71 percent, while 46 percent of water bodies have a moderate status and 2 percent have poor and bad status; the chemical status of the Somes River and some of its tributaries is poor, mainly because of discharges from the ore mining industry. All 15 subsurface water bodies, both phreatic and deep aquifers, have a good quantitative and qualitative status, benefiting the food industry (soft drinks) operating in the area.

The proportion of urban population is in line with the country average (55 percent against 54 percent). The map of local human development indicates that, on average, the river basin could be rated as middle developed, with several poor rural communities (in Salaj and Satu Mare counties) but also with high rated urban municipalities (e.g., Cluj, Baia Mare). The share of the total population connected to piped water supply is, with 62.3 percent slightly below the country average (65.4 percent); a similar situation for connection to sewerage with treatment (45 percent compared to 48 percent, respectively). This situation deviates slightly from the pattern of urbanization which, with 55 percent exceeds gently the country average (54 percent). The water demand for population accounts for about 31 percent of total demand in 2016.

The expected effects of climate change appear not very detrimental in this river basin, at least with respect to natural water resources: the studies done by INHGA in 2015 showed that the rivers in this basin would experience some increase of volume by about 2.5 percent (basin average), by year 2050. This is the only river basin with such a forecast. Actually, it appears that in this river basin the effects of climate change would be more harmful through the increasing incidence of high intensity rainfalls resulting in river floods as well as flash floods. The climate change would not impact dry farming agriculture given that the ETP largely accounts for 400-600 mm in the basin.

Floods risks are significant, especially in the Satu-Mare county which has been one of the worst hit counties in the country over the past two decades. Five significant floods occurred in the last 15 years, the largest number of floods in all river basins, same as in the Siret basin. Historic damages occurred on the Somes River both in 1970 and 1975, before flood protection infrastructure was built. However, the flood risk remains for both the Somes and the Tisa Rivers. Because it makes the northern border with Ukraine, flood risk management on the Tisa River demands international projects (under the EU Cross-Border Cooperation Program). Several dams on the Somes and tributaries (of which the most important are the Tarnita, the Stramtori and the Fantanele) contribute to water security and flood protection in the basin. None of these dams has been reported with safety issues or any operational restrictions.

The projections for population change showed a likely decrease of total population living within the river basin by 1.3 percent by 2020 and 6 percent by 2030, accompanied by an increase of urban population by 0.2 percent until 2020 and 0.7 percent until 2030, at the annual pace of 0.05 percent, compared with 2016 figures. The change trends in population number complemented by a steady increase of connection to water supply and sanitation to 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. It is estimated that to reach the annual norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas (reaching these values would imply roughly doubling the average water consumption per capita from 55.6 m^3/year to 109.5 m^3/year), the water demand for population supply would raise by 250 percent in 2020 and by 266 percent in 2030, to 155 million m^3 and 165 million m^3, respectively, compared with 62 million m^3 in 2016. However, it is difficult to believe that a sharp increase in connection rate would be complemented by a similar trend in water consumption per capita.

The Somes-Tisa basin is home to booming industries. Their fast pace development would also require a substantial increase in water demand, expected to double by 2020 and grow by 135 percent by 2030 to about 92 million m^3 and 113.5 million m^3, respectively, compared to the current 48 million m^3 (24 percent of total current demand).

A downward trend is expected to occur in water demand for agriculture mainly for livestock, because the current negative trend in the number of pigs and chicken is expected to continue until 2020 followed by a gradual and slight reverse by 2030, while the cattle and sheep populations would maintain the current slight upward annual trend of 1 percent. Under such scenario, the water demand would drop from the current 92 million m^3 (46 percent of total demand) to 86 million m^3 in 2020 and return to 91 million m^3 in 2030.

To summarize, the water demand would increase from 202 million m^3 in 2016 to about 264 million m^3 in 2020 and 297 million m^3 in 2030, representing 33 percent and 37 percent of the expected water availability, respectively. So, **there are no risks of water scarcity** as water availability will by far outreach demand, and attention should be focused on (a) **improving the**

TABLE 6.5. The Mures River Basin: Water Stress and Flood Risks

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
2	1	3	2	3	1	3	4	3

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.

quality of all water bodies, which are now well below the national average, (b) **mitigating floods risks**, and (c) **improving the WSS access rate** (that is not in line with the rate of urbanization and overall economic development).

The Mures River Basin has, with 3.9 billion m^3 from surface and 0.43 billion m^3 from subsurface waters, a significant water resource potential, above average, of which about 27 percent (1.07 billion m^3 from surface and subsurface) is utilizable for supply of various users located in the central part of Romania. The Mures River has a long path through central Romania where it collects all smaller rivers in the area and further flows across the western border to Hungary to discharge into the Tisa River. The ecological status of surface water bodies (rivers) is high: 87 percent of surface water bodies with good and high status and 11 percent with a moderate status; however, 2 percent of surface water bodies are still with a poor status and need to be improved. The chemical status of surface water is good, in general, with few tributaries collecting water from the ore mining area located in Western Carpathians that have poor chemical (and ecological) status because of their content of cyanide and other chemicals.

Of the 25 subsurface water bodies located within the Mures River Basin, four are deep aquifers and 21 are phreatic water bodies of shallow and medium depth; two phreatic water bodies cross the border to Hungary. All 25 subsurface water bodies have good quantitative status and 23 of them have a good qualitative status; however, two water bodies, one located on the Tarnava River and the other along the Mures River towards the border with Hungary, have poor quality, mainly because of leakages of pollutants from industrial, human and livestock activities. Despite the significant volume stored, the subsurface waters are little tapped: with less than 33 million m^3 abstracted annually (7 percent of all volume tapped annually country wide), the Mures River Basin is among the lower tapped river basins in the country.

The structure of the population shows that, with 56 percent of total, the urban population slightly exceeds the country average (54 percent) and is expected to further increase. The map of LHDI indicates that, on average, the river basin could be rated as upper-middle developed, with fewer poor rural communities (in Alba and Hunedoara counties) but also with many high rated urban municipalities (e.g., Arad, Targu Mures, Deva, Miercurea Ciuc). The share of total population connected to piped water supply is, with 72.4 percent, the third largest amongst river basins; a similar situation for connection to sewerage with treatment, where this basin has the second highest connection rate to sewerage and wastewater treatment (54 percent compared to 48 percent on average). This shows a strong interest of rural population in high standards of comfort and hygiene as the base for good livelihood. The water demand for population accounts for only 10 percent of total demand in 2016, being offset by the high industrial demand (77 percent).

The Mures River Basin was and remains highly prone to floods, some of them of a catastrophic scale; the floods that occurred in 1970 and 1975, as well as in 2000, 2005, 2006 and 2010, affected many localities of this river basin, particularly on the Mures River and the tributaries Tarnava Mare and Tarnava Mica. The floods in this basin are characterized by a small width of flooded area and high level of water (up to 2.8 m, based on still existing marks on walls) that increase the size of damages, mainly for civil constructions (houses, hospitals, schools, etc.). With one exception (the Balauseri Dam on the Tarnava Mica), no dams have been built in this river basin to enhance the flood risk management and flood protection infrastructure consists mainly of dykes and few temporary polders. One reason could be the particular shape of the relief: the rivers have narrow flood plains bordered with ridges, sometimes steep. This also explains why the area vulnerable to floods in this river basin is drawn as narrow ribbon along the main rivers.

The climate change would have significant effects on many ecosystems, including the natural water resources, as revealed by INHGA studies of 2015: by 2050, the rivers in the Mures basin would diminish their current annual stock by 9.9 percent. The frequency and severity of high intensity rainfalls would increase resulting in increased incidence of river floods and flash floods (the records of 2005–16 show that only a few flash floods events occurred in this basin). The climate change would not impact dry farming agriculture in the upper and mid sections of the basin (where the ETP values range between 400 and 600 mm annually) but is expected to hit hard the downstream areas where the ETP values of 800–1,000 mm are present and drought risk is significant.

The prospects for population change would follow the general pattern of the decrease of total population (by 1.3 percent until 2020 and 6 percent until 2030) combined with a slight increase in urban share of population by 0.2 percent until 2020 and 0.7 percent until 2030. The result of these opposite trends would be a drop of 1.1 percent for urban and 1.5 percent for rural population by 2020, and with 5.4 percent for urban and 6.9 percent for rural population by 2030. The change trends in population numbers complemented by an expected steady increase of connection to water supply and sanitation to at least 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. To reach the annual norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas by 2020, the water demand for population supply would increase by 115 percent in 2020 and by 130 percent in 2030, to 156 million m^3 and 167 million m^3, respectively, compared with 73 million m^3 in 2016 (reaching these targets would also double the average water consumption per capita from 55.7 m^3/year to 109.4 m^3/year).

The demand for industrial water is very high in Mures River Basin, representing 27 percent of the country total, driven by the industrial activity in various fields: steel plants, thermal power plants, fertilizers production, chemical plants. The water demand is expected to increase further, with 31 percent by 2020 and with 46 percent by 2030 (compared with 2016 values), the second highest rates of increase among all river basins (after Arges-Vedea basin to be discussed further).

As opposed to industry, the water demand for agriculture would show a general drop with 6 percent by 2020 and a come-back to the 2016 volume and a slight increase by 0.6 percent in 2030. The drop of water demand by 2020 is forecasted considering that the current negative trend in pig and chicken population is expected to continue, followed by a gradual reversal until 2030. A continuation of the slight trend upward in cattle and sheep population at annual pace of 1 percent is also expected. The water demand for agriculture would also include irrigation. A single irrigation scheme (Semlac-Pereg, 8,400 ha) is expected to be rehabilitated in this basin by 2020 and the degree of utilization to gradually increase from the current 10 percent to at least 35 percent until 2030. Thus, the demand for water would remain steady at 3 million m^3 until 2020 and would increase to 6 million m^3 until 2030.

To summarize, **the overall water demand would increase from 718 million m^3 in 2016 to about 967 million m^3 by 2020 and to 1,067 million m^3 by 2030, which would increase the demand-availability ratio from the current 69 percent to 103 percent in 2020 and 113 percent in 2030** (considering that the effects of climate change on water availability forecasted for 2050 would occur by 2020). Given that the demand would increase so sharply until 2020 and that the water availability may not change so fast, the demand-availability would still be very tight (with 92 percent) by 2020 and still get to 102 percent in 2030. Though, if the population consumption (and demand) would not increase by more than 10 percent from the current per-capita volume, the overall demand-availability ratio would remain below 100 percent until 2030 (at 86 percent and 95 percent, respectively) but with very little elasticity for any increase in demand or drop in availability. Further, **if we consider that about 80 percent of the water abstracted for population would return through wastewater treatment, that volume would be reused within the basin, reducing thus the net water consumption to 81 percent in 2020 and 86 percent of availability in 2030**. Since the volume of water used from subsurface resources is still low, an increase of using this alternative resource may be considered, quality and quantity permitting. Priority should therefore be given to mitigating floods and drought risks locally, including through pilot projects for wastewater reuse.

The Jiu River Basin starts in the mountains that host the oldest coal mining area and is made up mainly by the Jiu River with tributaries; after the two spring branches (the Eastern

TABLE 6.6. The Jiu River Basin: WSS Access Gap and Droughts Risk

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
3	4	3	2	2	1	4	3	3

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.

Jiu and the Western Jiu) join into one stream, the river has a dominant north-south flow towards the Danube. With 4.56 billion m^3 from surface waters, of which 2.11 billion m^3 utilizable (46 percent), Jiu River Basin is one of most reliable river basins in Romania. However, the average abstraction from surface waters amounts to 0.9 billion m^3 (42.6 percent of the utilizable resources) which means about 20 percent of total annual water stock, showing a significant elasticity for further increase of consumption. The ecological status of surface water bodies (rivers) is mixed, with 94 percent of water bodies having a good and high ecological status (the highest among all river basins) and 6 percent of them having a moderate status, while from chemical perspective the Jiu river does not reach the good status on the median and downstream sections mainly because of the industrial and agricultural pollutants active in Gorj and Dolj counties, particularly around the cities of Targu Jiu and Craiova. Besides nutrients content, heavy metals and chlorides are present in significant amounts.

The subsurface water resources of the Jiu basin, distributed among eight water bodies, are estimated to be 1.04 billion m^3, of which 0.57 billion m^3 are located in phreatic aquifers and 0.47 billion m^3 in deep aquifers. However, this resource is barely tapped with only about 22 million m^3 abstracted annually, on average (2.2 percent of the total resource and 4.7 percent of total abstractions country-wide), leaving, in principle, significant room for further increase. Most phreatic bodies are located in the lower basin, towards junction with the Danube River, with little extension as a narrow strip along the flood plain of the median sector and are with a poor chemical status (mainly because of the substantial presence of nitrates and nitrogen from agriculture). The deep aquifers are located in the upper basin and are in a good chemical condition.

The proportion of urban population living in the Jiu basin matches the country average of 54 percent, and the most important city in the area is Craiova with high index of human development. (Other important towns are Drobeta Turnu Severin, Targu Jiu and Petrosani). The map of LHDI shows a divided level of development with the northern area middle developed and a southern area mostly with poor and very poor localities and only few “islands” of middle developed localities; on average, the Jiu basin could be rated as lower middle developed. The low development level is also reflected in the low percentage of population connected to water supply systems (57.7 percent), below country average (65 percent) and sewerage with wastewater treatment facilities (40 percent), also below country average (48 percent). By contrast, the annual water consumption is, with 63.4 m^3/capita, one of the country’s highest and above the Banat basin; most likely, the high consumption is due to the better developed northern localities. These data confirm the direct link between human development and access to basic services for decent livelihood.

Floods risks are relatively low when compared to the rest of the country. Although four significant floods have hit the Jiu basin since 1999 (2000, 2005, 2006 and 2013), the size of damages inflicted was less significant than in other river basins. The annual socio-economic loss is estimated at around 1 percent of GDP, mainly in case of floods with a 100-year return period.

However, the narrow strips of plain along main water courses are vulnerable to floods in absence of strong flood protection infrastructure, particularly for the individuals and businesses located in those areas. The largest dam in the basin is the Valea de Pesti (other seven smaller dams are also operated in the basin); it is located in the upper basin and was identified in 2004 as operating with restrictions because of safety issues that are about to be addressed as part of EU financed Large Infrastructure Operational Program (LIOP). The incidence of flash floods, reflected in the records of the past 12 years shows that almost all localities in the basin have experienced at least one event; the size of damages was not investigated.

The climate change would have significant effects on many ecosystems, including the natural water resources, as revealed by INHGA studies of 2015: by 2050, the rivers in the Jiu River Basin would diminish their current annual stock by 11 percent (the highest among all basins). The frequency and severity of high intensity rainfalls would increase, in general, raising the risk of river floods and flash floods. While the upper basin benefits of high rainfall and lower ETP (400-600 mm/year), the lower basin is at a very high risk of drought because of low rainfall and high ETP (800-1,000 mm/year), combined with the low water storage capacity of the light soils (with high sand content), which dominate the entire area. Large irrigation schemes have been developed in the past (covering about 380,000 hectares), mainly with abstraction from the Danube River, to overcome the drought risk but only a few of them are still functional and with very little utilization. The harsher the climate would turn the more needed these facilities will become, and the functionality of the viable ones would need to be restored and improved.

The prospects for population change would follow the general pattern of the general decrease of total population (by 1.3 percent until 2020 and 6 percent until 2030) combined with a slight increase in urban share of population by 0.2 percent until 2020 and 0.7 percent until 2030. The result of these opposite trends would be a drop of 1.1 percent for the urban and 1.5 percent for the rural population by 2020, and of 5.3 percent for the urban and 6.8 percent for the rural population by 2030. The trends of change in population number complemented by an expected steady increase of connection to water supply and sanitation to at least 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. To reach the annual norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas by 2020, the water demand for population supply would increase by 138 percent in 2020 and by 155 percent in 2030, to 114 million m^3 and 122 million m^3, respectively, compared with 48 million m^3 in 2016 (reaching these targets would also double the average water consumption per capita from 63.4 m^3/year to 110.2 m^3/year). As mentioned, increasing so much the volume of water available for population in short time would lead to overinvestment in both WSS services and wastewater treatment facilities which would subsequently work at a lower and uneconomic capacity.

The demand for industrial water is the highest of all river basins, at 789 million m^3, representing 39 percent of total demand for industry, driven mainly by coal mining, thermal power plants and chemical plants. The water demand is expected to increase further, by 27 percent by 2020 and by 33 percent by 2030 (compared with 2016 values), up to 1,006 million m^3 by 2020 and 1,051 million m^3 by 2030.

The water demand for agriculture would indicate a different trend than industry with a general drop of 6 percent by 2020 and a return to current (2016) demand by 2030. The drop of water demand by 2020 is forecast considering that the current negative trend in pig and chicken population is expected to continue, followed by a gradual reversal by 2030. The continuation of the slight trend upward in cattle and sheep population at the annual pace of 1 percent is also expected. As the demand for irrigation is concerned, although a large area was developed and equipped in the past (covering about 380,000 hectares), only a small fraction of 7,000 hectares (4.6 percent of economically viable area) has been, on average, systematically used since 2010. Rehabilitation of an area of 48,600 hectares is planned until 2030 but it will be supplied from the Danube River and will not affect the water resources of the Jiu basin.

In conclusion, the overall water demand would increase from 904 million m^3 in 2016 to about 1,182 million m^3 by 2020 and to 1,238 million m^3 by 2030, which would increase the **demand-availability ratio from the current 43 percent to 63 percent in 2020 and 66 percent in 2030** (considering that the effects of climate change on water resource availability would take effect by 2020). However, the change in demand was estimated in the worst-case scenario that the human consumption per capita would increase by 2020 to the levels prescribed by norms (which is unlikely to happen so suddenly) and that industrial consumption would not decrease as a result of technological improvements. Therefore, one can say that there is a sufficient buffer in water resources in meeting future demand, except for local potential shortages, though the current untapped groundwater resources offer additional safety net. **The priority should be to increase the WSS access rate** which is well below the national average, and **address the increased risks of drought in the southern part of the Jiu basin**, currently equipped with irrigation schemes (many of them currently unused).

The Olt River Basin is the second largest river basin in Romania on water resource potential (after the Siret), with approx. 5.3 billion m^3, and a total area of 23,387 km2. The utilizable resource is the third largest (after the Siret and the Jiu), with 2.01 billion m^3, representing 37.92 percent of the utilizable resource. The Olt River (615 km) is one of the most important Romanian Rivers, being the longest river flowing exclusively through Romania. Its source is

TABLE 6.7. The Olt River Basin: Challenges in the South with Access, UWWTD and Drought Risks

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Flood risk	Climate change impact
2	4	3	4[a]	1	2	5[a]	3	5[a]

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.
a. In the South.

in the Hasmas Mountains of the eastern Carpathian Mountains. It flows through the Romanian counties Harghita, Covasna, Brasov, Sibiu, Valcea and Olt and flows into the Danube River near Turnu Magurele. The main tributaries of the Olt River Basin are the Raul Negru, the Barsa, the Cibin, the Hartibaciu, the Lotru, the Luncavat, the Oltet and the Cerna. The ecological status of surface water bodies (rivers) is high when compared to other river basins and above the national average: 81 percent of surface water bodies have a good and high status, while 19 percent of them have a moderate status. Overall, it has 14 bodies of subsurface water, all of them having a good quantitative and qualitative status.

The proportion of urban population is slightly above the national average—but with marked difference in poverty and human development between the northern part (in Transylvania) and the south (along the Danube). The upper part of the river basin has mostly lower-middle and middle-developed LHDI, while the southern parts of the river basin exhibit a much lower level of local human development, with very poor and poorly developed areas and only a few localities exceeding the threshold of middle development. Across the river basin, 67.1 percent of the total population is connected to piped water supply, slightly above the country average (65.4 percent); a similar situation is encountered for the connection to sewerage with treatment (51.2 percent compared to the country average of 48 percent).

The vulnerability to floods in the Old River Basin is smaller than the national average. Significant flooding occurred in 2005, damaging many villages and localities and causing significant economic losses. The expected effects of climate change would be significant at least with respect to natural water resources: the INHGA studies of 2015 showed that the rivers in this basin would experience a drop in annual water stock by about 9.5 percent (basin average), by year 2050. The agricultural drought hazard risk is significant across lower parts of the river basin, with small areas exposed to very high drought hazard risks. The climate change could also impact dry farming agriculture given that the potential evaporation (ETP) accounts for values above 800 and up to 1,000 mm in the lower parts of the basin.

The estimated changes in population would follow the general trend described for all other river basins, with a general decrease by 1.3 percent until 2020 and further by 6 percent until 2030, accompanied by an increase of urban share of population by 0.2 percent until 2020 and 0.7 percent until 2030 (compared with 2016 figures), at the annual pace of 0.05 percent. The change trends in population numbers complemented by an expected steady increase of connection to water supply and sanitation to at least 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. However, given the numerous localities with low Human Development Index (HDI) values in the river basin, increasing the connection rates close to the country averages would be very challenging and a huge effort would be needed to finance and implement a large number of WSS projects in the coming decade. It is estimated that to reach the annual norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas, which would exert additional pressure on the water resource (reaching these targets would increase by 80 percent the average water consumption per capita from 60.26 m^3/year to 108.41 m^3/year), the water demand for population supply would more than double in 2020 and 2030, to 163 million m^3 and 173 million m^3, respectively, compared with 76 million m^3 in 2016.

Water demand for industrial use in the Olt River Basin indicates an upward trend, with 26 percent and 36 percent increases expected by 2020 and 2030, respectively. In contrast, the water demand from livestock would drop by 6 percent in 2020 and increase again by 2030 towards the volume consumed in 2016, 96 million m^3. The drop until 2020 is expected because the current negative trend in pig and chicken population is expected to continue followed by a gradual reversal by 2030. It is also expected that the current slight upward trend in cattle and sheep population would continue at 1 percent annual pace. The water demand for agriculture would also include irrigation. 35,716 ha of irrigation scheme is expected to be rehabilitated in this basin by 2030 and the degree of utilization to gradually increase from the current 10 percent to at least 25 percent until 2030. Thus, the demand for water for irrigation would increase by 5 million m^3 until 2020 and would further increase to 27 million m^3 until 2030.

To summarize, the overall water demand would increase from 282 million m^3 in 2016 to about 394 million m^3 by 2020 and to 443 million m^3 by 2030, which would increase the **demand–availability ratio to 22 percent in 2020 and 24 percent in 2030** (from the current 14 percent in 2016)—meaning than no stress related to water resources availability is expected in the future. Priorities are focused on the southern part of the basin, which has a high level of poverty, low WSS access rate, low rate of compliance with the Urban Waste Water Treatment Directive (UWWTD) (small number of existing Wastewater Treatment Plant [WWTPs]) and will be severely impacted by climate change through increased magnitude and frequency of droughts.

The status of both surface and sub-surface water bodies is below the national average. The Arges-Vedea River Basin has an area of 21,479 km2 and has a water resource potential of approx. 3.25 billion m^3; the utilizable resource is 1.74 billion m^3, representing 53.5 percent of the utilizable resource. The Arges River is 350 km long; its source is in the Fagaras Mountains, in the Southern Carpathians and it flows into the Danube at Oltenita. The main city on the Arges is Pitesti. Upstream, it is retained by the Vidraru Dam, which has created Lake Vidraru. The Vedea River flows from the Cotmeana Plateau and into the Danube, having a total length of 224 km, of which 33 km is regulated. The ecological status of surface water bodies (rivers) in the Arges-Vedea River Basin is lower than other river basins: 57 percent of surface water bodies have a good and high status, while 40 percent of them have a moderate status and 3 percent have a poor and bad status. The Arges-Vedea River Basin has 11 bodies of subsurface water and all of them have a good quantitative status; nine achieve good qualitative status, and two achieve poor qualitative status.

The percentage of urban population is the highest of all river basins (67 percent), but this is mostly because the capital Bucharest (with approximately 1.8 million inhabitants) is included in the numbers. Apart from Bucharest, **the majority of the localities in the lower part of the river basin show high levels of poverty and under-development** (poor and very poor

TABLE 6.8. The Arges-Vedea River Basin: Major Hotspot for Water Security

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
4[a]	4[a]	2	4	4	4	5	5	5

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.
a. except Bucharest.

LHDI score). The share of the total population connected to piped water supply across the river basin is 71.2 percent, above the country average (65.4 percent); a similar situation is encountered for connection to sewerage with treatment (62.4 percent compared to the country average of 48 percent). However, the higher water supply connection numbers are influenced again by Bucharest, which attains a 95 percent connection rate to piped water and a 95 percent connection to sewerage with treatment. **If Bucharest is left out, the share of total population connected to piped water supply across the river basin is merely 25 percent, while connection to sewerage with treatment is only 16 percent.**

Arges-Vedea is a river basin occasionally hit by river floods and flash floods, with high flood risks in the south along the Danube. Several floods occurred between 2000 and 2016 (the most serious in 2005 and 2006), damaging villages and other localities and causing significant economic losses. The consolidated flood risk map finalized in 2015 shows several flood risk areas within the river basin. The effects of climate change would be more harmful through the increasing incidence of high intensity rainfalls resulting in river floods as well as flash floods. 49 accumulation lakes with a total volume of 921 million m^3 exist in the Arges-Vedea River Basin; of these, 21 have multiple uses, Vidraru being the most important one.

The expected effects of climate change would be highly significant, especially in the southern part of the basin along the Danube. The 2015 INHGA study showed that the rivers in this basin would experience a drop in annual water stock by about 9.2 percent (basin average), by year 2050. Changes in the regime of the multiannual average flows of various rivers, for the 2021-50 period compared to the reference period 1971-2000, were identified by INHGA. The Vedea River expects the largest reduction, with about 25 percent decrease in flow. The agricultural drought hazard risk is very high in the lower part of the Arges-Vedea River Basin, with large areas exposed to very high drought hazard risks. The climate change could also impact dry farming agriculture given that the potential evaporation (ETP) accounts for values above 800 mm in the lower half of the basin.

The estimated changes in population would follow the general trend described for all other river basins, with a general decrease by 1.3 percent until 2020 and further by 6 percent until 2030, accompanied by an increase of urban share of population by 0.2 percent until 2020 and 0.7 percent until 2030 (compared with 2016 figures), at the annual pace of 0.05 percent. The change trends in population number complemented by an expected steady increase of connection to water supply and sanitation to at least 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. However, if

Bucharest is not taken into account (having already 95% connection to water supply and sanitation) and given the large share of localities with low HDI values in the river basin, increasing the connection rates close to the country averages would be extremely challenging and an enormous effort would be needed to finance and implement a large number of WSS projects in the coming decade. It is estimated that to reach the annual norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas, which would exert additional pressure on the water resource (reaching these targets would also more than double the average water consumption per capita from 48.06 m^3/year to 113.94 m^3/year), the water demand for population supply would almost double in 2020 and 2030, to 313 million m^3 and 332 million m^3, respectively, compared with 179 million m^3 in 2016. However, it is very difficult to expect the sharp increase in water consumption per capita considering the numerous localities with low HDI values and the conservative attitude of rural population towards paying high water bills.

Water demand for industrial use in the Arges-Vedea River Basin indicates an upward trend, with 118 percent and 195 percent increases expected by 2020 and 2030, respectively (the largest increases of all river basins). In contrast, the water demand from livestock would show a drop by 6 percent in 2020 and increase again by 2030 towards the volume consumed in 2016, 192 million m^3. The drop until 2020 is expected because the current negative trend in pig and chicken populations is expected to continue followed by a gradual reversal between 2020 and 2030. It is also expected that the current slight upward trend in cattle and sheep population would continue at 1 percent annual pace. The water demand for agriculture also includes irrigation. 40,647 ha of irrigation schemes is expected to be rehabilitated in this basin by 2025, and the degree of utilization to gradually increase from the current values of below 5 percent to at least 35 percent until 2030. Thus, the demand for water would increase at 15 million m^3 until 2025 and would further increase to 34 million m^3 until 2030. Water stress is expected during summer months in dry years. High evaporation and increasing water stress due to the effects of climate change would increase the demand for irrigation, which may increase the water availability stress.

To summarize, the overall water demand would increase from 569 million m^3 in 2016 to about 926 million m^3 by 2020 and to 1,143 million m^3 by 2030, which would increase the **demand-availability ratio to 59 percent in 2020 and 72 percent in 2030** (from the current 33 percent in 2016)—**suggesting that at least some portion of the river basin may be subject to water stress** due to local patterns of demand versus resources availability. The Arges-Vedea is one of the most challenged river basin in Romania for water security, with very low

TABLE 6.9. The Buzau-Ialomita River Basin: Major Hotspot for Water Security

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
4	3	4	5	5	4	5	5	5

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.

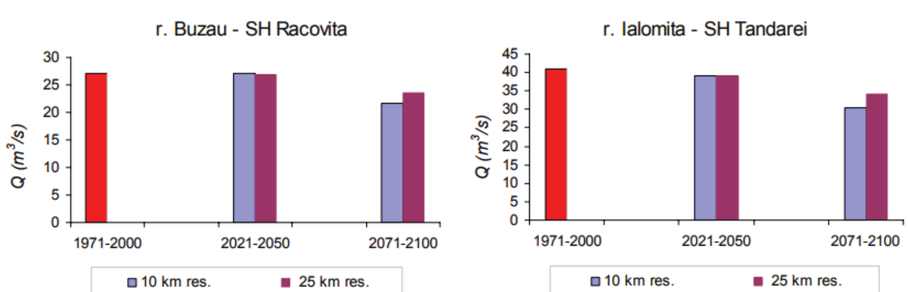
ratings in terms of poverty outside of the capital Bucharest, WSS access rate, floods risks, water quality, drought risk and expected impact of climate change.

The ecological status of surface water bodies in the Buzau-Ialomita River Basin is lower than the national average, with only 63 percent with the good and high status, and 37 percent with the moderate status. The situation is better for subsurface water bodies, both phreatic and deep aquifers, with 17 out of 18 having a good quantitative and qualitative status.

The share of total population connected to piped water supply is at 68.4 percent, slightly above the country average (65.4 percent); however, connection to sewerage with treatment for the Buzau-Ialomita River Basin is at 37 percent, significantly lower than the country average of 48 percent, showing **significant difficulties for implementation of the UWWTD**. The pattern of urbanization, at 45.8 percent, is among the lowest in the country (only Siret with 39.7 percent and Crisuri with 43.2 percent having lower values, while the country average is 54 percent). In practice, there is a **substantial polarization of wealth between a few relatively developed areas and a large number of poor and very poor rural localities with low WSS access rate**.

The expected effects of climate change will be very significant in the Buzau-Ialomita basin. The studies done by INHGA in 2015 showed that the rivers in this basin would experience a decrease of volume by about 5.8 percent (basin average), by year 2050. Under the EU Project CECILIA,[3] the analysis of the hydrological scenarios results shows that in the Buzau-Ialomita area, **the mean annual flow will decrease by 15–20 percent in the near future period (2021–50) and by 30–40 percent in the far future (2070–2100)** (figure 6.1), especially due to the increase of evapotranspiration. An analysis of changes in demands shows that the demand-supply gap will be manageable for the next 15–20 years, but significant measures will be needed to address vulnerability in the time period after that. Climate change is expected to impact dry farming agriculture given that the ETP accounts for values of over 1,000 mm in large areas within the basin. Water stress will intensify during summer months in dry years. **Large areas of the Buzau-Ialomita are at a high risk of agricultural drought**.

FIGURE 6.1. Comparison of Mean Annual Flow Modification in Climate Change Conditions from RegCM



Source: CECILIA EU project, 2009.

Flood risks in the Buzau-Ialomita River Basin are relatively high. The two main rivers of the basin, Ialomita and Buzau, did not threaten seriously to flood important areas and create substantive damages in the past 15 years, except in 2005, when two flood events on Ialomita River destroyed many houses in several villages located in the lower basin. However, in 1975, the same river flooded over 150,000 ha and the width of the flooded area reached up to 12 km in some sections. The flood risk maps of both rivers show that significant areas are at risk of flood in their lower sectors and corresponding investment for new flood protection infrastructure have been included in the River Basin Flood Management Plan. Climate change is expected to further increase the current level of floods risks.

The prospects for population change showed a likely decrease of the total population living within the river basin by 1.27 percent by 2020 and 5.97 percent by 2030, accompanied by a slight increase of urban population by 0.7 percent by 2020 and 0.8 percent by 2030, at the annual pace of 0.05 percent, compared with 2016 figures. The change trends in population numbers complemented by a steady increase of connection rates to water supply and sanitation, as country averages, to 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. However, given the high percentage of poor and very poor localities in the river basin, increasing the connection rates close to the country averages would be very challenging and an enormous effort would be needed to finance and implement a large number of WSS projects in the coming decade. It is estimated that to reach the norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas (reaching these values would imply more than doubling the average water consumption per capita from 45.2 m^3/year to 112.6 m^3/year), the total water demand for population supply would raise by 287 percent in 2020 and by 305 percent in 2030, to 202 mill. m^3 and 215 mill. m^3, respectively, compared with 70 mill. m^3 in 2016. However, it is difficult to believe that a sharp increase in connection rate would be complemented by a similar trend in water consumption per capita.

The Buzau-Ialomita basin is also expected to see increased industrial demand. The positive pace of development would require an increase in water demand, by 28 percent by 2020 and by 24 percent by 2030 to about 162 mill. m^3 and 179 mill m^3, respectively, compared to the current 126 mill. m^3 (39.3 percent of total current demand). A downward trend would occur in water demand for agriculture, mainly for livestock, because the current negative trend in numbers of pigs and chicken is expected to continue until 2020 followed by a gradual and slight reverse by 2030, while the cattle and sheep populations would maintain the current slight upward annual trend of 1 percent. Under such scenario, the water demand would drop from the current 116 mill. m^3 (36.2 percent of total demand) to 109 mill. m^3 in 2020 and return to 116 mill. m^3 in 2030.

To summarize, the water demand would increase from 320 mill. m^3 in 2016 to about 384 mill. m^3 in 2020 and 582 mill. m^3 in 2030, representing 123 percent and 173 percent of water availability—meaning that the basin would be under severe water scarcity. **The Buzau-Ialomita River Basin is a major hotspot for water security**—not only in terms of **water scarcity**

TABLE 6.10. The Siret River Basin: WSS Access Gap, High Floods Risks and Poor Quality of Rivers

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
2	5	4	4	2	3	4[a]	5	4

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.
a. In the east.

but also in terms of **difficulties to comply with the UWWTD, low surface water quality, and high climate change impact through droughts and floods**. For agriculture, as water stress will intensify during the summer months in dry years due to increased drought risks and since the Buzau-Ialomita has one of the largest irrigated areas in the country, which is also entirely gravity fed, rehabilitation of most irrigation schemes in the context of climate change may be desirable and should be analyzed in details, along with potential for new crop patterns and moving to high value agriculture as a key engine to push for local economic development.

The Siret River Basin has the largest area (42,890 km2) and is the largest river basin in Romania on water resource potential, with approx. 5.63 billion m^3; consequently, the utilizable resource is also the largest, with 2.66 billion m^3, representing 47.25 percent of the utilizable resource. The Siret River (559 km) is one of the most important Romanian Rivers, marking the international border with Ukraine in the north of Romania and discharging in the Danube. Its main tributaries are the Bistrita, the Trotus, the Moldova and the Suceava. The Siret River has a high hydro-energetic potential and great fresh water supply.

The ecological status of surface water bodies (rivers) is average when compared to other river basins: 69 percent of surface water bodies have good and high ecological status, while 31 percent of them have the moderate status. The Siret is a hotspot for chemical pollution of the aquifers located in the north of the Siret River Basin at the border with Ukraine. Overall, the Siret River Basin has 6 bodies of subsurface water, all of them with good quantitative status; five of them achieve good qualitative status, while one achieves poor qualitative status.

The population is mostly rural (60 percent), being the highest level of all river basins, with low WSS access rate—but the poverty level is average, since the western part of the river basin has middle-developed LHDI, while the eastern and south-eastern parts of the river basin exhibit a lower level of local human development, with many very poor and poorly developed areas. The large share of rural population and poor development also reflects in the lowest share of total population connected to piped water supply across all river basins: 49.5 percent, significantly below the country average (65.4 percent); a similar situation is encountered for connection to sewerage with treatment (34.1 percent compared to the country average of 48 percent).

The Siret River Basin is highly prone to river floods and flash floods. Significant floods occurred between 2000 and 2016 (the most serious in 2005, 2006, 2008 and 2010), damaging many villages and localities and causing significant economic losses. In 2005, the Siret River recorded a historic flow with values between 5,000 and 5,500 m^3/s, representing one of the highest flows on the interior rivers in Romania. The consolidated flood risk map finalized in 2015 shows that one main flood risk area is along the junction of the Siret, the Prut and the Danube Rivers, near Galati. Due to the torrential character of most of the rivers in the Siret basin, water consumption appeared and developed from simple water use to complex accumulations. 357.7 km of dams and 31 accumulation lakes have been built, to ensure different uses of the water sources and to diminish the floods impacts. The Poiana Uzului dam on the Siret was included in the HRMEP project in 2011-12 and still needs to be rehabilitated. The Belci dam is located on the Tazlau River, under the authority of Water Basin Administration (ABA) Siret. The dam was mainly built for water supply of Onesti city and hydropower production, and registers the only Romanian dam failure in the past 50 years. The failure of the dam took place in 1991, because of heavy floods, which overtopped the crest. The dam is not in use since the breach, nor are any maintenance works done around it. Taking into account the flood peaks that have been recorded in past 30 years at the dam site, ABA Siret proposed under the Flood Risk Management (FRM) plans issued in 2015 that the Belci dam could be reconsidered under a changed purpose from water supply and hydropower into flood protection, as a non-permanent reservoir. This would require significant reconstruction and rehabilitation works at the dam to restore its safe functionality.

The expected effects of climate change would be significant, at least with respect to natural water resources: the INHGA studies of 2015 showed that the rivers in this basin would experience a drop in annual water stock by about 9.6 percent (basin average), by year 2050. The effects of climate change would be more harmful through the increasing incidence of high intensity rainfalls resulting in river floods as well as flash floods, with past records indicating an extremely high incidence of flash floods. The agricultural drought hazard risk is significant across the eastern and lower parts of the river basin, with small areas exposed to very high drought hazard risks. The climate change could also impact dry farming agriculture given that the potential evaporation (ETP) accounts for 500-700 mm in the east and lower parts of the basin.

The estimated changes in population would follow the general trend described for all other river basins, with a general decrease by 1.3 percent until 2020 and further by 6 percent until 2030, accompanied by an increase of the urban share of population by 0.2 percent until 2020 and 0.7 percent until 2030 (compared with 2016 figures), at the annual pace of 0.05 percent. The change trends in population number complemented by an expected steady increase of connection to water supply and sanitation to at least 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. However, given the large share of rural population and the numerous localities with low HDI values in the river basin, increasing the connection rates close to the country averages would be very challenging and a huge effort would be needed to finance and implement a large number of WSS projects in the coming decade. It is estimated that to reach the annual norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas, which would exert additional pressure on the water resource (reaching these targets would also more than double the average water consumption per capita from 48.06 m^3/year to 113.94 m^3/year), the water demand for population supply would more than triple in 2020 and 2030, to 198 million m^3 and 211 million m^3, respectively, compared with 54 million m^3 in 2016. However, it is very difficult to expect the sharp increase in water consumption per capita considering the numerous localities with low HDI values and the conservative attitude of rural population towards paying high water bills.

Water demand for industrial use in the Siret River Basin has an upward trend, with 26 and 38 percent increases expected by 2020 and 2030, respectively. In contrast, the water demand from livestock would show a drop by 6 percent in 2020 and increase again by 2030 towards the volume consumed in 2016, 112 million. m^3. The drop until 2020 is expected because the current negative trend in pig and chicken populations is expected to continue followed by a gradual reversal by 2030. It is also expected that the current slight upward trend in cattle and sheep population would continue at 1 percent annual pace. The water demand for agriculture would also include irrigation. 5,779 ha of irrigation scheme are expected to be rehabilitated in this basin by 2030 and the degree of utilization to gradually increase from the current 10 percent to at least 35 percent until 2030. Thus, the demand for water would increase to 12 million m^3 until 2020 and would further increase to 24 million m^3 until 2030.

To summarize, the overall water demand would increase from 232 million m^3 in 2016 to about 397 million m^3 by 2020 and to 436 million m^3 by 2030, which would increase the demand-availability ratio to 22 percent in 2020 and 25 percent in 2030 (from the current 9 percent in 2016)—meaning that **there should be no expected water stress due to mismatch between demand and available resources** in the future. The Siret basin is however a hotspot for water security due to low access rate, low compliance with the UWWTD, high risks of floods and high expected impact of climate change. Special attention should be given to developing flood protection infrastructure and conducting dam rehabilitation works.

The Prut-Barlad River Basin has low water resources, being, with approx. 360 million m^3, the second lowest river basin in Romania on water resource potential; consequently, the utilizable resource is also scarce (the second lowest in Romania), with only 230 million m^3, representing 64 percent of the utilizable resource. The Prut River (742 km) is one of the most important Romanian Rivers, being also an international border with the Republic of Moldova and Ukraine. The Barlad River is a tributary of the Siret, and is located in the eastern part of Romania. A large share of rivers and water bodies (up to one third of the total) are ephemeral (non-permanent), which reduces their capability to sustain ecosystems.

TABLE 6.11. The Prut-Barlad River Basin: Hotspot for Water Scarcity, Poverty and Floods Risks

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
5	5	4	5	3	4	5	5	5

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.

The ecological status of surface water bodies (rivers) is very low when compared to other river basins (only the Dobrogea-Litoral River Basin has worse quality): 34 percent of surface water bodies have the good and high ecological status, while 66 percent have the moderate status. Prut-Barlad is a hotspot for chemical pollution of the aquifers located in both the north and the south of the Prut-Barlad basin (border with Moldova), which also happens to be a hotspot for aquifers over-abstraction. The Prut-Barlad River Basin has seven bodies of subsurface water, all of them with a good quantitative status; however, only four of them achieve good qualitative status, while the other three have poor qualitative status.

With 54 percent of total river basin population, rural population predominates and is slightly above the national average—but it has **one of the highest levels of poverty, being located in the poorest and least developed part of the country**. The poor development also reflects in a low share of total population connected to piped water supply: 53.6 percent (second lowest after the Siret River Basin), significantly below the country average (65.4 percent); a similar situation for connection to sewerage with treatment (37.2 percent compared to 48 percent country average). A large portion of small agglomerations between 2,000 and 10,000 PE do not yet have any sewage collection systems, and the situation is especially critical in the Prut-Barlad basin on the border with Moldova, a region with a high density of small agglomerations.

The vulnerability to floods in the Prut-Barlad basin is significant. The consolidated flood risk map finalized in 2015 shows that one main risk area is along the junction of the Prut, the Siret and the Danube Rivers, near Galati. Several significant floods occurred between 2000 and 2016 (in 2002, 2005, 2006, 2007, 2010) mainly on the Prut, the Miletin, the Jijia, and the Barlad Rivers, which continue to be at risk of further floods. A recent complex exploratory research project (CLIMHYDEX)[4] highlighted a general increase of the frequency of occurrence of flash flood events for the upper Barlad River Basin. The project produced various studies to improve knowledge on the variability of the most important weather and climate extremes occurring in Romania at various time scales and to estimate the uncertainty associated with their projections of the future climate, as well as to quantify climate change impact on hydrological regime focusing on extreme events. For the Barlad River Basin, a general increase of the flash floods frequency in the upper catchment was forecast, and a decrease of this frequency for the middle and lower basin for both 2021–50 and 2071–2100 compared to the reference period 1976–2005. Seven dams and reservoirs located in the basin contribute to flood protection and water security.

The expected effects of climate change will be significant. The INHGA studies of 2015 showed that the rivers in this basin would experience a drop in annual water stock by about 10 percent (basin average) by year 2050. The effects of climate change would also be harmful through the increasing incidence of high intensity rainfalls resulting in river floods as well as flash floods. The Prut-Barlad is a drought-prone river basin. The agricultural drought hazard risk is high across the whole river basin, with small areas exposed to very high drought hazard risks. High values of evaporation have been reported in the Prut-Barlad River Basin. The climate change would impact dry farming agriculture given that the potential evaporation largely accounts for values over 800 mm in most parts of the basin, with a small area reaching values over 1,000 mm (map 3.8). On a monthly basis, significant amounts of water evaporate during the summer (especially in July, August), about 40 percent of the total amount of water evaporated annually.

The prospects for population change would follow the general decreasing pattern for the total population living within the river basin to go down by 1.3 percent by 2020 and 6 percent by 2030, accompanied by an increase of the urban population by 0.2 percent by 2020 and 0.7 percent by 2030 (compared with 2016 figures), at annual pace of 0.05 percent. The result of these opposite trends would be an increase of 7 percent for urban population and a decrease of 3 percent for rural population by 2020, and an increase of 8 percent for urban and a decrease of 12 percent for rural population by 2030. The trends in population numbers complemented by the expected steady increase of rates of connection to water supply and sanitation to at least 80 percent by 2020 and 90 percent by 2030 would increase significantly the demand for water. However, given the high percentage of poor and very poor localities in the river basin, increasing the connection rates close to the country averages would be very challenging and a huge effort would be needed to finance and implement a large number of WSS projects in the coming decade. Another trend is for the water available for population to reach the annual norm of 95 m^3/capita in urban and 128 m^3/capita in rural settlements, which would exert additional pressure on the water resource (reaching these targets would also more than double the average water consumption per capita from 51.01 m^3/year to 111.6 m^3/year), the water demand for population supply would more than triple in 2020 and 2030, to 175 million m^3 and 186 million m^3, respectively, compared with 54 million m^3 in 2016. However, it is very difficult to expect the sharp increase in water consumption per capita considering the low HDI values and the conservative attitude of rural population towards paying high water bills.

The dominant rural economies in the Prut-Barlad River Basin do not indicate a significant upward trend in water demand for industrial use and just 29 and 42 percent increases are expected by 2020 and 2030, respectively. The water demand from agriculture (in general) would show an increase by 23.6 percent in 2020 and by 169 percent compared with the volume consumed in 2016, 31 million m^3. The majority of the public irrigation schemes are located in the southern (lower Danube plain) and eastern part of the country (south of the Prut-Barlad basin, at the borders with Moldova and Ukraine). Small viable and marginally viable irrigation areas are located along the Prut River. Water stress is expected during summer months in dry years in the river basin, due to low water stock, especially in populated urban settlements. **High evaporation values and increasing water stress due to the effects of climate change would increase the demand for irrigation**, which may further increase the water availability stress.

To summarize, the overall water demand would increase from 260 million m^3 in 2016 to about 403 million m^3 by 2020 and to 476 million m^3 by 2030, which would **increase the demand-availability ratio to 62 percent in 2020 and 73 percent in 2030**—meaning that **the Prut-Barlad River Basin may be suffering from water stress in certain localized areas**. It is a major hotspot for water security, due to not only water availability stress but also low performance in terms of WSS access, UWWTD compliance, quality of water bodies, high floods and drought risks, and expected impact of climate change.

The Dobrogea-Litoral (sea shore) basin is located in the south-eastern part of Romania and has a number of specific features as it comprises three different geographical landscapes: the Dobrogea plain (the area between the Danube in the west and north, and the Black Sea in the east), the Danube Delta and the Black Sea shore. Each of these parts could be considered a separate entity because of their specificity with respect to water resource use, quality, and management.

Although bordered on three sides by water (the Danube and the Black Sea), **the Dobrogea area has scarce own surface water resources (except for the Danube River)**, consisting of few small rivers (with low flow rates that cannot allow any permanent use) and the lakes located in the proximity of the sea shore and along the Danube in the west. The multiannual water stock of the internal rivers amounts to 145 million m^3 which makes Dobrogea (surface-waters-wise) the poorest basin in Romania. The natural lakes account, in total, for 1.5 billion m^3, but their water's chemical composition makes them unsuitable for drinking; hence, they are used for fishing, irrigation, tourism, and sailing. Four permanent reservoirs exist in the area with a total storage of 24.5 million m^3, which have been built for fish farming and small-scale irrigation. The utilizable resource is also very small, amounting to about 40 million m^3 (27 percent of the total—a high share). **The ecological status of surface water bodies (rivers) is also the poorest in Romania,** with 90 percent of them of moderate status and only 10 percent of good and high status. The limited surface waters all have a good chemical status, because the majority of the industries are located close to the Danube or the Black Sea. The main water resource remains the Danube (within its share, Romania can tap annually for its own use 20 billion m^3).

The subsurface resources amount to 2.1 billion m^3, of which the utilizable resource accounts for 383 million m^3 (18 percent of total). Most of the subsurface water, 350 million m^3 (91 percent of total) is stored in deep aquifers, while only 33 million m^3 are available from phreatic deposits (where water has a higher mineral content). The subsurface water has uneven territorial distribution, with 288 million m^3 in the south and 95 million m^3 in the north. The average annual abstraction, however, does not exceed 65 million m^3 (17 percent of total), mainly because of the high cost of pumping from deep aquifers with good quality.

TABLE 6.12. The Dobrogea River Basin: Irrigation and Danube Delta Challenges

Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change impact
5[a]	1	2	1	3	4	4	3	5

Source: World Bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.
a. Except the coastal city of Constanta.

The Danube Delta, managed as a Biosphere Reservation (RAMSAR Site) has plenty of water provided by the Danube together with the deltaic lakes (Razim, Sinoe, Babadag, Smeica, etc.), which are also the main resource for all activities (they are also used a source of drinking water by people living in remote areas with no access to piped systems).

The Dobrogea-Litoral basin has the second highest urbanization rate (63 percent) among river basins, with Constanta and Tulcea being the main cities in the area. Constanta is also the main harbor on the Black Sea and an important trade center for Eastern Europe, connected to Rotterdam through the Danube-Rhine Canal systems. The map of human local development indicates an average middle development around Constanta, but many poor localities elsewhere (particularly in the delta). By contrast, the rate of population connected to piped water supply systems is, with 81.2 percent, the highest in Romania, and a connection rate to sewerage with treatment is 54.2 percent.

The exposure to flood risk is relatively modest, and exists mainly in the western and northern areas along the Danube, where the low plain has been embanked, but the risk of dykes overtopping remains, particularly with the recent change in the pattern of high flows on the Danube. Significant floods occurred here in 1988, 2001, 2004 and 2005, but with smaller damages compared to other basins. The vulnerability to flash floods exists, but is scattered across the basin; very high damages have occurred, however, in Babadag and Costinesti (on the sea shore) following high intensity rain storms.

The climate change would have significant effects on many ecosystems, both in Dobrogea and the Danube Delta, affecting not only the natural water resources but the vegetation and fauna habitats; the INHGA studies of 2015 estimated the change in the annual water stock by year 2050 but their assessment did not include Dobrogea; however, based on the estimates for neighboring basins, we considered that a 10 percent decrease in water stock of surface water bodies is reasonable, although it would not make much difference for the already scarce resources. Besides, there was no estimate for the likely change in the annual water stock for the Danube River. However, the frequency and severity of high intensity rainstorms would increase, raising the river and flash flood risk. The increasing frequency of very high flow rates exceeding 15,000 m^3/sec (the average flow rate is 6,000 m^3/sec) on the Danube in June, that occurred three times in the last seven years is a warning. The annual rainfall in Dobrogea does not exceed 400 mm, while the ETP exceeds 1,000 mm, creating a permanent exposure to drought which, combined with regular eastern winds, increases the drought effects, which are expected to increase. Large irrigation schemes have been developed on over

585,000 ha to offset the drought risk, but only 143,600 ha are economically viable (the rest pump water at elevations that are too high to be economic) and should be used intensively (after rehabilitation and modernization).

The prospects for population change would follow the general pattern of decrease of the total population (by 1.3 percent by 2020 and 6 percent by 2030) combined with a slight increase of the urban population share by 0.2 percent by 2020 and 0.7 percent by 2030. The result of these opposite trends would be a drop of 1.1 percent for urban and 1.6 percent for rural population by 2020, and of 5.3 percent for urban and 7.1 percent for rural population by 2030. Considering the current gap between the connection rates to water supply and sewerage with treatment, we estimated that more funds would be invested in fostering connections to sewerage with treatment and less to water supply (which would only increase by 3 percent by 2020 and reach 90 percent in 2030). To reach the annual norm of water available for population in urban areas of 95 m^3/capita and 128 m^3/capita in rural areas by 2020, the water demand for population supply would increase by 64 percent in 2020 and by 67 percent in 2030, to 78 million m^3 and 79.6 million m^3, respectively, compared with 48 million m^3 in 2016 (reaching these targets would also double the average water consumption per capita from 66.7 m^3/year to 107 m^3/year). As mentioned, increasing the volume of water available to the population so drastically in such a short time would lead to overinvestment in both water supply, and sewerage and wastewater treatment facilities, which would subsequently work at a lower and uneconomic capacity.

This basin has the highest consumption of water for industrial activities, mainly because of the demand from the Cernavoda Nuclear Plant: the annual demand for industrial water in 2012 was of 2,501 million m^3 (more than the cumulative values for all other river basins), all abstracted from the Danube. In absence of an alternative methodology to estimate the future water demand for industry, we accepted the approach taken by ANAR in preparing the RBMP that showed that the industrial water demand would further increase sharply to 6,860 million m^3 in 2020 and 9,400 million m^3 in 2030.

The water demand for agriculture, including livestock and irrigation, would show a decrease by 2.5 percent made up of a decrease by 6 percent of the demand for livestock and an increase by 82 percent of demand for irrigation. The decrease by 2020 is expected considering that the current negative trend in pig and chicken populations is expected to continue, followed by a gradual reversal by 2030. The slight upward trend in cattle and sheep population recorded in the past years is expected to continue at the annual pace of 1 percent. Thus, it is expected that water demand would return to the current demand (2016) by 2030. It was also estimated that about 40 percent of the demand for livestock would be abstracted from surface waters while the rest would be abstracted from the Danube or phreatic aquifers. On irrigation, despite the large area equipped in the past, only a small fraction remained operational and was used recently: 3,910 hectares were irrigated annually, on average, in 2010–16, that is 2.7 percent of the economically viable area. Rehabilitation of 54,700 hectares supplied from the Danube River is planned by 2030.

In conclusion, the overall water demand would increase from a total of 3,817 million m^3 in 2016 to about 7,620 million m^3 by 2020 and to about 10,600 million m^3 by 2030, which **would increase the ratio of water demand-availability from the current 19 to 38 percent in 2020 and 53 percent in 2030**—meaning that the Dobrogea basin would not be subject to water stress, provided that the demand can be met through the Danube, as well as abstraction from the deep aquifers for domestic potable supply in large cities. The main issues are related to the quality of surface water—which is unlikely to improve due to the conditions of the Danube—as well as adapting to increased frequency and magnitude of droughts due to climate change.

6.3. Conclusion: Hotspots for Water Security

6.3.1. Hotspots for Water Security at River Basin Level

The rating carried out for the nine above-mentioned dimensions of water security for each of the 11 Romanian river basins has been summarized in table 6.1. The last column indicates the total rating for each river basin, combining the rating for each of the nine analyzed dimensions, and allows to **classify the river basin in three clusters according to water security risks** (plus Dobrogea as a special case).

TABLE 6.13. Water Security Rating for the 11 Romanian River Basins

	Poverty	Access WSS	% rural	UWWTD	Water quantity	Water quality	Drought risk	Floods risk	Climate change	Total
Banat	4	2	3	3	1	3	3	5	4	**28**
Crisuri	3	2	2	1	1	2	3	3	2	**19**
Somes-Tisa	3	4	3	2	1	4	2	4	2	**25**
Mures	2	1	3	2	3	1	3	4	3	**22**
Jiu	3	4	3	2	2	1	4	3	3	**26**
Olt	2	4	3	4	1	2	5	3	5	**29**
Arges-Vedea	4	4	2	4	4	4	5	5	5	**37**
Buzau-Ialomita	4	3	4	5	5	4	5	5	5	**40**
Siret	2	5	4	4	2	3	4	5	4	**33**
Prut-Barlad	5	5	4	5	3	4	5	5	5	**41**
Dobrogea	5	1	2	1	3	4	4	3	5	**26**

Source: World bank's elaboration.
Note: UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation; Blue: average rating for water security risk; Green: lower level of water security risk; Red: higher rating for water security risk.

The three major hotspots for water security are the river basins of the Arges-Vedea, the Buzau-Ialomita and the Prut-Barlad. The first two are located in the south of the country on the lower Danube, while the third is located in the northeast, on the border with Moldova. These three river basins all combine high risk of water availability stress (demand over available resources) by 2030, together with high poverty rates, low WSS access, very low compliance with the UWWTD (few WWTPs installed), low quality of surface water bodies, high risks of floods and droughts, and high expected impact of climate change. Each of these river basins would be a good candidate for implementing an integrated water security program at basin level, combining investment and technical assistance for WSS in rural areas, dams and flood protection, and rehabilitation of irrigation perimeters along with pilots for wastewater reuse.

The second cluster is composed of the three river basins of the Banat, the Olt and the Siret, which have an "average" rating for water security due to specific challenges. All have very high flood risks and poor quality of surface water, with relatively low compliance with the UWWTD, and are to be heavily affected by climate change. The Banat River Basin is also affected by relatively high poverty, while the Olt and the Siret River Basins have lower than average WSS access rate not in line with their overall poverty level.

The third cluster is composed of the four river basins of the Crisuri, Somes-Tisa, Mures and Jiu—which have a lower level of water security risk. However, these river basins still show some poor performance on some dimensions of water security, such as low WSS access rate for the Somes-Tisa and the Jiu (despite average poverty level), some stress for water availability in the Mures and Dobrogea basins, water quality issues for rivers in the Somes-Tisa and Dobrogea basins, drought risks in the Jiu and Dobrogea basins, and floods risks in the Somes-Tisa and Mures basins.

The Dobrogea River Basin is a special case with specific water security challenges. Without the contribution of the Danube, it would be affected by extreme water scarcity, and domestic potable supply in the city of Constanta has to rely on expensive deep aquifer pumping. Because of eutrophication affecting the Danube delta, it has the worst ecological status of all Romanian River Basins (only 10 percent of surface water bodies with good ecological status). In contrast, it is amongst the best performers for WSS access, UWWTD compliance and lower floods risks.

6.3.2. Hotspots for Water Security at County Level

The "hotspot" analysis can also be carried at a smaller scale to identify the most challenged counties for water security. The counties more at risk can actually be found among the three clusters identified above (including in the third cluster of basins less at risk i.e., Jiu).

By far the largest hotspot is represented by all the counties that border on the lower Danube—namely Dolj, Olt, Teleorman, Giurgiu, Ilfov and Calarasi (in the south of the basins of Jiu, Olt, Arges-Vedea and Buzau). They all have high poverty, low WSS access, high drought risk and impact of climate change. In addition, those of Teleorman, Olt and Giurgiu also have a high risk of floods.

In the Prut-Barlat basin, the counties of Botosani (north) and Vaslui (south) show high poverty, low WSS access, poor surface water quality, and water resources stress with over-abstraction of aquifers. Also, in the north of the Siret basin and on the border of the Prut-Barlad basin, the **Suceava** county has a high poverty level, low WSS access, and very high flood risks (including flash floods).

For flood risk, the hotspots have been historically concentrated in seven counties, where the cost of floods exceeds on average 4 percent of the annual local GDP. The two most affected have been the counties of Ialomita (in the south, lower Danube) and Satu Mare (in the north-west, at the borders with Hungary and Ukraine), with the economic costs of floods exceeding 6 percent of local, GDP on average. In five other counties, the cost of floods has exceeded 4 percent of the local GDP historically—namely, Iasi (Prut Barlad basin, border with Moldova), Arad (west, border with Hungary), and the three counties of Teleorman, Giurgiu and Calarasi long the lower Danube. Another noteworthy county at risk of floods is Timisoara, south of the Arad county and on the border with Serbia. **It must be mentioned though that hotspots for flood risks are challenging to identify.** In practice, most of the territory of Romania is at a significant risk of floods. Furthermore, climate change is expected to change the pattern of floods, and also increase the frequency and damage from flash floods.

Notes

1. For instance, the INHGA climate change study estimated the variations in water stock in 2050, without intermediate years.
2. World Bank Country Risk Profiles for Floods and Earthquakes, 2017.
3. Project CECILIA Central and Eastern Europe Climate Change Impact and Vulnerability Assessment, supported by the European Commission's 6th Framework Program.
4. The described findings are based on the Final Report of the CLIMHYDEX PCCE Project: Changes in Climate Extremes and Associated Impact in Hydrological Events in Romania, coordinated and published by the National Meteorological Administration in October 2016.

Chapter 7 Water Security—Is Romania Ready for the Challenges Ahead?

This concluding chapter takes a broader view at water security in Romania, discussing whether the country is sufficiently equipped to addresses the many water challenges ahead—broadening the discussion from compliance and inclusion to also address other aspects of water security, such as resilience to climate change, improved water resources management and flood protection, and adapting to increased frequency and magnitude of droughts and floods. After a review of the transversal issues that affect water security but were not discussed in the previous chapters, this chapter summarizes the many challenges previously identified. It then discusses the various actions that would need to be taken to achieve water security in Romania in the changing environment, including achieving both compliance and inclusion in WSS services, building resilience and sustainable water resources management, and making a better use of the potential of irrigated agriculture to support economic development in poor rural areas.

7.1. Transversal Aspects of Water Management in Romania

Beyond the specifics of the various water sub-sectors analyzed in previous chapters, there are several transversal issues that impact water security in Romania. This includes some broad or generic trends that go beyond the scope of the water sector but still affect it significantly, namely, the overall level of economic development, demographic trends, EU funds absorption challenges and public administration gaps. This also includes public policies in other sectors—such as energy, agriculture and housing—which significantly impact or even may sometimes conflict with sustainable water management. Finally, there are also opportunities for the water sector of a transversal nature, such as the potential development of water-related tourism, promoting a greener economy and enhancing innovations through partnerships with the water sector.

While the preceding chapters have reviewed the many aspects of water management through the prism of its various sub-sectors, **a broader look at such transversal issues will be taken in the subsequent two sub-chapters**, in so far as they are relevant for the future prospects of water security in Romania. It will discuss successively the **main cross-sectoral trends that affect the Romanian water sector**, as well as the **main other economic sectors**, where public policies can impact (and sometimes conflict with) the goal of achieving water security.

7.1.1. Generic Cross-Sectoral Trends Affecting the Water Sector

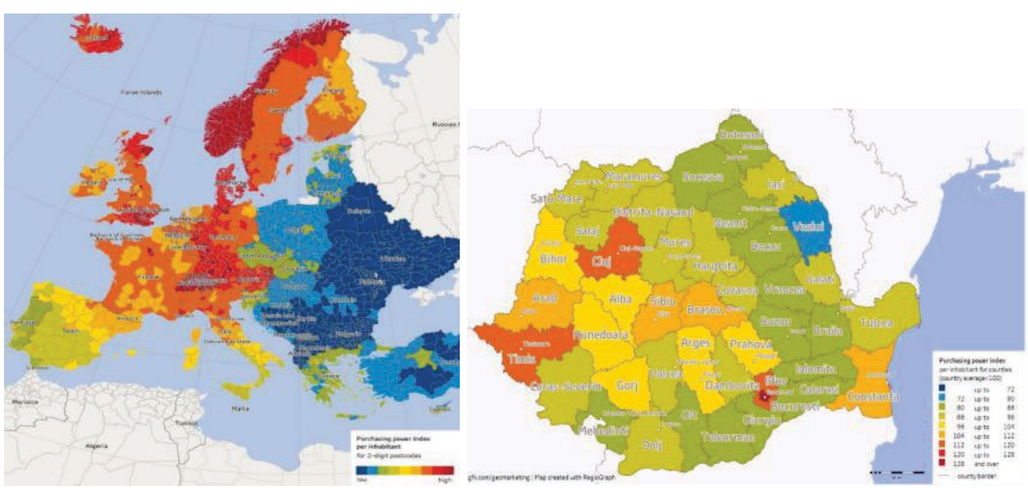
The level of economic development is the first generic issue affecting the development of the water sector as a whole—as it limits the capacity of Romania to address its many water challenges due to scarce financial resources. There is no question that harmonization with the EU water legislation has brought many benefits to Romania. The access and quality of Water Supply and Sanitation (WSS) services has improved, there has been a notable reduction in pollution discharges to water bodies, and the country is moving towards sustainable water management. Map 7.1 below shows the purchasing power index per capita across Europe, and for Romania at the counties level.

Yet, **Romania has an obligation to comply with the EU "*environmental acquis*" that was largely designed before 2000 by, and for, richer countries—even though its Gross Domestic Product (GDP) per capita is still well below the EU average** despite the strong economic growth achieved in the past decade. This creates obvious financial limitations, considering the high investment needs. As shown in map 7.1 above, compared to other EU-13 countries of Central and Eastern Europe, only some parts of Romania have already caught up with Poland, Hungary and Croatia in terms of economic development, as measured by the purchasing power index per capita indicator. Figure 7.1 below shows the evolution in GDP per capita since 1990 amongst countries of the Danube basin.

For a country like Romania—the second poorest in the EU after Bulgaria—the cost of compliance represents a considerable financial burden. This is especially the case for the Urban Waste Water Treatment Directive (UWWTD), which requires massive investments in sewerage infrastructure, starting from a very small base. The large funding gap, with many needed investments ending up being postponed, is an obvious and major impediment for achieving water security. Furthermore, prioritization of scarce investment funds is driven by EU the compliance agenda—with most EU cohesion funds targeted at sewerage infrastructure—and only a small portion going towards inclusion (closing the potable water access gap) or sustainable water resources management (e.g., floods protection).

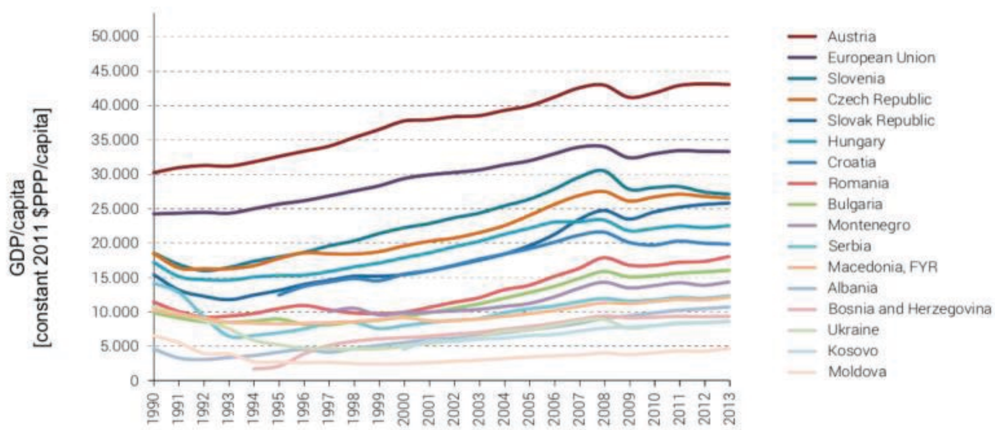
The demographic decline and out-migration phenomenon, combined with about half of the population (mostly poor) leaving in rural areas, is the second major transversal issue affecting the water sector in several ways. The large size of the rural population in Romania—which

MAP 7.1. Purchasing Power Index per Capita across EU Territory (Left) and Romanian Counties (Right)



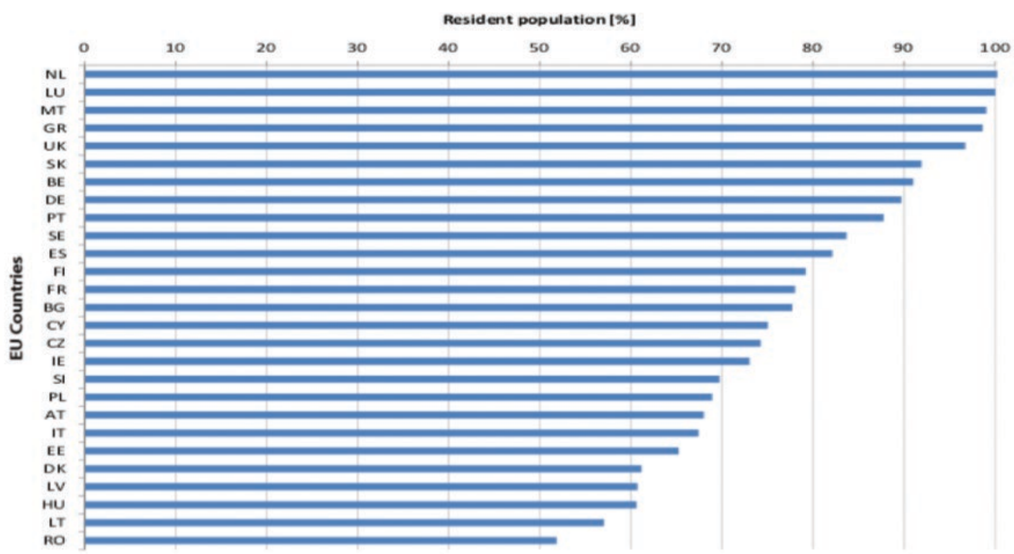
Source: GfK Purchasing Power Europe Study, 2016.

FIGURE 7.1. Evolution of GDP per Capita in Danube Basin Countries during 1990–2013



Source: WB DWP, State of the Sector, 2015.

FIGURE 7.2. Share of Urban Population across EU Countries



Source: Eurostat.

has the highest rural rate (48 percent) amongst all EU countries (figure 7.2)—means that the overall cost of compliance is higher on a per capita basis than for other countries, because of the higher unit costs for piped potable water and sewerage services in low density areas.

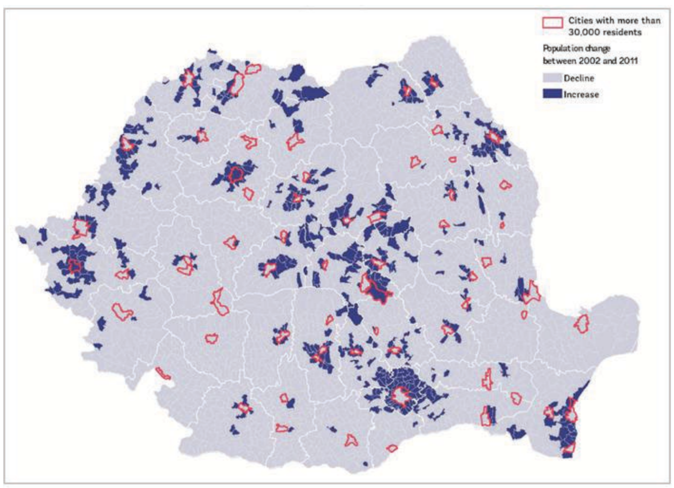
It must be noted though that **for the demographic decline, the dichotomy between urban and rural areas is not entirely clear cut.** Map 7.2 below shows the demographic evolution across the country's territory over the past 15 years, with an overall decline in population except in a few areas (in dark blue). It is noteworthy that many cities appear to be also affected by the demographic decline, while some rural areas (around towns, mostly in the Transylvania region and close to the Hungarian border) show some increase in population.

The move towards financial sustainability of WSS services in poor depopulating rural areas poses serious challenges. The massive outmigration to both cities and abroad creates a risk of building over-capacity systems, as well as making some unnecessary WSS investments—as for instance building a sewerage network and wastewater treatment plant in a village with a declining population that may find itself below the UWWTD threshold (2,000 PE) in the next decade.[1] There are also serious local capacity challenges for providing such services in rural areas in an efficient manner.

Another transversal issue is the slow absorption of EU funds, which has been a chronic problem in Romania, not specific to the water sector. During the last EU programming period 2007-14, Romania was the worst performer amongst EU-13 countries, with an absorption rate of only 73 percent, as shown in table 7.1 below. This can be attributed to a mix of fundamental weaknesses in public procurement (lack of transparency, irregularities), weak public administration and slow responsiveness, as well as lack of adequate co-financing mechanisms. One issue frequently mentioned by stakeholders is that it appears that civil works tenders can be easily blocked in court by losing bidders, not necessarily with due motive and *in fine* resulting in long execution delays.

Some sector-specific factors have also affected EU funds absorption by WSS utilities. The slow absorption rate and major delays in civil works execution can be explained at least partly by the fact that, at the start of the previous EU funding cycle, the public regional utilities (ROCs) were still relatively new, and the amount of construction work

MAP 7.2. Map of Demographic Changes in Romania between 2002 and 2015



Source: WB lagging regions study, 2017.

TABLE 7.1. EU Funds Absorption in Eastern Europe for the 2007–14 Programing Period

Target Countries	Available budget, bn EUR	Available budget per capita, EUR	Contracted grants, bn EUR	Paid grants, bn EUR	Contracting ratio, %	Payment ratio, %
Bulgaria	6.7	926.9	7.0	6.4	105	95
Czech Republic	26.3	2,495.9	27.0	23.3	103	89
Croatia	1.3	305.5	1.5	0.7	117	57
Hungary	24.9	2,528.6	29.2	27.7	117	111
Romania	19.1	959.5	22.1	13.9	116	73
Slovenia	4.1	1,987.8	4.4	4.3	107	105
Slovakia	11.7	2,144.4	14.2	11.3	122	97
Total	94.1	1,621.2	105.4	87.6	112	90

Source: KPMG Report on EU Funds in Eastern Europe, 2015.
Note: Croatia joined only in 2013.

planned was considerable after two decades of very little investment in WSS infrastructure at national level. The execution capacity of both the operators and the private construction companies was therefore seriously stretched.

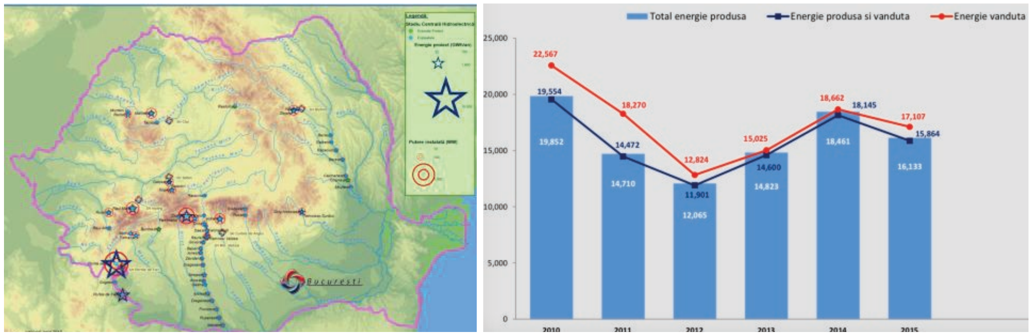
The instability of public administration is also a major cross-sectoral problem, especially at the level of local authorities. This situation has been aggravated in recent years; local administrations have been becoming weaker as many competent staff have been leaving due to low salary levels for local civil servants. This phenomenon is of course accentuated in smaller rural agglomerations due to rural migration, itself fueled by the lack of access to basic services. While this problem has been partly addressed in the water sector through centralization—with national agencies such as National Administration "Romanian Waters" (ANAR) (for the management of water resources), National Agency of Land Reclamation (ANIF) (for irrigation) and regional utilities for the provision of WSS services (ROCs)—this does affect the water sector in two ways. First, many local authorities are unable to play their rightful role as WSS infrastructure owners under the Intercommunity Development Associations (IDAs), and properly supervise the performance of the regional WSS utilities. Second, this trend also makes the remaining municipal WSS operators—who still serve about 1.5 million people in municipalities that have refused to join the WSS regionalization process—even less sustainable.

The right level of decentralization for the Romanian water sector, looking beyond their current institutional limitations and capacity gap, is still an open question. Water is essentially a local resource—with availability varying greatly across locations, and being very expensive to carry through pumping over long distances. Many EU countries have been struggling to find the right balance between central and local authorities for water management, and the right level and nature of empowerment for their local authorities in water management. Romania is no exception. The regional basin agencies (ABAs) under ANAR currently have limited operational and financial autonomy, as well as little interactions with local authorities. They also apply a set of rules and tariffs, which are the same across the country, despite large discrepancies in the local conditions among the eleven river basins. Valuable lessons ought to be learned from other EU countries that, like Romania, have many decades of experience with river basin management. For instance, in France, the river basin agencies have considerable operational and financial autonomy, and are empowered to make decisions on *inter alia* setting their own level of water charges based on local conditions, or allocating investment subsidies. Another important aspect to consider is that sustainable urban water management goes beyond the scope of the WSS utility: mayors have a key role to play in preventing stormwater pollution through proper urban planning to reduce urban drainage, such as by setting limitations on impervious surface.

7.1.2. Public Policies in Other Sectors Affect Sustainable Water Management

Hydropower generation plays a key role in the Romania energy sector—providing on average 25–30 percent of the national electricity production, depending on each year's rainfalls (see map 7.3). In 2015, the total electricity production stood at 6,590 MWh, of which

MAP 7.3. Large Dams Operated by Hidroelectrica (Left) and Annual Generation in MWh (Right)



Source: Hidroelectrica 2016a.

1,894 MWh came from hydropower generation. The share of renewable sources of energy in total power generation in Romania is significant: currently at 36 percent and expected to further increase as the government intends to continue modernization and decommissioning of some of the obsolete and high-emission thermal power plants.

As previously mentioned**, the national hydropower company *Hidroelectrica*, which is majority-owned by the central government, owns and operates most of the hydropower plants** in the country, and associated dams. About half of the Romanian dams have hydropower generation as the sole or main purpose. In 2016, Hidroelectrica had a turnover of 3.4 billion lei—or about 900 million euros. More than 85 percent of hydropower generation comes from its large-scale reservoir hydropower plants, with an installed capacity of more than 25 MW; their location is shown in map 7.3 below.

The largest Romanian hydropower station called Lake Iron Gate 1 ("*Portile de Fier 1*") is located on the Danube River, and is one of the largest in Europe (and the largest on the Danube) (photograph 7.1).[2] The other large plants are mostly located on the Mures, the Siret and the Olt Rivers that flow southward to the lower Danube. *Hidroelectrica* also operates about 150 small hydropower plants (SHP) spread throughout the country (many old SHPs have been sold to private investors since 2013).

Romania still has a significant untapped potential for increasing hydropower generation. The hydropower potential has been estimated at 36,000 MW per year, against a current total installed capacity of only 6,400 MW—that is, only 18 percent of the potential capacity. However, the figures for the total hydropower potential vary depending on which environmental constraints (especially restrictions in protected areas) are applied. Several projects are currently underway to complete construction of large hydropower stations that were initiated during the communist period and stopped for more than two decades. This includes the Tarnita-Lapusteti hydropower station (Cluj county, to be completed by 2020, with an installed capacity of 1,000 MW for a total investment of 1.2 billion Euros), as well as the Racovita hydropower plant.

PHOTOGRAPH 7.1. **View of the Portile de Fier Hydropower Dam on the Danube**

Source: Turism Orsova.

There is a general consensus that the current operating mode of hydropower dams by *Hidroelectrica* is not sufficiently geared towards other uses—especially in relation to respecting environmental flows as required under the EU legislation (Water Framework Directive [WFD] and Habitat Directive). Although the operation permits are issued by ANAR, the actual operational schedule of the hydropower plants is often not well aligned with the water management requirements in the river. *Hidroelectrica* has obvious incentives to release water on the basis of demand from the national grid, and especially during peak hours, to avoid power outages, which is, in fact, its main mandate (10 percent of its sales are through the open, spot market). This means, however that it seeks *inter alia* to store water based on expected future demand, limiting water flows during certain periods and abstraction by other users—which has potential to reduce (or even stop) environmental flows during dry summers—negatively impacting the ecology of the river. Another problem worth noting is the lack of fish migration aids, even at major dams such as the Iron Gate 1—an issue that has been discussed internationally (ICPDR) for many years.

Another contentious issue has been the spread of micro hydropower plants owned by private investors in protected natural areas—with an infringement case opened against Romania by the EC in 2015 for non-compliance with the WFD. The renewable energy act passed in 2008 (220/2008) established a public subsidy (tradable green certificates) to incentivize investors. As a result, more than 500 micro hydropower plants were built by private investors. While these represent only a minute portion of the grid demand, multiple concerns have been raised over transparency in contract attribution, legality of many projects under

EU environmental laws (including projects located in Natura 2000 areas), and lack of sufficient control for environmental flows and mitigation (fish passes).

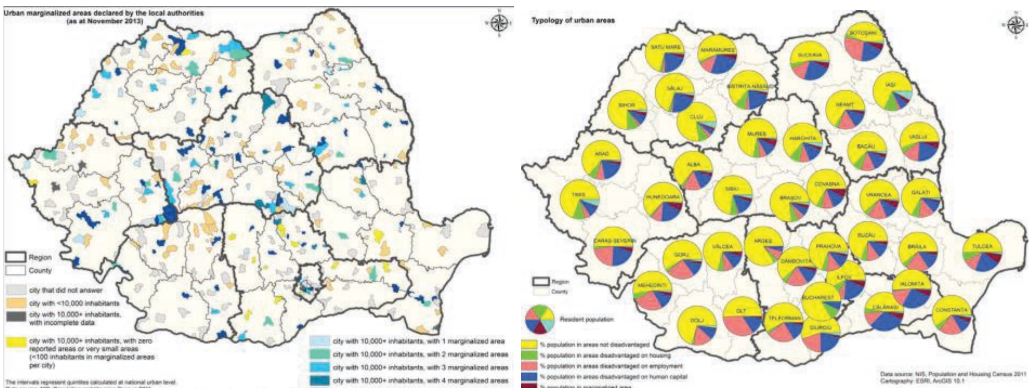
Hydropower is clearly an area that requires a more integrated approach between the EU water and energy policies. Even though Romania has developed only a portion of its hydropower potential, development of new dams may conflict with the WFD objectives regarding prevention of hydro-morphological alterations, endangering Romania's compliance with the WFD. Further development would have to be aligned with the requirements of the WFD regarding new modifications to the physical characteristics of surface water bodies, alterations to the level of groundwater, or new sustainable human development activities,[3] as well as with the Habitat Directive.

There is also a need for better integration of EU water policy objectives with the Common Agricultural Policy (CAP). A 2014 EU Court of Auditors special report on the integration of EU water policy objectives with CAP underlined the challenges qualifying it as only a "partial success". The agricultural sector in Romania faces acute challenges due to the extreme fragmentation into small farms, with a majority of small private owners lacking financial capacity and technical knowhow, and focused on subsistence farming, compounded by the expected impact of climate change, which will *inter alia* transform the climate in southeastern Romania (lower Danube, which has most of the country's arable lands) into a semi-arid climate. As such, climate change will increase irrigation demand and possibly change the economic viability of irrigation schemes (some currently non-viable scheme may become viable). Romania currently lacks a clear strategic vision for its irrigated agriculture.

Currently, there are two main instruments used for integration between water and agricultural policies: cross-compliance and the European Agricultural Fund for Rural Development (EAFRD). Cross compliance is linked to making some subsidies conditional to farmers applying environmental friendly practices and greening measures (green crops, trees belt around fields) under the EAFRD. The responsibilities for implementing the Action Program for the Protection of Waters against Pollution with Nitrates from Agricultural Sources and the Code of Good Agricultural Practices, to comply with the requirements of the Nitrates Directive, rest with the Ministry of Waters and Forests and the Ministry of Agriculture and Rural Development, and the financing is from the budgets of these two ministries and the sources attracted by them.

The urban policies regarding marginalized neighborhoods—which go far beyond the water sector—are crucial for closing the urban access gap for piped water and improved sanitation. Map 7.4 shows (for agglomerations above 10,000) that marginalized urban settlements are located all across Romania and in all large agglomerations. These marginal neighborhoods are main focal points of poverty in urban areas, and include many Roma settlements. Many of them do not have proper access to piped water and sewerage, as well as other basic public services. Where water networks exist in those areas, there tend to be significant levels of illegal connection and water theft, as well as unpaid bills. WSS services issues in these marginalized neighborhoods—both the access gap and the issue of water theft and unpaid

MAP 7.4. Distribution of Cities by Number of Marginalized Areas Identified by the Authorities (Left) and Proportion of Population by Counties Living in Disadvantaged or Marginalized Areas (Right)



Source: WB based on NIS 2013 data.

bills—cannot be solved at the level of the WSS utility alone but require a concerted effort by local authorities. Issues of land ownership and illegal occupation need to be solved. Infrastructure investments need to be made jointly for various public services so as to optimize costs, together with urban revitalization program that include social actions targeted at these marginalized communities, to *inter alia* foster behavioral change towards payments of utilities bills.

Urban planning policies can also significantly impact stormwater management, and ultimately determine whether the good ecological status of surface waters can be achieved under the WFD. While a large proportion of sewerage networks in Romania are mixed— that is, they collect both domestic and industrial sewer effluents and rainwater from urban drainage—there are still a portion of the networks which are separated, and the stormwater collected falls under the purvey of local authorities, who should *inter alia* develop retention ponds so as to minimize the impact of major storms on receiving water bodies. Local authorities are also responsible for the collection of solid waste, which if not done properly often ends up in surface waters after rainfalls having a significant negative environmental impact on surface water bodies. Finally, as already mentioned, local authorities can also reduce significantly stormwater pollution through proper urban planning directed at reducing the volume of urban drainage, such as by setting limitations on impervious surface, enhancing soil absorption of rainwater through using adequate materials for roads and pavements, as well as promoting the use of green roofs.

An aspect of housing policies specifically related to WSS services is the lack of a modern framework for condominium buildings—which poses major problems to WSS utilities for bills collection and water losses. Like in other EU-13 countries of Central and Eastern Europe, a large portion of the urban population in Romania lives in condominium buildings with large apartment blocks. These pose special challenges for the utilities to meter and bill individual households, since the piped water network within the entire condominium is within private property and outside of the control of the utility. Different approaches are used for billing condominium, but none is satisfactory. When billing is done based on a bulk meter at the entry of the property, with the amount then divided between the dwellers, collecting bills can be a challenge as it is not possible to cut services to those who do not pay. When billing is done based on meters installed at the entry of each apartment, the water losses due to leakages in the condominium's piped network end up being incorporated into the utility's overall Non-Revenue Water (NRW) indicator, even though they come from private pipes it does not control. Another issue is the difficulty of accessing and reading meters of customers living in block buildings.

While Romania has the highest rate of private ownership of housing amongst EU countries, there is no legal framework to promote responsible management of buildings by private owners. This directly affects overall maintenance of this buildings including the internal plumbing. In practice, it is likely that a significant proportion of the high level of NRW of Romanian WSS utilities (about 50 percent overall) comes from both leakages through the building's internal distribution plumbing (physical losses), and under-metering of individual customers (commercial losses). Useful lessons can be learned from other EU countries on how to ensure responsible management and maintenance of buildings by private owners—which is essential for water utilities. As an example, the legal framework that has been put in place in France is presented in box 7.1.

BOX 7.1. Legal Framework for Dealing with Condominium Customers—The Case of France

In France, all private buildings are legally required to be managed by a professional company, on behalf of a specific legal entity under which the various owners are held jointly and financially responsible. Still, several systems for water metering have co-existed until recently, depending on specific agreements made.

In the first option, there is one bulk meter at the entrance of the building and the total volume is allocated according to the surface of each apartment—this concerns about 2.5 million apartments.

In the second option, there is one bulk meter installed and owned by utility, plus individual meters for each apartment that are installed and owned by the condominium. The individual meters are used to allocate the overall consumption metered at the level of the bulk meter, and any discrepancy (such as due to water leakage in the building plumbing) is the responsibility of the condominium (which is a legal entity with the power to bill the dwellers for all costs).

box continues next page

BOX 7.1. continued

In the third option, the utility installs individual meters at the entry of each apartment, within the building. This is allowed by a recent change in law, but in practice the legal framework does not clarify the exact conditions for the utilities to do that on private property, and what they may request in terms of upgrading of internal plumbing of the building (e.g., in case of lead pipes) and how much they can charge the households. In practice, each municipality/utility has a lot of flexibility on how they apply this.

The law makes it possible for dwellers in a condominium, if they decide so through a vote by majority, to force the utility to switch from pro rata billing based on surface, to individual metering done either by the condominium (option 2) or the utility (option 3). This decision is typically driven by several factors, such as whether the allocation mechanism creates a significant discrepancy between billed and actual consumption, and who has to pay for the installation of the individual meters. Utilities tend to favor option 3 for buildings where there are bills collection issues (so that the utility can cut the supply to some households without affecting other dwellers in the building), and option 2 for buildings where there are significant leakages in internal plumbing.

A new law was passed in 2016 making individual meters under the third option compulsory for all buildings which have central heating—but on the condition that the installation of individual meters be "technically possible and economically viable", with exemptions depending on specific situations. This still leaves leeway to utilities, and it is expected that the various situations will continue to coexist for many years.

Finally, there are many interfaces between water and disaster management policies. This obviously includes flood protection management, but also seismic risk for dams and strategic water infrastructure, such as large potable treatment plants, pollution risks on the Danube due to heavy navigation traffic (oil spills or accidental pollution, given the role of the Black Sea region as a transit route for major oil and gas exports), and the risk of industrial pollution accidents that may affect water bodies. Water management must be considered a major aspect of disaster risks management.

7.2. Romania Faces Serious Challenges to Water Security

7.2.1. Water Security Challenges Are Many-Fold, Public Awareness Is Insufficient

Most countries around the world are finding that the "old style" approach of ensuring water security by focusing on the supply side is becoming unsustainable. This traditional approach of dealing with water stress by investing in more infrastructure production capacity is showing its limits in the face of the worldwide trend of ever increasing demand, growing threats to water bodies, and the impact of climate change. Romania is not immune to this change in paradigm: the country is already close to the water stress threshold based on the level of average annual utilizable water resources per capita. The main reason why water stress is not yet felt across Romania (with the exception of some specific areas, e.g., Constanta) is the drastic fall in water demand that took place through the economic structural adjustment in the 1990s, that has so far given the country significant flexibility in managing its water resources.

Despite the many achievements of the past decade, Romania still faces a number of significant challenges that threaten water security. The analysis developed in this report has identified a series of key issues and challenges, which include: lack of access to piped potable water and flush toilets leading to significant public health and inclusion issues, concern over affordability of WSS tariffs for the poor, insufficient development of sewerage collection networks and wastewater treatment plants to reduce pollution of rivers (together with non-compliance with UWWTD and an upcoming infringement case from the EC), a major financial gap in infrastructure investment, the expected significant impact of climate change (more flooding events and droughts), lack of a clear national policy for irrigated agriculture. As was outlined in the report, the focus on complying with the EU water legislation—while largely beneficial—has also somewhat diverted attention, in a context of scarce investment resources, from the crucial issue of inclusion. And overall, the manifold institutional gaps remain major bottlenecks for improving the Romanian water sector.

As already indicated in the introductory chapter, **achieving water security for a country comprises three goals: ensuring sustainable use of water resources, delivering affordable services to all (inclusion), and mitigating water-related risks.** This requires efficiently developing and managing water infrastructure, being able to rely on capable and properly incentivized institutions, and due sharing of information, including with the general public. The importance of being able to rely on efficient and accountable institutional actors cannot be overemphasized. Furthermore, **inclusion is an integral part of water security**, because a country cannot realistically claim to have achieved water security unless all of its population—and especially the poor and most vulnerable—have access to affordable water and sanitation services and are duly protected from water-related hazards like floods. **The key findings on the current shortcomings and challenges for water security in Romania have been summarized in table 7.2 below.**

7.2.2. The Financial Gap for Investment Is Vast but Uncertain

The financial effort required from Romania to comply with EU water legislation is considerable. It was estimated at about 21 billion euros for implementing all measures contained in the first River Basin Management Plans (RBMPs) cycle. The total consolidated figure stood at 21 billion euros for the cost of compliance, with 13 billion Euros for the period 2016–21, and 6 billion euros for 2022–27. This figure is broadly in line with a 2015 WB compliance stocktaking report

TABLE 7.2. Key Challenges and Shortcomings in Water Security & Inclusion in Romania

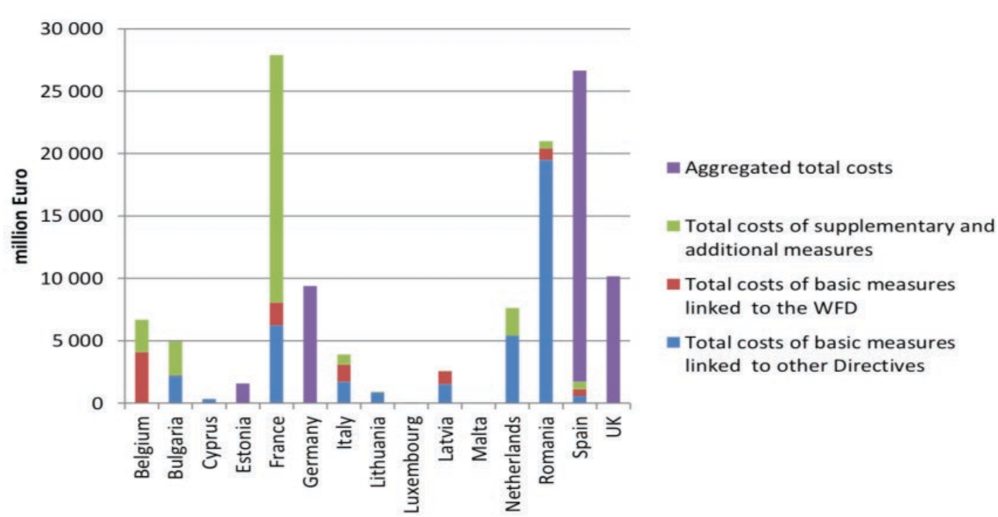
	Key challenges & shortcomings in water security in Romania *(with the most critical ones highlighted in bold)*
Water Resources Management	**Romania is almost a water-stressed country**, with several river basins already below the water stress and/or water scarcity level (on a per capita basis);
	Floods risk: high exposure, lack of O&M and capex funding to maintain and expand flood infrastructure as per the FRMPs, ANAR's institutional constraints;
	Many dams have deteriorated and have to be operated well below their initial design level to ensure safety;
	Significant expected impact of climate change, with more droughts and floods and establishment of a semi-arid climate in the Southeast (the majority of arable lands);
	Lack of funding for dam rehabilitation and completing/building new dams, despite a need to increase storage capacity in line with other EU countries;
	Poor ecological status of lakes and intermediate coastal water bodies (Danube) in the context of WFD compliance;
	Improving environmental flows in dam management under the WFD;
	ANAR need financial and institutional strengthening/modernization.
Water Supply and Sanitation	**Major access gap for potable water and sewerage services**, making Romania a complete outlier among EU countries;
	Major inclusion issue: the WSS access gap affects mostly the poor in rural areas and urban marginalized neighborhoods;
	Poor operational performance of many WSS operators for NRW (water losses);
	Compliance with UWWTD is proving a major challenge—the 2018 targets will not be met and the country may need a decade at least to achieve compliance;
	The **regionalization** process is encountering difficulties, with many small local authorities resisting joining regional public utilities;
	Increasing concerns about affordability of WSS tariffs for the poor, especially in view of expected future tariff hikes;
	Resistance of households to becoming connected to piped WSS services;
	Lack of national WSS strategy including how to close the WSS financial gap, notably in light of the depopulation of rural areas;
	Lack of a specific WSS strategy for rural areas and small agglomerations;
	Achieving full compliance with DWD on all potability parameters.
Irrigation	Lack of exit strategy for the old irrigation infrastructure being currently unused;
	Lack of strategic vision for irrigated agriculture in the face of climate change;
	Poor prioritization and lack of funding for rehabilitation of economically viable irrigation schemes.
Cross-cutting	**Complying with complex and expensive EU water legislations**, with a GDP per capita much lower than the EU average;
	Institutional weaknesses of many water sector players;
	Huge financial gap for water investments, not fully estimated and optimized;
	Overall lack of prioritization of water investments;
	Slow absorption of EU funds for water investments;
	Uncertainties regarding future demand in the face of declining demography and climate change;
	Public policies in other economic sectors strongly affecting (and sometimes conflicting with) **water security** (hydropower, agriculture, urban planning).

Source: World Bank elaboration.
Note: ANAR = National Administration "Romanian Waters"; DWD = Drinking Water Directive; EU = European Union; FRMP = Flood Risk Management Plan; GDP = Gross Domestic Product; NRW = Non-Revenue Water; O&M = Operations and Maintenance; UWWTD = Urban Waste Water Treatment Directive; WFD = Water Framework Directive; WSS = Water Supply and Sanitation.

that gave a figure of 24 billion Euros. Figure 7.3 below provides a comparison of total water investment costs for the first round of RBMPs among several EU countries. While only a few EU-13 countries are included, it illustrates the magnitude of the financial efforts required by Romania to catch up with older EU countries. Most of this investment was related to compliance with other directives under the so-called "basic measures", which for the largest part corresponds to investments required under the UWWTD.

The consolidated figure, based on the second RBMPs cycle, for the total cost of compliance is estimated at about 29 billion euros. This calculation was made as part of this study through a review of the financial data contained in the RBMPs submitted to the EC in 2016. The corresponding data is summarized in table 7.3, which also provides a breakdown between the 3 successive RBMPs cycles and the various categories of investment. This means that the total cost of compliance has been increased by about 8 billion euros compared to the consolidated estimate of the first RBMPs, while about 9 billion was covered under the first RBMP cycle

FIGURE 7.3. Comparative Cost of the First RBMP Planning Cycle



Source: Acteon 2012.

TABLE 7.3. Capex Cost of Compliance for the 3 RBMPs Cycles, for Different Categories

Planning Cycle	Category					
	Human Agglomerations	Industry	Agriculture	Hydro-morphology	Others	Total
2009-2015	7,217,731,724	1,061,257,952	308,327,846	41,134,547	351,448,133	8,979,900,202
2016-2021	12,434,190,176	414,073,799	595,830,795	35,928,911	181,774,021	13,661,797,702
2022-2027	6,608,897,654	9,300	0	4,769,000	0	6,613,675,954
Grand Total	**26,260,819,554**	**1,475,341,051**	**904,158,641**	**81,832,458**	**533,222,154**	**29,255,373,858**

Source: World Bank's calculation based on 2nd RBMPs, ANAR 2016.

(though it is not clear that this whole amount was actually executed). An overwhelming proportion of the investment is for domestic WSS services, essentially for building sewerage collection systems and wastewater treatment plants.

The investment has focused so far on compliance—while it should also address inclusion and sustainable water management. The cost of achieving universal access to piped potable water—in line with other EU countries—stands at about 6 billion Euros. The cost of the massive rehabilitation of water distribution networks that would be required to significantly reduce physical losses (leakages)—and which could easily exceed the 10 billion euros mark—has for a large part not been incorporated into the business plans for the next decade, given the financial constraints and the need to focus first on UWWTD compliance. There are also only partial estimates for the overall cost of achieving sustainable water management in the long run. The required investments for flood mitigation, as identified in the (Flood Risk Management Plans) FRMPs, stand at 3.7 billion Euros. The cost of the proposed governmental program for rehabilitating irrigation infrastructure stands at 1 billion euros but this is probably under-estimated.

Furthermore, capex costs related to dam investments and adaptation to climate change are still unknown. There is currently no consolidated estimate for the cost of rehabilitating the many deteriorated dams (that have to be operated below design level to ensure safety) and completing the dams the construction of which had stopped in the early 1990s—though Ministry of Waters and Forests (MWF) has indicated that it was carrying out a review, with the identification of dams and estimated costs to be available in early 2018. Most of these investments appears highly needed for increasing the country's storage capacity in the face of climate change, and catching up with the water storage level achieved by older EU member states. The overall cost of adapting water management to the expected impact of climate change—with increased frequency and magnitude of floods and droughts and the establishment of a semi-arid climate in southeastern Romania (where most arable lands are located)—is not known. All investment planning in the various sub-sectors has been done so far based on historical data instead of climate change projections.

Looking in more details at the remaining WSS investment needs, the total capex figure for UWWTD compliance is not well-known—and the information available is not entirely consistent. The costs for compliance with UWWTD were initially estimated at 13 billion euros for agglomerations above 10 000 PE (a large portion having been already funded in the previous and current Sectoral Operational Program [SOP] program) and 4 billion euros for agglomerations between 2,000 and 10,000 PE (with 75 percent of the estimated costs for sewerage networks). This initial figure for small agglomerations appears seriously underestimated, considering the large size of the rural population and high unit costs. This figure is much less than the compliance investments for human agglomerations as shown in table 7.3 above.

In the absence of a national financial strategy for the WSS sector, it is not surprising that there are no definite figures for the required sewerage investments. The attention so far has been on the larger ones above 10,000 PE, largely leaving out the required investments for wastewater compliance in agglomerations between 2,000 and 10,000 PE. Consulting firm BDO broadly estimates that the aggregate investment figure for ROC to build backbone sanitation infrastructure (main networks and Wastewater Treatment Plant [WWTP]) in all rural agglomerations above 2,000 PE should be about 6-7 billion Euros, but this will largely depend upon the degree of recourse to Individual Appropriate Sanitation (IAS) in the future. It is to be hoped that, as the regional master plans are currently being updated, their consolidation should provide a clearer picture of the overall investment needs of the WSS sector for the next decade.

For potable water, the capex for achieving universal access has been estimated at about 6 billion Euros, with only 1.26 billion allocated until 2020. The 2004 action plan for potable water had estimated at 5.6 billion euros the needs until 2015, of which only a small portion was funded and executed. This figure was slightly increased to 5.8 billion euros for 2014-20 (even though 1.38 billion euros of cash-flow were spent in 2007-13).[4] This figure seems to be broadly in line with international benchmarks, assuming that the cost of connecting households to piped water would be in the range of 1,000-1,200 euros per capita (total of 5-6 billion euros for providing access to 5 million people). However, with only 1.26 billion allocated so far, there is a gap until 2020 of 4.54 billion (about 80 percent).

The need for public subsidies to close the WSS access gap for the poor may also have been overlooked. So far, all WSS investment figures have assumed that households would (and could) pay for the cost of installing in-house plumbing and flush toilets once connected to the WSS networks. However, given the high poverty level in some areas of Romania—both rural areas and urban marginalized neighborhoods—it is possible that many poor households may not be able to afford such an expenditure on their own. If confirmed, some form of public subsidies targeted at the poorest and most vulnerable families may be needed to ensure that the inclusion gap for access to WSS services can be closed. Such schemes have had to be put in place in countries in other continents that had faced major WSS access gaps, with valuable experiences to be drawn *inter alia* from MICs in Latin America (Brazil, Colombia).

The currently available funding sources from the EU until 2020 for WSS investments (about 6 billion euros under LIOP and PNDL) are below the actual needs. The Large Infrastructure Operational Program (LIOP) (financed from state budget and EU funds) 2014-20 has allocated 4.1 billion euros for investments with the 43 regional operators (of which 2.4 billion euros for investments in wastewater collection and treatment), while the National Program for Local Development (PNDL, financed from the state budget) has allocated 8.61 billion lei (equivalent of 1.9 billion euros) for water supply, sewerage and waste water treatment (WSS) facilities in 2015-19.[5] Furthermore, the National Program for Rural Development (PNDR) of the Ministry of Agriculture has allocated 0.34 billion euros for 2014-20 to finance WSS investments in agglomerations below 10,000 inhabitants.[6] It is not clear that this level of EU grant funding from Cohesion Funds will still be available for the next investment round after 2020—meaning that the financial gap is expected to be even larger in the next round of EU cohesion funds.

Allocated EU funds for flood management until 2020 are also well below the needs—even though this should be considered a "no-regret" investment. The consolidated flood investments identified in the FRMPs stand at approximately 3,7 billion euros. Considering the significant impact that floods have on the Romanian economy—this figure being close to the estimated value of damages incurred over the last two decades—such investment should be considered as "no regret" and carried out as a priority. Yet, flood investments for **only 246.6 million euros**—less than seven percent of total capex needs—have been proposed for financing under LIOP for 2017-20.

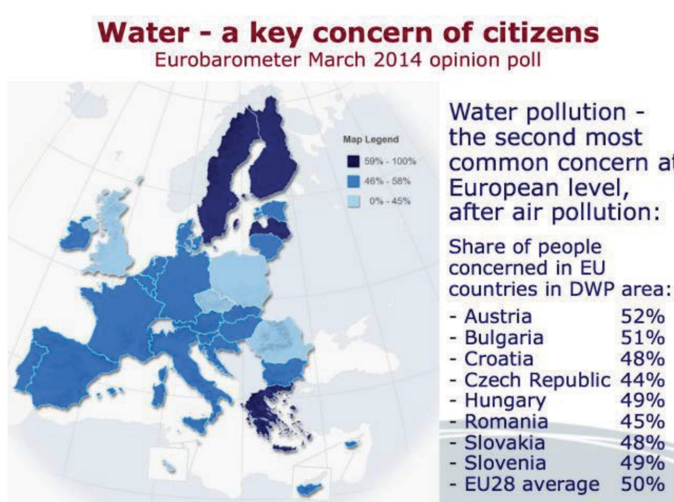
7.2.3. Need for Institutional Strengthening and Public Awareness Building

Along with the financial gap, **institutional gaps and weaknesses represent the second major bottleneck impeding Romania's progress towards water security** over the next decade. Closing the funding gap is not enough: transforming money into tangible outcomes for the population requires efficient institutions. While much has been achieved in terms of institutional modernization over the past decade, the performance of many water players is still affected by institutional weaknesses and lack of capacity. The negative impact of this situation is multifold and includes *inter alia* lack of capacity to properly prioritize investment in a context of budget shortages, lack of capacity to efficiently execute investment programs (translating into slow absorption of EU grant funds), and lack of capacity to ensure that these investments are transformed into sustainable benefits for the population. Any future efforts to help Romania in moving towards compliance, inclusion and water security through new investments, should be backed in parallel with **significant technical assistance for institutional strengthening**.

Given the magnitude of the above-mentioned challenges, there is a need for more public awareness of the importance of sustainable water management. An EU-wide opinion poll carried out in 2014 (map 7.5) showed that less than half of the Romanian population appears concerned by water pollution—one of the lowest rate among EU countries (along with UK, Poland and the Czech Republic). Even though the difference with other European countries may not be big, especially when compared with other countries of Central and Eastern Europe, this suggests a gap in awareness of water issues—considering that Romania faces much bigger challenges that its EU neighbors for complying with EU water legislations, especially to reduce sewage pollution.

In this context, **improving public awareness of the Romanian population of the many water challenges facing the country should become a priority.** This should especially be the case for facilitating public acceptance of the WSS reform,

MAP 7.5. Water Pollution—A Key Concern of Citizens



Source: Eurobarometer EC, March 2014 opinion poll.

and of the major efforts that will still be required to achieve UWWTD compliance. These will require in particular that several million people connect to sewerage collection services, as well as further tariff increases. Social marketing can be crucial for shifting perceptions towards reforms, and experiences in other countries have validated the usefulness of well-designed communication campaigns to support water reforms. In particular, there is often a difference between the "capacity to pay" and the "willingness to pay", and the later can be shifted (except for the poorest and more vulnerable households) by explaining the benefits of reliable WSS networks—with the public health risks of self-water supply, and environmental benefits of sewerage services.

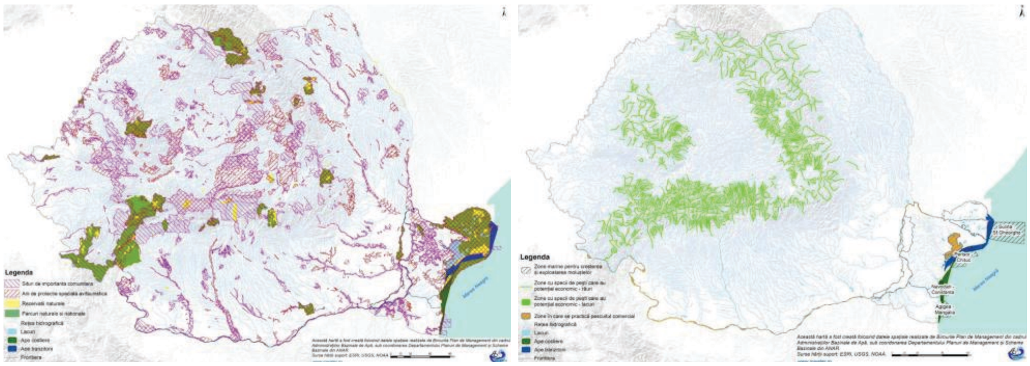
7.2.4. Opportunities for Leveraging the Development of the Romanian Water Sector

While the discussion so far has emphasized the considerable challenges facing Romania on its path towards water security—and in particular the magnitude of the financial efforts required for the country—there are also a **series of positive elements linked to water security, that go beyond the sector and can bring other economic benefits**. These are discussed in the following paragraphs and include tapping the potential for freshwater tourism, moving towards a greener Romanian economy, and using the water sector as a source of technological innovation in the country.

Water for tourism: the potential of the many still-preserved Romanian Rivers is untapped. Compared with many more developed EU countries, Romania has the advantage of being still endowed with vast wilderness areas. While tourism is quite developed in the Danube Delta, the large number of pristine rivers and streams in the Carpathian mountains of Transylvania is a unique asset that has not yet, but could, be leveraged for local economic development. There is currently little if any awareness in Romania of the potential for developing river fishing tourism—for fishing, kayaking or canyoning—and the benefits in can bring for sustainable local economic development in remote rural areas that were formerly deprived of economic opportunities. Achieving a good or high ecological status for rivers under the WFD can be more than just about legal compliance with EU directives: this has intrinsic economic value and could be translated into revenues for local poor population in rural areas (map 7.6).

Successful experiences in Croatia, Slovenia, the Czech Republic and Poland demonstrate the real potential and benefits of water-related tourism in protected rural areas which often lack economic development opportunities. This has become the main economic activity in some rural villages of Croatia and Slovenia, with foreign fishermen from Western Europe paying up to 100 euros per day for the right to fish on the best stretches, along with the side revenues they bring to local hotels, restaurants and shops. Such water tourism allows to monetize the environmental benefits of having pristine and protected rivers in a way that benefits local and often poor communities (as opposed to benefiting a few private individuals from the outside, as is the case for micro hydropower plants that have been built in Transylvania).

MAP 7.6. Protected Areas under EU Legislation where Water Resources Management Plays an Important Role (Left) and Protected Water Bodies of Economic Interest (Right)



Source: ANAR 2016.

PHOTOGRAPH 7.2. Trout Fishing Tourism Potential in Romania (Retezat Park): "There Is Still Hope"

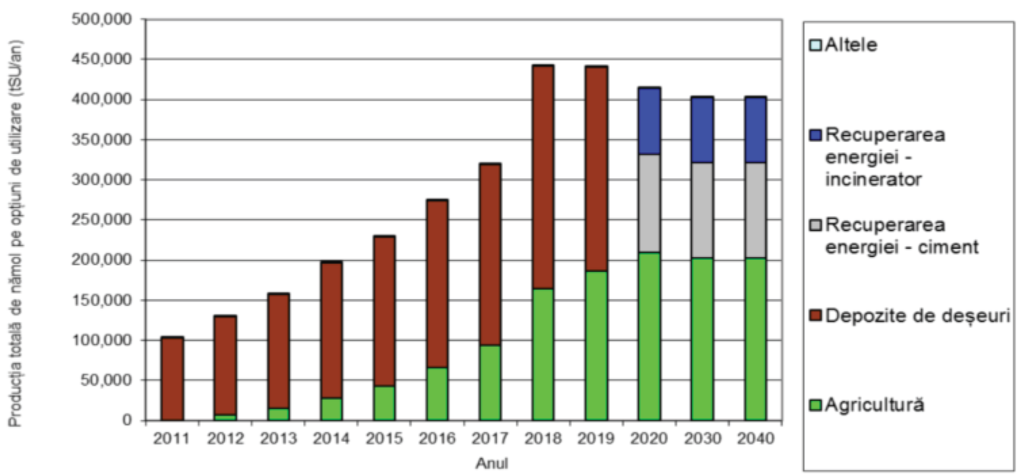
Source: Fly Fishing Romania, 2016 http://www.flyfishingromania.com/.

Developing freshwater fishing tourism requires sustainable fisheries management, in partnership with local communities (photograph 7.2). The above-mentioned countries of Central Europe that have successfully developed local fishing tourism did so by implementing sustainable fisheries management (salmonids i.e., trout or grayling) in protected portions of their rivers. This involves fish-stocking of native genetic strains, and the enforcement of "catch-and-release" stretches where all fishes must be released after being caught—following a model developed in the USA. The local populations are heavily involved in sustainable river management—including safeguarding the rivers from poachers and preventing pollution. A "catch and release" stretch in Romania was established in 2017 in the Somesul Cald Valley, as a partnership between the Forest Division, park administration, a fishermen association, a small Romanian private tour operator and the local community.

There are also several opportunities for the Romanian water sector to make a valuable contribution to promoting a greener circular economy—which remain largely untapped. A crucial element is to improve management of sludge from WWTPs, gradually increasing the amount that is recycled in agriculture. Figure 7.4 shows that the share has been increasing over the past seven years, with half of all sludge from WTTPs expected to be recycled in agriculture by 2020, while the other half would be recycled for energy or in concrete factories. This also includes promoting biogas production from WWTPs, which can significantly reduce the electricity purchase and carbon footprint of WWTPs, and which for large plants owned by the regional public utilities could be developed with private funds under Public-Private Partnership (PPPs). Finally, this includes the promotion of treated wastewater reuse for agriculture in the context of climate change adaptation (see next paragraph). Such "green" initiatives in water management would be in line with the EU vision, as promoted by the European Environmental Agency, to move towards a greener, more circular and resource-efficient economy in EU member states.

A major opportunity would be the promotion of wastewater reuse in specific areas expected to be most affected by climate change, and where high pumping costs currently make irrigation not economically viable. Although reuse of treated wastewater has been allowed in the existing legislation, this option has been largely ignored in the development of master plans for new WWTPs. Treated wastewater reuse in Romania would be facilitated by the fact that

FIGURE 7.4. Sewage Sludge Management: Current Status and 2040 Projections



Source: ANAR 2016.
Note: In green: volume in tons per year to be used in agriculture.

the whole territory has been declared sensitive area—meaning that WWTPs are required to carry out advanced treatment, making the effluents suitable for irrigating several crop categories—thereby reducing the cost of reuse. The economic viability of developing reuse around the new WWTPs being built as part of compliance with the UWWTD, in the parts of the country that will be most affected by climate change (the basins located in the lower Danube and the Prut-Barlat basin)—should be explored, focusing especially on areas where freshwater irrigation schemes are not technically or economically viable.

In the context of developing a national strategy for adapting water management to climate change, a few pilot projects for wastewater reuse could be developed. The experience of other EU countries—such as Spain, Cyprus (where two-third of all treated wastewaters are reused in agriculture), Malta and Greece (Thessaloniki)—could be particularly beneficial for Romania, especially with regards to fostering acceptance by farmers.

Finally, more efforts could be put into fostering the adoption of technological innovations in the Romanian water sector. Around the world, the water sector as a whole—whether WSS, water resources management or irrigation—is not well-known for its openness to new ideas and ways of doing things. It is still largely dominated by a "business as usual" mentality where innovations are usually perceived as inherently risky. This is not specific to Romania, but there are several aspects of the water sector in Romania that make promoting water innovations even more challenging. The legal constraints put in place against PPPs in WSS services are *inter alia* reducing opportunities for benefiting from private sector innovations from abroad—as would be the case for example with BOT schemes which promote technical innovations in WWTPs through a result-based turnkey approach. Another limitation is the lack of transparency and accountability of WSS operators for performance—which reduces incentives to seek innovations to improve efficiency and service quality. In the context of the many water security challenges facing Romania in the near future, promoting innovations should be part of the government's reform agenda, especially since the water sector has seen recently a wave of new technologies brought about by the digital revolution and allowing more efficient water management (e.g., remote monitoring of water quality, metering and leaks detection) and optimizing investment costs (e.g., for wastewater: IAS and extensive treatment through reeds beds).

7.3. WSS Reforms: Achieving Compliance and Inclusion Go Hand-in-Hand

7.3.1. The WSS Sub-Sector Is still Heavily Dependent on EU Grant Funding

Amongst EU-13, Romania is the country which has been spending the largest proportion of its GDP on WSS investments over the past decade. This is illustrated in figure 7.5 below showing a proportion of about 0.65 percent of GDP for Romania, ahead of all other EU-13 countries of Central and Eastern Europe (Hungary and the Slovak Republic being at about 0.50 percent, Slovenia and Croatia at about 0.55 percent), and almost double as the share of GDP dedicated to WSS investment in neighboring Bulgaria. On a per capita basis, the ranking is modified due to the fact that Romania has a lower GDP. Romania invested about 80 euros per capita

FIGURE 7.5. WSS Investment in Euros per Capita and Share of GDP amongst Danube Basin Countries

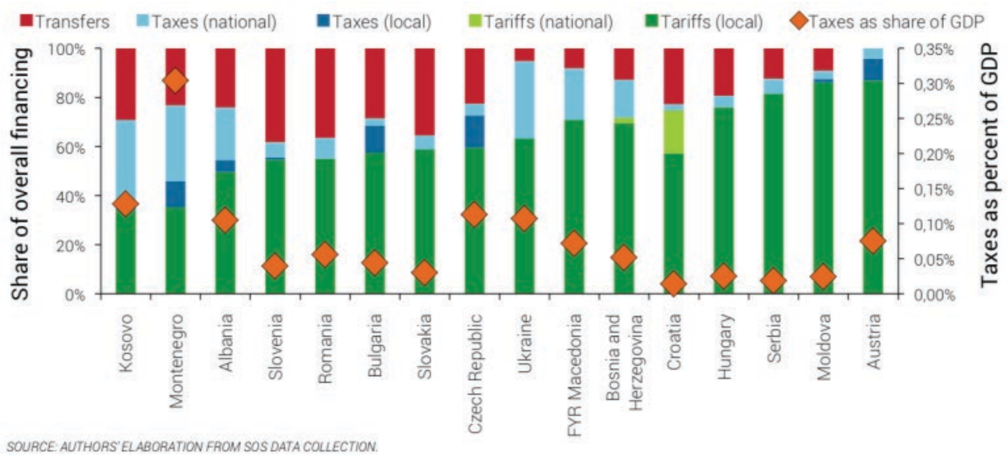
Source: WB DWP, State of the Sector, 2015.
Note: Bar graph = capex in euros per capita; orange line = percentage of GDP.

per year which is less than the Slovak Republic, Slovenia and the Czech Republic, about the same level as Hungary and Croatia, but still more than double the level in Bulgaria.

A large proportion of the costs of WSS services in Romania—and most of the investment costs—has been covered so far by EU cohesion funds. Figure 7.6 shows the sources of funding for the WSS sector is the various countries of the Danube basin, including 7 other EU-13 countries, as breakdown into tariffs, taxes and transfers (EU cohesion funds in the case of EU countries) that is, following the "three Ts" framework. The proportion of transfers in Romania is close to 35 percent. Considering that investments represent about half of total WSS expenditure in Romania, as shown in figure 7.7, this suggests that more than two-thirds of investments is being financed through EU cohesion. This is close to the proportion of EU transfers for WSS capex in the Slovak Republic and Slovenia, but these two countries are much more advanced than Romania for compliance with the UWWTD, and will not need significant further funding for compliance investment after the end of the ongoing 2016-20 cycle.

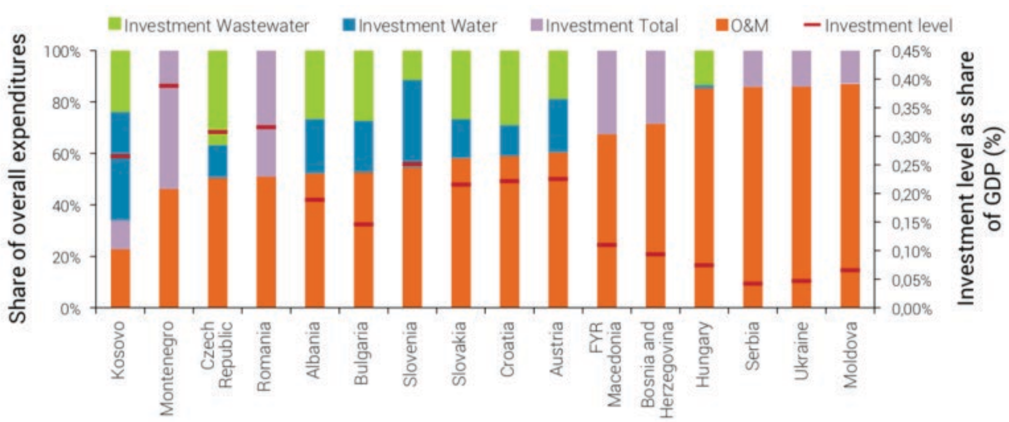
In view of the probable reduction in EU grant funding after 2020, the financial framework for WSS services in Romania will need to evolve. As already explained, despite the significant funds already spent or allocated, there will still be a significant investment financing need for the next two decades—not just for achieving UWWTD compliance but also to close the potable water access gap and to implement sustainable assets management policies (e.g., rehabilitation of water distribution systems to reduce water losses). Funding for WSS can only come from one of the three Ts, meaning that with reduced amounts available from EU funds, there will be no option but to increase the two other Ts—namely tariff levels and allocation from national or sub-national budgets (taxes). Currently, in the case of the large

FIGURE 7.6. **Breakdown of WSS Financing into the 3 Ts amongst Danube Basin Countries**



Source: WB DWP, State of the Sector, 2015.

FIGURE 7.7. **Breakdown of WSS Expenditure into O&M and Investment in Danube Basin Countries**



Source: WB DWP, State of the Sector, 2015.
Note: GDP = Gross domestic product; O&M = Operations and Maintenance; WSS = Water Supply and Sanitation.

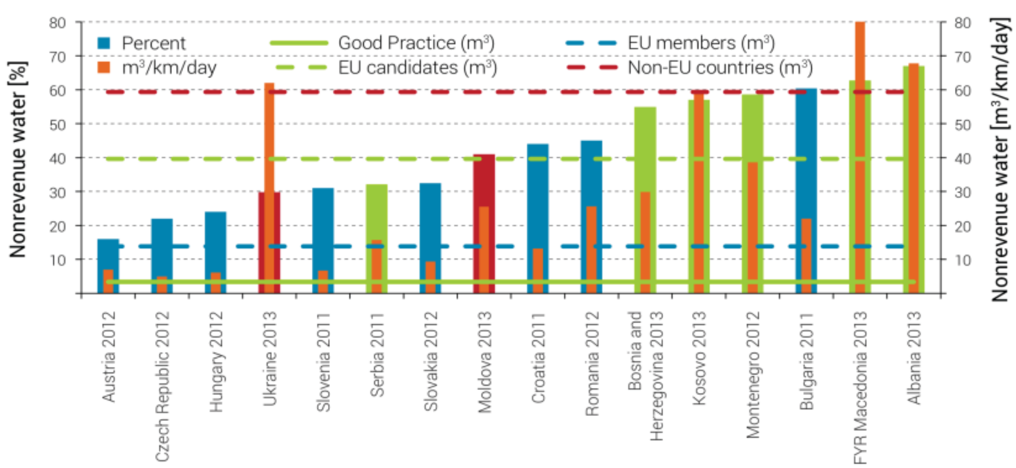
operators, WSS tariff levels cover the full Operations and Maintenance (O&M) costs plus some surplus for co-financing EU grants for investment, and there are some budget transfers from the central budget. Small municipal operators largely rely on municipal budgets from local taxes, as tariffs rarely cover the full O&M costs.

A financial strategy for the WSS sector should be developed, to identify the set of measures necessary to close the financial gap and ensure that both compliance and inclusion are achieved over the next decade in a sustainable manner. As analyzed in the WSS chapter, tariff levels still have some way to go to match the level of other EU countries, including in Central and

Eastern Europe, but the financial strategy should not rely solely on tariff increases, if only because this would be politically undoable. The first element of the WSS financial strategy must be to improve the cash generation at operator's level through efficiency gains (see next paragraph)– that is, asking the WSS operators to demonstrate some efforts before asking the population or the government to increase their contribution to the sector. Generating more operating cash flow will increase the debt capacity of operators and reduce the needs for tariff increases. The introduction of a social water tariff targeted towards the poor to ensure that poor families will still be able to afford the WSS bill, should also be a must to make certain that tariff increases are implemented in a fair and socially viable manner. The investment program needs to be optimized and executed in an efficient manner that reduces the risks of cost overruns, and options to leverage on commercial debt and PPPs (such as BOTs for WWTPs) need to be explored. Finally, the budget contribution, which must only come as the last resort, should be channeled in an efficient and transparent manner. Multiple lessons can be learned from other EU countries.

The priority in improving operational performance should be to reduce the level of water losses (NRW)—which is high in comparison with other EU countries. This is illustrated in figure 7.8 below which compares the NRW levels for all countries of the Danube basin, using both the indicator of percentage of water losses over total volume produced, and the volume of water losses per km of network per day. Only Bulgaria has a worse average NRW level based on percentage of volume produced, while Romania has the worst NRW performance of all EU countries when using the losses per km/day indicator. While there is no objective data available on the relative proportion of physical (leakages) and commercial (undermetering and water thefts) losses for the NRW performance in Romania, the previous analysis in this report estimated that commercial losses probably account for between a quarter

FIGURE 7.8. Comparison of NRW Levels in Danube Basin Countries



Source: WB DWP, State of the Sector, 2015.

and a third of the total NRW figure. There is currently a lack of awareness amongst Romanian WSS utilities of the problem of customers' under-metering—both the cost of the associated losses and the added revenues that could be brought by improving metering.

In the short term, efforts to reduce NRW should focus first on reducing commercial losses—which could bring over the next three to five years an additional revenue of 245–410 million lei per year. The value of 1 m^3 saved from commercial losses is much higher than the value of 1 m^3 lost to leakage—the former being based on tariff per m^3, and the latter only on the marginal cost (chemicals and pumping). It is likely that the regional utilities will continue to encounter challenges in reducing their physical losses, as the regionalization process continues and small rural systems being incorporated are in a poor condition. NRW reduction program for reducing physical water losses (leakages in distribution network) requires major rehabilitation investment, can be technically long and complex to implement (requiring not just massive pipes replacement but a good understanding of the hydraulics of the networks) and often has a low financial payback. In contrast, NRW reduction programs targeted at commercial losses have faster payback and are typically considered to be "low-hanging fruits". It is also worth noting that reducing commercial losses should help in improving the official figure for the national piped water access rate, since illegal (un-registered) connections would become accounted for.

The reduced VAT on potable water services—at 9 percent instead of the standard 19 percent—is an inefficient subsidy that fails to benefit the poor. Reduced VAT rates for the potable water portion of the WSS bills are quite common in older EU member states (UK, Portugal, Austria, The Netherlands, Luxembourg, Italy, France, Spain, Greece, Germany and Belgium). However, amongst EU-13 countries of Central and Eastern Europe, only Poland, Slovenia and the Czech Republic have introduced, like Romania, a reduced VAT rate for potable water. While the aim of a reduced VAT rate is to make the WSS bill more affordable to customers in the face of increasing tariffs, this is not the most efficient way to subsidize the WSS sector, since the reduction benefits all customers regardless of their income status. Furthermore, in the specific context of Romania, a reduced VAT for piped potable water represents a strongly regressive subsidy that benefits the rich and fails to reach most of the poor—since it benefits only those who are connected to piped water services and fails to reach the many poor families not connected to piped water systems.

Canceling this VAT rebate and allocating the additional proceeds to closing the inclusion gap should be considered, as part of an overall strategy to optimize the financial framework of the WSS sector. Considering the huge financial gap in WSS investments and scarce budget resources, removing the VAT rebate for water would generate additional financial resources to the national budget, which could in turn be targeted to finance the social needs of the WSS sector—either for accelerating investments to close the piped water access gap, or for financing a new social water tariff targeted at poor and vulnerable families (see more on than in following paragraphs). The current shortfall in tax receipts due to the reduced potable water VAT can be estimated at around 40-50 million Euros.[7]

7.3.2. UWWTD Compliance Is a Major Challenge that Is Likely to Last another Decade

Romania had negotiated the most favorable amongst EU-13 countries interim deadlines for compliance with the UWWTD under its accession treaty. Table 7.4 below presents the various interim deadlines for the UWWTD for all EU-13 countries. While each EU-13 country negotiated specific schedules for interim deadlines, with different (and not always comparable) benchmarks, Romania has the latest deadline for final compliance with the UWWTD, set for December 2018, while other countries had negotiated at best December 2015 as final deadline (cases of Hungary, Latvia, Poland, the Slovak Republic, and Slovenia). It is also noteworthy that the neighboring Bulgaria had negotiated an even less favorable final deadline, on December 2014. This was justified by the fact that the country started a decade ago with the lowest development of sewerage infrastructure among all new EU-13 countries.

As already indicated in previous chapters, **Romania is the worst performer amongst all EU-13 countries on UWWTD compliance**. It failed to meet its previous interim deadlines for larger agglomerations (above 10,000 PE) in 2013 (for sewage collection) and 2015 (for wastewater treatment). However, this should not overcast the considerable efforts that have been made so far by the Romanian authorities, and what has been achieved in the past decade—especially considering the magnitude of the infrastructure investments involved and the fact that the country started from a very low baseline when compared to other EU-13 countries.[8] Based on the latest available data, as of December 2016, as much as 84.5 percent of the total pollution load in larger agglomerations was reported to be collected (Article 3), but only about 17 percent in smaller agglomerations (between 2,000 and 10,000 PE—agglomerations C). As much as 78.5 percent of the total load in large agglomerations was reported to be treated (Article 4), against less than 15 percent in agglomerations C. For compliance with Article 5 (more stringent treatment), 45 percent of the total load nationwide was receiving tertiary treatment, but, again, only 5 percent of the load in agglomerations C.

While it is clear that Romania will fail to meet the final 2018 deadline, there is a sharp contrast in the compliance status between large and smaller agglomerations. The total pollution load from large agglomerations is estimated at 14.8 million PE, against a total of 5.1 million PE in agglomerations C. As shown with the 2016 data provided in the previous paragraph, for large urban agglomerations a large majority of the pollution load is already collected and treated before discharge. But very little of the pollution load from smaller agglomerations (between 2,000 and 10,000 PE) is currently collected and treated. The last 2018 interim deadline refers to compliance in agglomerations C, and it is obvious for these smaller agglomerations not only that Romania will fail to comply but also that it is still very far from complying.

TABLE 7.4. Interim Deadlines for UWTD Compliance for the Various EU-13 Countries

EU-13 Member State	Deadline of UWWTD transition period
Bulgaria	2010/**2014**
Czech Republic	2006/**2010**
Cyprus	2008/2009/2011/**2012**
Estonia	2009/**2010**
Hungary	2008/2010/**2015**
Latvia	2008/2011/**2015**
Lithuania	2007/**2009**
Malta	2006/**2007**
Poland	2005/2010/2013/**2015**
Romania	2010/2013/2015/**2018**
Slovak Republic	2010/**2015**
Slovenia	2008/2010/**2015**

Source: World Bank's elaboration.
Note: last year for each country corresponds to full compliance, intermediate years use different benchmarks. UWWTD = Urban Waste Water Treatment Directive.

Construction of wastewater infrastructure in large agglomerations (above 10,000 PE) is more or less on track. A large number of construction projects are currently being implemented, and it can be reasonably expected that most of the urban pollution load will be collected and treated by the years 2020-22. Several large WWTPs have already been completed, as in the case of Bucharest since 2012 (photograph 7.3). Many of the other projects are in construction phase and should be completed in next two years, and the rest of the remaining civil works are being designed or tendered.

There are, however, **two major issues that may delay further Romania's legal compliance with the UWWTD in large agglomerations**—which requires that more than 98 percent and 99 percent of the total pollution in each agglomeration be collected and treated respectively. The first issue is about urban slums: expansion of the sewerage network there and connecting households will be difficult, due to issues *inter alia* of enforcement of the rule of law, and frequent absence of legal property titles. As previously mentioned, solving this problem has to do with broader urban policies and goes well beyond the water sector. The second issue is linked to the resistance by many households to connecting to the new sewerage networks—which generate additional costs for them compared to their current individual sanitation practices. Unless these two issues are addressed proactively, it is likely that Romania will still fail to achieve legal compliance for larger agglomerations after 2020-22 (since more than the 1-2 percent of the pollution load will still fail to be collected and treated).

PHOTOGRAPH 7.3. View of the New Bucharest WWTP (*Apa Nova Bucuresti*)

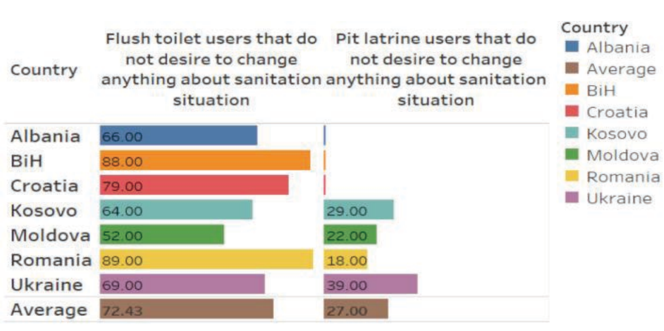
Source: ICPDR.

The situation is even more worrisome for smaller agglomerations (between 2,000 and 10,000 PE) where there is currently no clear perspective for UWWTD compliance. These pose a series of special challenges and require a dedicated strategy. The issues there are significantly different and more challenging than for expanding sewerage services in urban areas. These include higher unit cost for sewerage collection systems, higher incidence of poverty in rural areas, which makes affordability of sewerage collection and wastewater treatment more problematic,[9] lower capacity of local WSS providers to implement and subsequently operate the new sanitation infrastructure, the need to often invest in parallel in water distribution networks, resistance of the (poorer) rural households to connecting to newly installed WSS networks, and resistance from local municipalities to join the regional public utilities (which has so far been a condition for access to EU grant funding for investments).

It must be noted that the resistance to connecting to sewerage systems in rural areas is largely due to unmatched expectations—between what the UWWTD requires and what households want. Figure 7.9 below shows a comparison between various Danube countries of the proportion of rural households that are satisfied with their current sanitation practices, and do not want any change. In Romania, 89 percent of those already having access to flush toilets do not want any change—much more than in any other Danube country—meaning that they would resist being connected to a new sewerage network (and pay more). As for those who currently use pit latrines, while most of them want to change (18 percent are satisfied, the lowest figure amongst countries in the sample), what they really want is access to flush toilets, not connection to a sewerage collection system. In this context, it is worth reflecting that **promoting expansion of sewerage networks in rural agglomeration may require to develop special programs that promote in parallel the financing and installation of flush toilets on households' premises,** so as to address the needs of households and reduce resistance to connecting.

A revised final UWWTD compliance deadline for Romania could be tentatively set at 2027—which would be 10 years after the current final deadline. This has been proposed by the government in recent discussions with the EC. Interestingly, a similar revised deadline for 2027 has also been proposed by the other EU-13 countries having sill the largest compliance backlog—namely Bulgaria and Cyprus—in their latest discussions with the EC. It is worth reflecting that compliance with the UWWTD has been a major challenge for most of the EU countries, including many of the oldest and much richer member states. The 11-year interim period that was negotiated by Romania, with the 2018 deadline being actually quite short when looking at the experiences of older member states. Even though the UWWTD was enacted in 1991, the city of Brussels (that hosts the EC headquarters) still did not have a wastewater treatment plant 15 years later and was discharging its

FIGURE 7.9. Proportion of Rural Households Satisfied with Current Sanitation in the Danube Countries



Source: WB study on WSS rural access gap in Danube countries, 2017.

raw sewerage into the river. During the 8th reporting exercise (based on 2014 data), there were several older (and richer) EU members that had still not fully complied with the UWWTD—23 years after the Directive was enacted.

Achieving compliance by 2027 will require considerable efforts, with significant new policy actions and reforms to be carried out—the largest challenge being agglomerations C in rural areas. Apart from Bulgaria, which also has major delays with compliance in large urban areas, the remaining difficulties encountered by other EU-13 countries for UWWTD compliance are all related to compliance in agglomerations C (between 2,000 and 10,000 PE)—underlining the magnitude of the special challenges outlined above. This is notably the case for Cyprus and Slovenia, which are well advanced for UWWTD compliance in large urban areas, but have a serious backlog for sewerage investment in smaller agglomerations, not dissimilar to the current situation in Romania.

Preparing a viable strategy for UWWTD compliance in agglomerations C should be a priority in the context of the impeding infringement case to be brought by the EC. For a large majority of these smaller agglomerations, there are no sewerage projects even at the design stage, and how to deal with the specific challenges of sewerage services in rural areas has not been yet fully thought through. Such strategy should not only address the various above-mentioned challenges, but also look at the opportunity to optimize the cost of compliance. One option, for instance, would be to take advantage of the fact that compliance for more stringent treatment under Article 5 does not need to be done for every WWTP in each agglomeration, but can be calculated based on data consolidated from various WWTPs at the level of each receptory water body—allowing to build WWTPs with less stringent treatment and use lower cost techniques such as reed beds. Another key measure of the proposed rural UWWTD strategy would be to make a more extensive use of IAS.

The recourse to IAS in rural areas should be a strategic priority, given the high proportion of rural population in Romania. The 2015 report by the EC Court of Auditors on UWWTD in the Danube River countries found that Romania reported that only 1 percent of its total load was collected through IAS—as opposed to 7 percent in the Czech Republic and 13 percent in the Slovak Republic. In Western European countries, such as France, Spain and Portugal, as well as in Scandinavian countries, well designed and properly operated individual sanitation systems have been key for being able to comply with the UWWTD, and many best practices and valuable lessons can be learned.

The potential for making a better use of IAS in Romania is underlined by another important finding from the WB 2017 household survey: 96 percent and 38 percent of flush toilet and pit latrine users respectively stated that they have an on-site facility for the management of sludge or wastewater. Among these, respectively 59 percent and 67 percent stated they have emptied their pit or tank, and 31 percent and 25 percent that they did so in the past one year. Since there is already an informal market in Romania for pit and tank emptying, formalizing and regulating this service to ensure that adequate treatment and disposal is taking place would generate clear environmental and public health benefits, and be of critical help to reaching compliance in rural areas—while also contributing to job creation and economic development there.

The upcoming EC infringement case will raise the bar for complying with the UWWTD—by increasing the scrutiny and pressure from the EC. Romania will need to demonstrate credibility and pro-activeness in solving the various problems and bottlenecks—which are not just of a financial nature. Again, the country could benefit from valuable lessons to be learned from other EU countries which have been struggling in the past to comply with the UWWTD, through peer-to-peer exchanges.

A credible revised Implementation Plan (IP) would need to be submitted urgently to the EC, but the MWF is not yet in a position to do so—as it will require considerable work to gather reliable data and propose a strategy addressing the many bottlenecks. The objective of such an updated IP must be to present in a realistic manner the various measures and actions to be carried out by the Romanian authorities to achieve UWWTD compliance over the next decade. **The updated IP must be based *inter alia* on a proper field inventory of the situation on the ground**, considering that the situation in rural agglomerations (between 2,000 and 10,000 PE) is not currently well known. While the proposed strategy for rural UWWTD compliance is not necessarily a pre-requisite for preparing the updated IP and could be developed in parallel, it should still outline the key challenges and how they will be dealt with in some detail.

The establishment of a reliable national database to be able to monitor the progress in each agglomeration, and report to the EC every six months, will be a must—although its establishment will be complicated by the overlaps between many institutional actors including MRDPAEF, the regulator National Regulatory Agency on Communal Services (ANRSC), the local authorities and the WSS operators. It shall enable stakeholders—both at the government and EC levels—to monitor the progress towards compliance and take corrective actions whenever specific projects encounter implementation difficulties. It would also help Romania demonstrate its commitment and steady action towards continuous reduction of distance to compliance with UWWTD, even though it may not be able to yet fully comply with its targets under the accession treaty. The development of such database is made necessary by the complexity and overlaps between the many institutional players involved in data collection and investments—a situation which is described in details in box 7.2.

The O&M sustainability of the newly installed wastewater infrastructure—both sewerage networks and treatment plants—must also to be addressed. So far, efforts have concentrated on infrastructure development, with the construction of new sewage collection and wastewater treatment systems. Ensuring that the new infrastructure and, in particular, the new WWTPs (which can be technologically challenging) are properly maintained and operated, so that each agglomeration can *in fine* meet the effluent discharge standards of the UWWTD, will become critical in upcoming years. This means ensuring that the WSS operators have sufficient financing for O&M, as well as human capacity, and also ensuring proper monitoring of effluent discharges (along with penalties for non-compliance).

BOX 7.2. Shortcomings in Data Collection for UWWTD Monitoring and Compliance

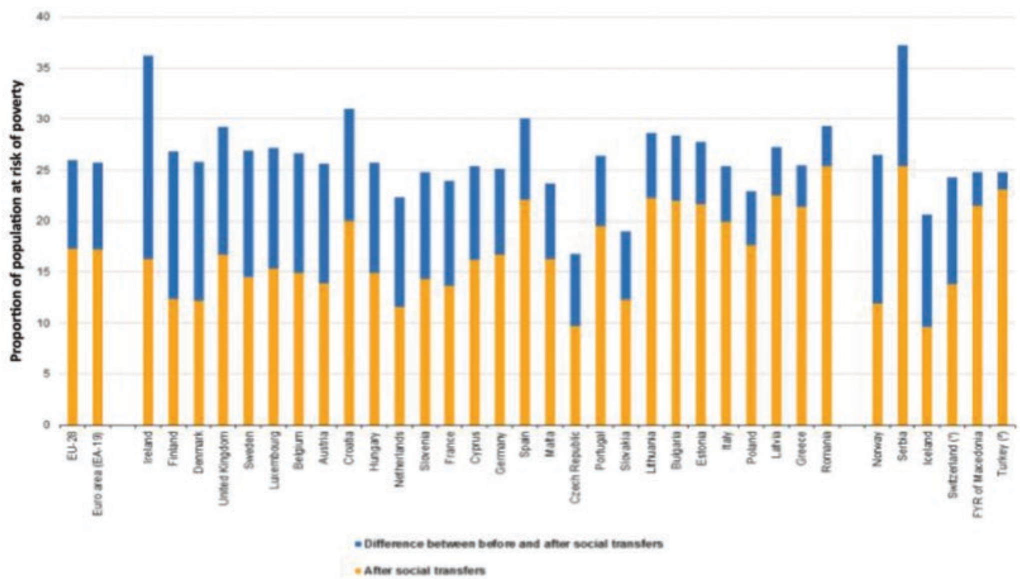
The first shortcoming is that all entities involved in Urban Waste Water Treatment Directive (UWWTD) implementation have their own databases with their own sets of reference elements that are updated at different intervals: ANAR does the update every six months for population agglomerations (reference used by UWWTD) while National Regulatory Agency on Communal Services (ANRSC) updates the information every three months at territorial administrative units (TAU) level. Since a clear definition of population agglomeration is missing from the Directive or Operational Program (or is vague), there is much room for interpretation, mostly (but not only) in rural areas, where an agglomeration could include a number of villages of a commune, a group of communes (with all or some of their villages), or a group of villages belonging to a number of neighboring communes! In the absence of a clear rule, the decision is left to the discretion of local administrations (plus sometimes at county level and with the influence of the regional operator). In short, while the financial rationale governs the establishment of agglomerations, this is not clearly linked with data collection.

The second major problem is that the source of information on UWWTD compliance differs between the institutions involved in directive compliance—namely ANAR, ANRSC, MRDAPEF/LIOP and MARD/NRDP. **ANAR** gets information from the water operators (either regional or local) through their requests for operational license (such license is requested once a new water supply/sewage system is ready to operate and includes the number of beneficiaries, by agglomeration i.e., territorial coverage). **ANRSC** gets information from the operators, by TAU, with the mention of beneficiaries connected to the water or sewerage network, regardless of any informal participation in an agglomeration. **MRDPAEF/LIOP** gets the information on the number of beneficiaries of a new project, *by agglomeration* (as defined in the project), from the feasibility study submitted for review and financing but nothing after the completion of works. Finally, **MARD/NRDP** also gets the information on beneficiaries, *by TAU*, from the feasibility study submitted for review and approval for financing; NRDP provides financing to local administration at commune level. Hence, there is significant variability in the source of information by public institutions and this induces also significant confusion while making any correlation with the national system of statistics difficult.

7.3.3. Inclusion: Closing the Water Access Gap and Ensuring Affordable Tariffs

Romania faces major inclusion challenges overall—not just for water—when compared with other EU countries. The country is well behind in growth distribution, and existing social transfers in Romania are not effective at reducing poverty. Romania has the least developed social safety net of all EU countries, and does not compare well even with non-EU countries of the region. Figure 7.10 shows the proportion of population at risk of poverty in EU countries as

FIGURE 7.10. **At-Risk of Poverty Rates in EU Countries, before and after Social Transfers (2015)**



Source: EC based on Eurostat.

well as 3 other non-EU countries of the region (Serbia, the Former Yugoslav Republic of Macedonia and Turkey). While Romania is ranked 4th for the proportion of the population at risk of poverty, it is ranked first after the impact of social safety nets are taken into account—with the smallest improvement due to safety net of all EU countries. The proportion of the population at risk of poverty, after social transfers, is comparable to Serbia and even higher than in FYR Macedonia and Turkey. Overall, **Romania is the most "unequal" EU country**—with the sharpest discrepancies between urban and rural areas, and between rich and poor households—so it is not surprising that it is such an outlier for access to piped water, which affects mostly the poor.

As already indicated, Romania is a complete outlier for access to piped potable water among the EU countries, with an access rate of only 77.6 percent (including in-house self-supply) **and 4.5 million people lacking in-house access** (based on the latest 2016 household surveys). As of 2015, only 12.6 million people had access to piped water from a centralized water distribution system—which translates into a national coverage of less than 64 percent. While the coverage rate in urban areas stands at 94 percent, it is at less than 29 percent in rural areas, where most of the poverty is concentrated. Between 2008 and 2015, the access rate has increased by 11 percentage points, with 1.2 million people gaining access. Romania is still far from the EU average of 95 percent of population with access to public piped water supply.

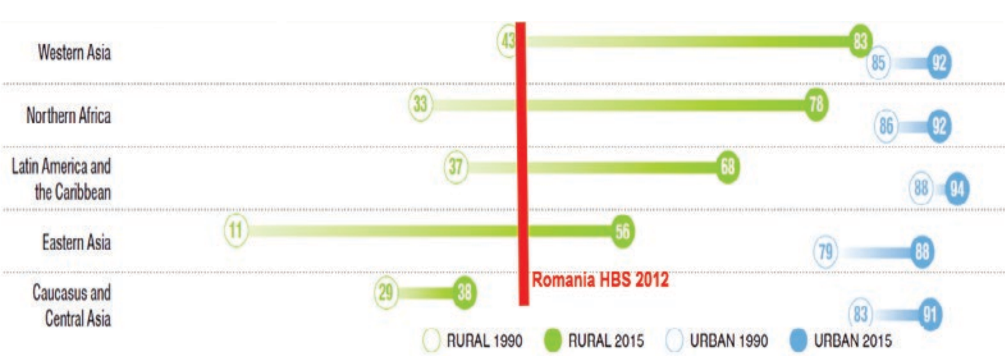
This piped water access gap is a serious public health issue—with about 12 percent of the population (2.5 million people) reported to be relying on unsafe, non-potable water sources.

Potability from private wells is not monitored and most shallow wells (which are used for self water supply by poor families) are subject to contamination, especially given the low rate of connection to sewerage collection system and the prevalence of environmentally inappropriate individual sanitation such as pit latrine that contaminates shallow groundwater.

Romania appears also to be falling behind the global trend—across all continents, including in developing countries—of increasing access to piped potable water in rural areas. Figure 7.11 shows rural-urban gaps in coverage of piped water on premises for several regions of the world, and its evolution between 1990 and 2015. The piped water access rate in rural areas has almost caught up with urban areas in Western Asia, and considerable progress has been achieved in Latin America (from 37 percent to 68 percent) and Northern Africa (from 33 percent to 78 percent). This is especially remarkable as these regions have to deal with major demand increases due to population growth. Currently, the piped water access rate in rural Romania is comparable to where Western Asia was back in 1990, and considerably below the Latin America and North Africa averages.

Romania's piped water access rate is lower than in all other non-EU countries in the region except for Moldova—but also lower than in many developing countries in Latin America and North Africa. A comparison of the piped water access rate of Romania and other Danube basin countries was already shown in previous chapters. Table 7.5 below shows the access rate to piped water in developing countries of Latin America (LAC) and North Africa, in 2015 as well as in 1990, 2000 and 2010. The most advanced countries in LAC—namely Chile, Uruguay and Argentina—have now achieved almost universal piped water access. Brazil, Mexico and Panama are close to the 95 percent EU average. Surprisingly, the 77.6 percent access rate in Romania (2016) is lower than in many LAC countries, including even the poor ones in Central America, such as Honduras (90 percent) and Guatemala (85 percent), or Ecuador (85 percent). In North Africa, Tunisia has a higher access rate (82 percent), and only Morocco has a lower access rate of 64 percent (but it started in 1990 at only 38 percent—at a level comparable to where Romania was at the time).[10]

FIGURE 7.11. Rural-Urban Gaps in Piped Water Coverage for Various Regions of the World



Source: WB 2017 based on JMP WHO-UNICEF.

TABLE 7.5. Access to Piped Water in Latin America and North Africa Countries (1990, 2000, 2010, 2015)

Percent

	1990	2000	2010	2015
Ecuador	59%	71%	81%	85%
Argentina	87%	92%	96%	98%
Brazil	78%	86%	92%	94%
Chile	88%	94%	98%	99%
El Salvador	42%	59%	72%	78%
Nicaragua	51%	58%	64%	66%
Mexico	75%	83%	90%	92%
Panama	80%	87%	90%	92%
Peru	55%	65%	74%	78%
Uruguay	90%	93%	98%	99%
Honduras	60%	73%	86%	90%
Guatemala	50%	65%	80%	85%
Colombia	77%	82%	87%	88%
Algeria	67%	72%	76%	77%
Tunisia	60%	71%	79%	82%
Morocco	38%	50%	60%	64%

Source: JMP WHO-UNICEF 2017.

This surprising comparison should be a call for radical action for the central government. It is worth reflecting that this peculiar situation is the result of historical and cultural practices. Contrary to neighboring Bulgaria where the communist regime had pushed for universal access to piped potable water, in Romania this was not considered a priority and access rate in the early 1990s was very low, at less than 40 percent nationwide. Since then, the country has made considerable efforts to close this access gap, starting from a very low base—but the question is whether this is enough for an EU member state. As already mentioned in this report, at the current rate of increase (1.4 percent per year), it would take until 2040 for Romania to achieve universal access to piped water—but in practice 2050 may be more realistic since increasing coverage will be increasingly difficult as more remote settlements have to be dealt with. **Closing the piped water access gap should become a matter of national priority**, with an ambitious national program to address the various challenges through sufficient financial resources and innovative solutions.

While it is not covered currently under the Drinking Water Directive (DWD), **the piped potable water access gap may also soon become a compliance issue—and become a legal problem of a similar magnitude to sewerage access under the UWWTD**. The EC is currently reviewing the DWD as part of the REFIT (Regulatory Fitness and Performance Program) exercise, which is screening the entire stock of EU legislation on an ongoing and systematic basis to identify burdens, inconsistencies and ineffective measures, and propose corrective actions. Although a final deliberation has not yet been made, it is quite likely that the DWD will be revised in the near future to include access to piped potable water. This would put Romania in an uncomfortable situation of legal non-compliance, of a magnitude not dissimilar to the UWWTD, adding more pressures to close the piped potable water access gap.

In the short term, the access rate to piped water in Romania is expected to increase significantly, but this will fall short of achieving the ambitious target of 85 percent access by 2020. The WSS connection rate is expected to record increasing values when the 2016 and 2017 figures will be released by ANRSC due to the delayed impact of the implementation of SOP financed investments (an important part of the connections related to the investments in network expansion had not been finalized yet by 2015). This delay was partly due to resistance by households to connecting, due to *inter alia* unwillingness and lack of capacity to pay the higher tariffs of the regional public utilities.

In practice, the issues of UWWTD compliance and inclusion go hand-in-hand. Romania will not be able to comply with the UWWTD without dealing with potable water access and ensuring that the poor can access affordable WSS services. There is no point in trying to connect poor households to a sewerage network if they are not connected to piped water, and if they cannot afford a flush toilet. The issue of inclusion and closing the piped water access gain must be fully addressed in the UWWTD compliance strategy already mentioned in previous paragraphs. The experience of Portugal could hold useful lessons for Romania, as it also had a low piped water coverage (about 75 percent) when it joined the EU in 1986, but has been able to close the gap and achieve universal piped potable access. As a matter of fact, compliance with the UWWTD in rural agglomerations above 2.000 PE will require that massive investment be carried out in parallel to connecting many of these rural households to piped potable water—meaning that the push on UWWTD compliance in rural areas should have a significant impact in helping to close the piped water access gap.

It is important to highlight that Romania is also not on track for complying with Target Six of the Sustainable Development Goals (SDGs), which requires that access for all to safe and affordable drinking water and adequate sanitation be achieved by 2030. In practice, access to centralized piped water systems is not always required for ensuring that households are using safe potable water. Yet, with more than half of the 4.5 million people without in-house piped water reported to use unsafe, non-potable, water sources, it is unlikely that all self-supplied households could become connected to piped network systems by 2030. In spite of that, there is no plan so far at the national level for guaranteeing safe water to those who will still depend on self-supply from private wells. While compliance with the UWWTD is expected to greatly reduce contaminations of shallow wells, other proactive measures should be put in place, as part of a dedicated WSS strategy for rural areas. Equally, there is no plan yet on how to ensure that the more than 6 million Romanians who currently do not have flush toilets can get access to adequate sanitation over the next decade.

Dealing with the WSS affordability issue should become one of the priorities of the WSS sector—both for social equity and to unblock the reform and compliance process. This report showed that tariff affordability for the poor is becoming a concern for poor families in view of the recent tariff rises, and will become even more of a concern as further increases are expected in the future. Furthermore, the level of WSS tariffs of the regional public utilities is one of the key reasons why many households are resisting connecting to the piped networks (both water and sewerage), and also why many local mayors have been resisting joining the regional utilities. Ensuring that WSS tariff can be made affordable for poor and vulnerable families is therefore crucial for closing the access gap, complying with the UWWTD, completing the regionalization process and ensuring social fairness.

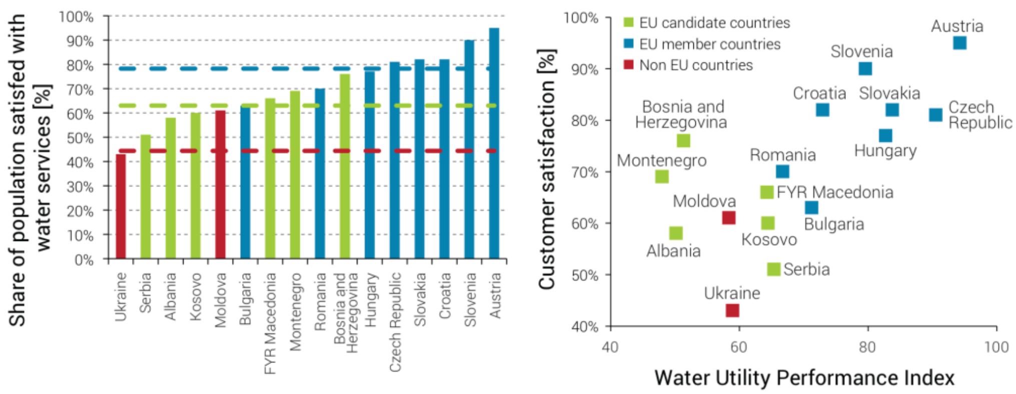
The introduction in Romania of a social WSS tariff, targeted at the poor, should be one of the next steps of the reform. Ensuring affordability of WSS services for the poor is not explicitly addressed in the existing EU water legislation—it is part of what has been called the "hidden agenda" in this report—even though the initial goal of the EC when putting in place the 2.5 percent threshold pricing rule was to ensure affordability for the poor. This current regulatory pricing rule fails to protect the poor, and (capping further tariff increases for the average and rich households) artificially limits the scope for the WSS utilities to gradually move towards full cost recovery, making it more difficult for the sector to close the capex funding gap and gradually reduce dependence on EU grants. Some sort of social support to help the poor pay their WSS bills is therefore needed, and a 2017 report by the EU Court of Auditors on DWD implementation in Romania, Bulgaria and Hungary specifically recommends to consider providing financial support to poor households.

A social WSS tariff in Romania would need to be customized to local conditions—and probably be funded through transfers from the central budget and administered at the central level (as opposed to cross-subsidies at the utility level). As already mentioned, water utilities in many other EU countries (Spain, Portugal, France, Malta, England and Wales, Italy, Belgium and Greece) have put in place over the past decade social water tariffs targeted at the poor.[11] While these experiences hold valuable lessons, the fact that all these schemes are financed through cross-subsidies between customers within each utility may not be applicable to the current context of Romania. In line with the proposal for introducing a social water tariff currently being discussed in the neighboring Bulgaria, this new scheme may have to be funded through a central budget allocation, and could be better administered at the national level using some existing social safety scheme to ensure proper targeting and identification of beneficiaries (such as the heating subsidy). It could also be at least partly funded by canceling the current rebate on VAT for piped potable water—which is a regressive subsidy which benefits the rich and fails to reach the poor—and reallocating the proceeds to this new social scheme.

7.3.4. Reforming WSS Utilities: Combining Commercialization with Inclusion

Customer satisfaction with WSS providers appears to be lower in Romania than in all other EU countries except Bulgaria. Based on 2013 Gallup data, it stood at about 70 percent, below the

FIGURE 7.12. Share of Population Satisfied with WSS Services in Danube Countries (Left) and Water Utility Performance Index (Right)



Source: SOS Danube Water Program 2015, based on Gallup opinion poll 2013.

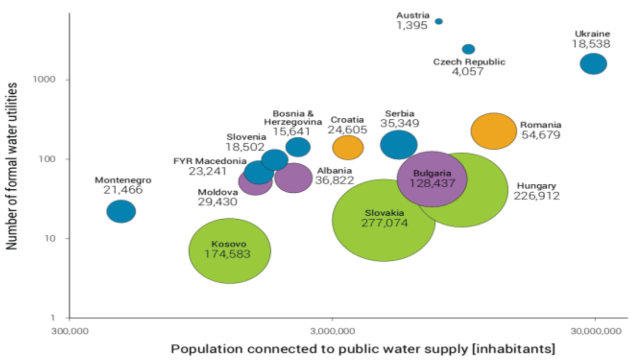
satisfaction rate in all EU countries by between 10 and 25 percentage points, with the exception of Bulgaria. Nonetheless, customer satisfaction is above non-EU countries of the region—above Serbia by 20 percentage points, and Albania and Moldova by about 10 percentage points. This is broadly in line with the ranking based on the Water Utility Performance Index, which rates Romanian WSS utilities as average, but the satisfaction level appears slightly higher than the Performance Index—Bulgaria scoring better than Romania on the performance index but less on satisfaction rate (figure 7.12). This tends to suggest that attention to customers would be relatively satisfactory amongst Romanian WSS utilities.

As previously discussed, **the regionalization process—the cornerstone of the WSS reform—is still incomplete**. While the large WSS operators (43 regional public utilities and 2 large private operators) now provide services to about 11 million people (87 percent of the population served by piped water systems), there are still about 1.6 million people being served by small local WSS operators (about 900 in total, including a few small private operators). The current average size of the regional public utilities (ROCs) stands at about 200,000 people—not far from Hungary and the Slovak Republic and ahead of Bulgaria (as shown in figure 7.13 below), which all have largely completed their regionalization process—but because of the large remaining number of small providers, the average size of Romanian WSS operators is still at about 55,000 people. This is low especially when considering that the original plan was to end up with one utility per river basins, which would have meant 11 utilities serving close to 1.8 million people on average.

The resistance from local populations and mayors in rural areas to joining a regional public utility may be linked to a perception that ROCs do not pay sufficient attention to rural customers. The 2017 household survey by the WB found that, in addition to complaining about the higher tariff levels of ROCs compared to municipal services, rural customers also complained that they were receiving less attention from ROCs than from municipal services (repairs and general information) (figure 7.14). This suggests that responsiveness of ROCs in rural areas could be improved and may be part of the reasons for the current “blockage” of the regionalization process.

The current regionalization model seems to be showing its limits—with current perverse incentives to expand in rural areas. While utilities agglomeration does bring tangible benefits in terms of cost (economies of scale and scope) as well as for dealing with local capacity gaps, it cannot be expected by itself to solve all the sector’s woes. In Romania, the combination of trying at the same time to agglomerate WSS services while establishing creditworthy regional public utilities—while understandable in principle—has proven difficult due to the specific conditions of the country, especially the large access gap and high poverty rate in rural areas, combined with demographic decline and outmigration. In such a context, combing regionalization with commercialization (pushing the ROCs to access commercial lending for the co-financing of EU grants) has introduced disincentives for the newly created regional utilities to expand into rural areas—because by doing so they often incorporate highly deteriorated systems, reducing their operational performance and creditworthiness. At the same

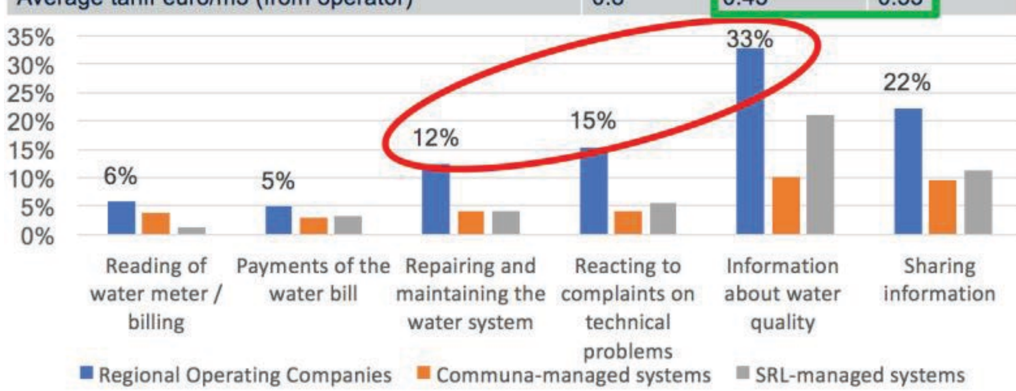
FIGURE 7.13. Number and Average Size of WSS Utilities in Danube Basin Countries



Source: WB DWP, State of the Sector, 2015.

FIGURE 7.14. Rural Customers’ Complaints about Water Services from ROCs, Municipal and SRL Services

	ROC	Communa	SRL
Thinks tariff is fair (%)	47%	58%	73%
Medium expenditure euro per m3 used (invoices)	0.88	0.55	0.66
Average tariff euro/m3 (from operator)	0.8	0.45	0.53



Source: WB study WSS access gap in Danube countries, 2017.
Note: ROC = Regional Operating Company; SRL = Limited Liability Company.

time, local authorities and the populations in poor rural areas have little incentives to join the regional utilities, as it means having to pay much more for their water supply.

Completing the regionalization process will require a reconciliation of the somewhat conflicting goals of inclusion and commercialization—and probably a revision of the model as part of the development of a national WSS strategy. Currently, the Romanian WSS sector finds itself in a rather paradoxical situation: it has managed to establish a series of competent large public WSS operators, some of them showing reasonably good performance compared to other EU countries—which is an achievement not to be understated—but at the same time these well-performing public utilities have disincentives to expand in poor rural areas. The current model seems to have been pushed to its maximum, as many ROCs are close to their maximum borrowing capacity at the current tariff level.

Adjusting the current model shall require a set of measures, at the level of both regional utilities and local authorities. For regional utilities, the previously mentioned introduction of a social water tariff for the poor, as well as channeling budget support to the utilities that expand in rural areas so that the added costs are not entirely supported by the existing customers (introducing cross-subsidies at national instead of just county level), ought to be considered. For local authorities, making mayors responsible in case of non-compliance with EU legislations (e.g., with fines), in case of refusal to join a regional utility, may be considered. Whether full regionalization should become compulsory, or whether the remaining presence of small local WSS providers should be accommodated (with corresponding access to grant funding for investment) is a key issue to address. The experiences from regionalization reforms in other EU countries—such as in Greece, Bulgaria, Italy, Portugal, Hungary, the Slovak Republic, France and The Netherlands—could bring many valuable lessons.

A new national WSS strategy should also address a series of other policy issues. It should consider the introduction of a fixed charge in the WSS tariff structure, as it is done in the majority of WSS utilities of older EU countries, which would improve the creditworthiness of the utilities by making them less exposed to demand risk. The current ban on PPP for WSS services should also be revisited in the light of the acute financial gap facing the WSS sector and intense pressures for compliance and inclusion, to allow for some contractual models such as BOTs for WWTP and Performance-Based Contracts for NRW reduction. Such PPP schemes would be beneficial to the current sector situation and are fundamentally different from the concession model already in place in Bucharest and Ploiesti in that the delivery of WSS services to the customers would remain fully under the control of the regional public utilities. Finally, more efforts ought to be put in transparent access to performance data of the WSS operators—so as to promote better accountability and push for improvement. The national WSS utilities association ARA is an asset and should be closely associated to the development of the proposed national WSS strategy, as a key stakeholder.

The regulator ANRSC needs to switch to pushing for efficiency improvement of WSS operators. It will be important for the national regulator ANRSC to start putting more pressure on the management of the ROCs to improve their performance. In parallel, local mayors through the IDAs should also play an increasing role in supervising the ROCs' management and pushing for efficiency savings, in order to reduce future needs for tariff increases. So far, ANRSC has focused its work on approving business plans and tariff increases. This has been the case for all newly established regulators in the Danube basin countries, and is fully understandable: the Romanian WSS sector has been in a state of flux, and the experiences of other countries with many decades of WSS regulation (England, Chile, Colombia) show that establishing a solid regulatory framework takes time.

Regulating publicly-owned utilities is inherently challenging, since financial penalties do not have the same impact and cannot be imposed in the same way as with private operators. This is of special importance as further tariff increases will probably be needed in the future, especially as regulatory rules will need to allow for financing of assets renewal after 2020. Experiences from other EU countries should be of much value, and knowledge transfer initiatives through some form of "peer-to-peer" partnership could be especially useful, insofar as regulation of public utilities is more about political economy than economic theory (i.e., more an art than a science)—and this skill is better learned through face-to-face exchanges and coaching. The experience of Scotland—gradually turning around a very poor performing public utility through skillful regulation—as well as Portugal,[12] could hold valuable lessons.

7.4. Building Resilience and Sustainable Water Resources Governance

7.4.1. Many Challenges for Achieving the Good Status of Water Bodies under the WFD

Romania starts from a good base for the implementation of the WFD. As already indicated, the WFD represents a fundamental change in paradigm for EU water policies, aiming to achieve good status of all water bodies and integrated river basin management through a result-based approach that leaves flexibility to member states on how to achieve this good status. While it is widely acknowledged that its implementation will be a major challenge for many EU countries, Romania starts from a rather advantageous position. First, it has the advantage of starting from a good base, compared to older and more industrially developed EU countries. As many as 66 percent of surface water bodies already achieving good or high ecological status in 2016 (71 percent for rivers)—exceeding the current EU goal of 60 percent and putting Romania among the top three countries along with Estonia and the Slovak Republic. Also, it can count on almost a century of river basin management experiences.

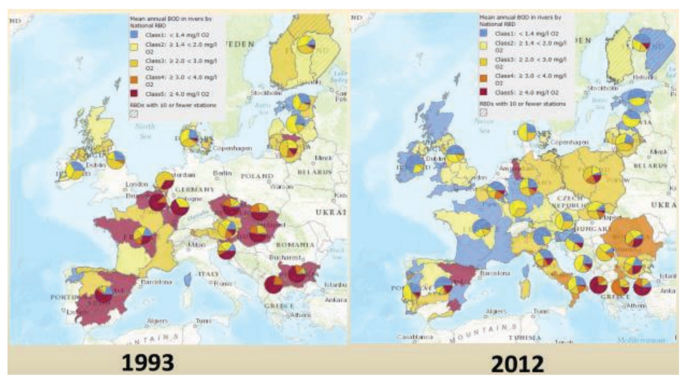
Romania still has a lot of room for improving the quality of its water bodies through the implementation of the UWWTD and Nitrates Directives, which should result in considerable pollution abatement. The country has already made significant progress in the previous RBMP cycle, as the proportion of surface water bodies having a good or high ecological status went up from 59 percent to 64 percent between 2009 and 2015. It is expected that this proportion shall further increase to more than 85 percent by 2012—the goal being that good environmental status be achieved for all water bodies by 2027.

The experience from older EU member states demonstrates that the implementation of the UWWTD has a major impact on the quality of surface waters. This is illustrated in map 7.7 below, which compares on two maps the biochemical oxygen demand (BOD) concentration in rivers in European countries between 1993 and 2012. BOD concentration in Spain and France (for which the most data was available) dropped drastically. However, the high concentration still found in some parts of Germany and England shows that domestic effluents is not the sole cause of organic pollution, and that the UWWTD does not by itself solve the BOD concentration problem in polluted rivers.

Implementation of the UWWTD in Romania—which is part of the "basic measures" under the WFD—has already brought about significant environmental benefits. While Romania has currently the largest contribution to the BOD and nutrients concentration in the lower Danube, a significant drop has been achieved between 2005-06 and 2011-12, as shown in figure 7.15 below. The improvement would be even higher if more recent data is used due to the many new sewerage networks and wastewater treatment plants put into operation in Romania over the past 5 years.

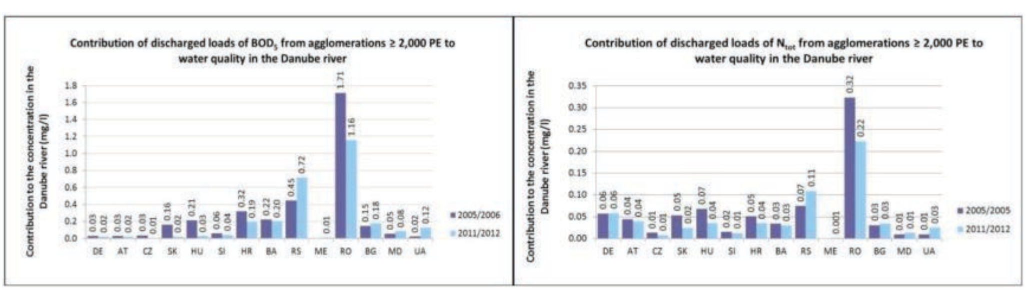
But the major challenges to UWWTD compliance are generating major delays, and could affect achieving the good ecological status overall by 2027. As already indicated, many households are resisting connection to the new sewerage networks, and there is no clear strategy for achieving compliance in smaller rural agglomerations (between 2,000 and 10,000 PE). Reaching UWWTD compliance by a new 2027 deadline (10 years after the current deadline) would still require major efforts. Were such revised deadline to be missed, this would have a negative impact on achieving the good status of water bodies under the WFD by 2027. In particular, the condition of lakes—for which Romania's performance is quite low (as opposed to rivers)—requires major improvements.

MAP 7.7. Evolution of BOD Concentration in European Rivers between 1993 and 2012



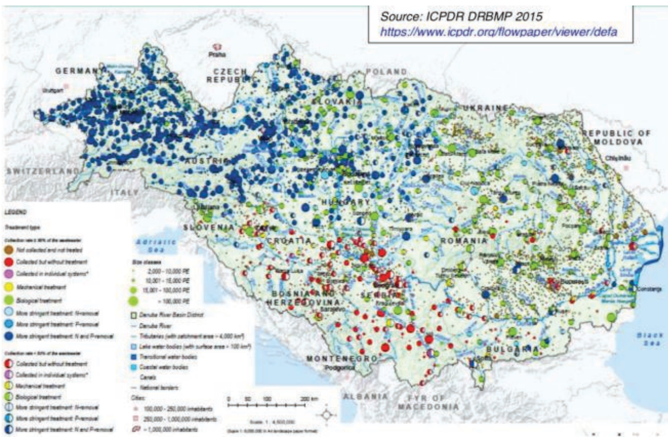
Source: Rakedjian 2017.

FIGURE 7.15. Contribution of Discharged Loads for Agglomerations above 2,000 PE to Water Quality in the Danube River



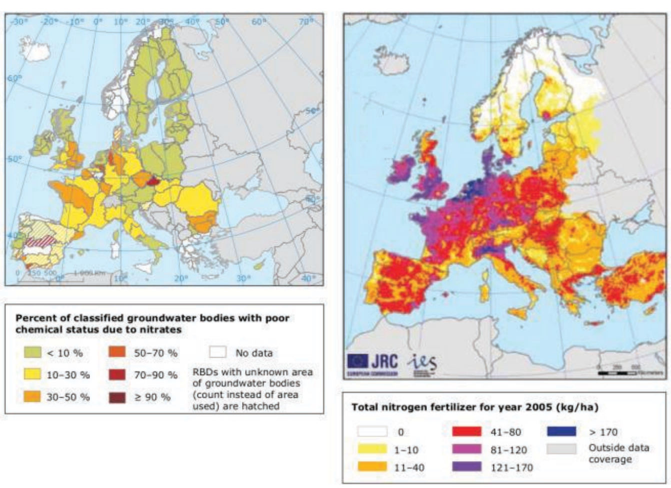
Source: Austria Env. Agency, for WB, 2017.

MAP 7.8. Level of Wastewater Treatment in Agglomerations above 2,000 PE in the Danube Basin in 2011–12



Source: ICPDR 2015.

MAP 7.9. Percentage of Groundwater Bodies Not Achieving Good Chemical Status due to Nitrates (Left) and Total Nitrogen Input from Organic and Inorganic Fertilizers (Right)



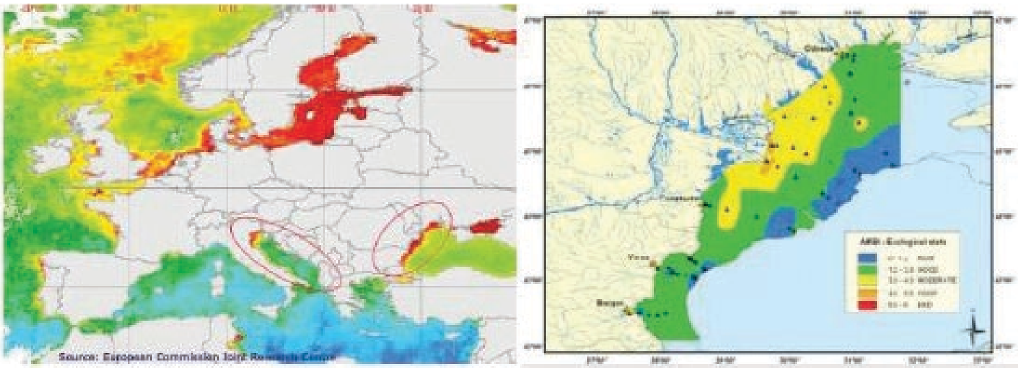
Source: EEA 2012a.

Reducing the pollution of the Danube River from domestic effluents also largely depends on upstream countries that are not yet members of the EU—and which have no plans to put in place WWTPs over the next decade. map 7.8 below provides a map locating the main sources of domestic effluent pollution from agglomerations above 2,000 PE in all Danube basin countries. While this map dates to 2011-12, little has changed in terms of wastewater infrastructure in non-EU countries, and the map illustrates that the non-EU countries from the former Yugoslavia—Serbia, Bosnia, Montenegro, and FYR Macedonia—altogether contribute very significantly to the domestic pollutants discharge into the Danube, with a large number of cities and towns equipped with sewage collection networks but discharging into the rivers without any wastewater treatment (red dots).

Improving the status of Romanian groundwater will also be challenging and require continuous efforts to continue the implementation of the Nitrates Directive. The long retention pace of pollutants in aquifers makes progress on improving groundwater quality difficult. With low income levels compared to other EU countries and low commitment of farmers, run-off from fields and farms remains hard to control (map 7.9). Regulatory restrictions and positive incentives (such as the pilot subsidy to encourage better animal manure management) have been put in place to good effect. The timely implementation of the new Additional Financing under the WB project INPCP will be essential to ensure that the “basic measures” under the Nitrates Directive can make a sizeable contribution to the WFD. Also, it must be noted that a large portion of the 400 million euros required for implementation of the Nitrates Directive over the next decade remains unfunded.

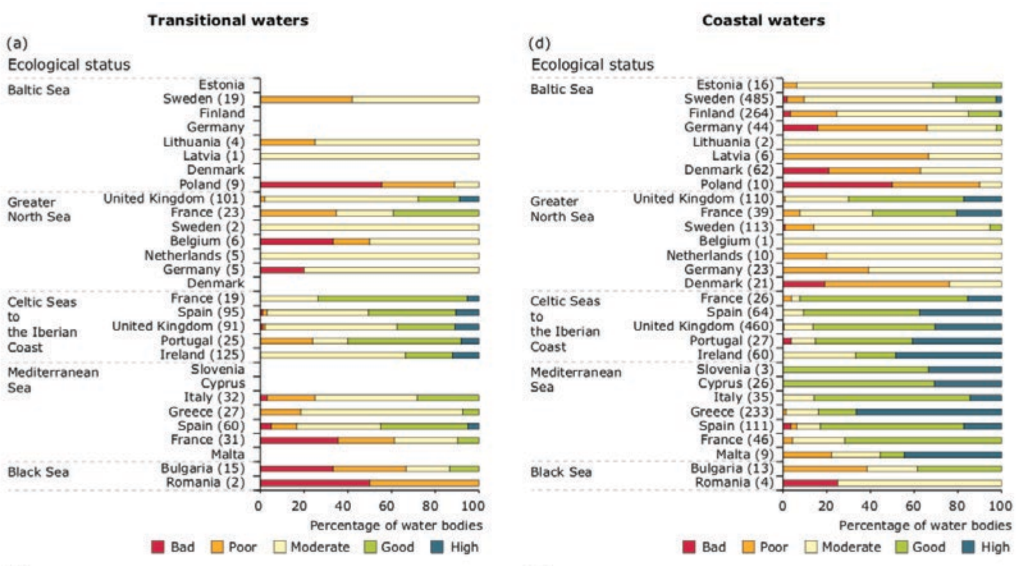
One major challenge will be achieving a good status of intermediate and coastal water bodies—which are in a poor state in Romania due to the eutrophication of the Danube delta. As shown in map 7.10 below, the Danube delta is subject to acute eutrophication due to the heavy nutrients load of the Danube River. The pollution is due not only to the Danube River, but also to the Dniester River flowing from Moldova and Ukraine (without any notable pollution abatement measures). The Black Sea fish stock has deteriorated dramatically over the past three decades, with the diversity of commercial fishes caught shrinking from about 26 species to six.

MAP 7.10. **Eutrophication in European Coastal Waters (Left) and in the Danube Delta (Right)**



Source: EEA.

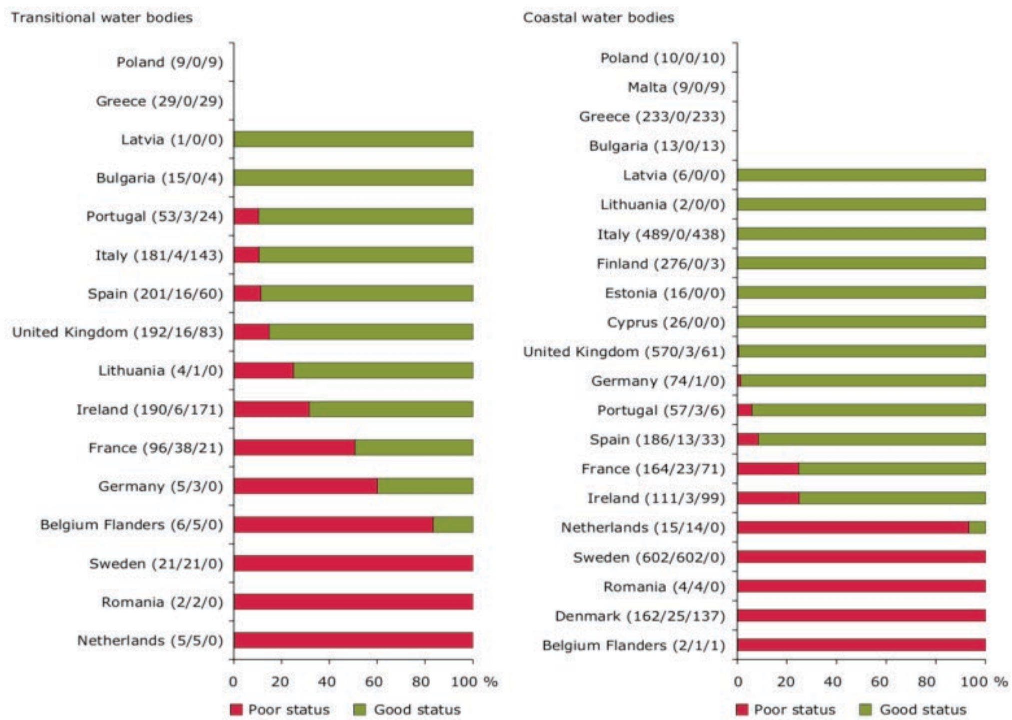
FIGURE 7.16. **Ecological Status of Transitional and Coastal Water Bodies in EU Countries**



Source: EAA 2012d.

Because of the poor situation of the Danube River and Delta, Romania is amongst the worst performers for the ecological and chemical status of transitional and coastal waters. Figure 7.16 below compares the ecological status of transitional and coastal waters among EU countries in 2012. Romania—whose limited stretch of coasts on the Black Sea is entirely influenced by the Danube delta—has one of the worst performances, alongside Germany (the North Sea) and the Scandinavian countries (the Baltic Sea). Figure 7.17 shows in turn the chemical status of EU countries in 2012, with Romania being ranked last together with The Netherlands, Sweden and Denmark.

FIGURE 7.17. **Chemical Status of Transitional and Coastal Water Bodies in EU Countries**

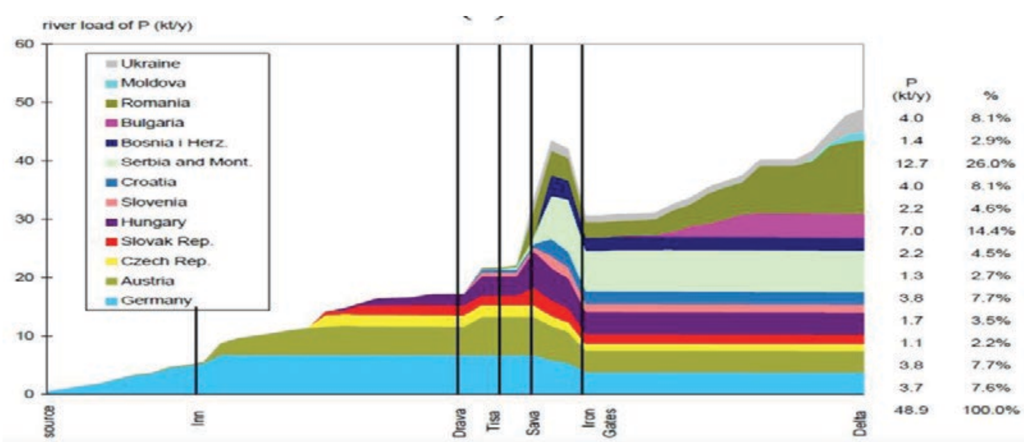


source: EEA 2012d.

Unfortunately, it is not clear whether the implementation of the UWWTD and Nitrates Directive will have much impact on reversing the eutrophication of the Danube Delta. In practice, most of the nutrient load comes from upstream countries—Austria, the Slovak Republic, Hungary and Serbia, as well as the Bulgarian side of the lower Danube. This is shown in figure 7.18 in the case of phosphorus. While the contribution of Romania is significant and the largest one, it is closely followed by Serbia—which is not yet an EU country and is therefore not subject to the EU water directives—and Romania's total contribution is only about a quarter of the total P load. The recent announcement by the EC that Serbia (and Montenegro) would be put on a fast track for EU accession by 2025 is good news for the Danube delta—though it is unlikely that the environmental benefits would start being felt before 2030 at best. Although, it must be noted that more support by the EC to WWTP development in Western Ukraine, as part of the EC Near policies, could have a significant impact in helping improve the ecological conditions of the delta.

In addition to the basic measures under the UWWTD and Nitrates Directive, Romania must also deal with other point source pollution from industries and agriculture. According to a 2015 inventory reflected in the last Danube River Management Plan (2016), 669 point sources of pollution have been identified, of which only 218 have treatment facilities in accordance with the Industrial Emissions Directive (IED) 2010/75/CEE, while other 451 industrial and

FIGURE 7.18. **Nutrients (P) Contribution to the Danube River by Country**



Source: GCI, Nachtnebel.

agricultural entities do not fall under the IED requirements. Still, their discharges in water bodies have to comply with other EC directives[13] and national legislation[14] and their compliance is monitored.

Many of the supplementary measures under the 2nd RBMP 2016–21 are so far not fully funded, and implementation is currently being delayed. This includes both dealing with the above mentioned hotspot for industrial and agriculture point-source pollution, as well as supplementary measures for more stringent wastewater treatment (removal of N and P) in agglomerations below 2000 PE which fall outside of the scope of the UWWTD.

Achieving good ecological status under the WFD is not only linked to reduced pollution of water bodies, but will also require a series of additional actions that may be challenging. The WFD actually requires the combination of three factors: improving water quality, protecting physical habitats (reducing hydro-morphological alterations) and ensuring sufficient flow regimes. Hydro-morphological alterations will be a challenge in a context of more dams and flood protection infrastructure, while ensuring sufficient environmental flow regime in existing dams will require revising operating manuals and improving supervision of operators (especially for hydropower generation, which often conflicts with the need to maintain environmental flows during dry months). Flood management should also make more recourse to re-establishing large natural wetland areas (buffer zones).

Finally, stormwater is not properly dealt with under the current directives (UWWTD and Floods Directive), and represents the next frontier for reducing the pollution of water bodies. Romania has a higher rate of combined sewers amongst Danube countries, and rain runoff overflows into rivers are frequent and uncontrolled. This has considerable negative impact on the quality of water bodies, yet is often underestimated. Stormwater sewage overflows cause microbiological and chemical contamination (including hydrocarbons from roads runoffs), oxygen depletion, litter and micro-plastics contamination. The EU legislation appears currently inadequate: the UWWTD focuses on "standard flow" sewerage pollution, and although pluvial floods are covered under the FPMP[15] of the Flood Directive, there is no investment requirement.

While the focus for sewage pollution abatement is now on UWWTD compliance, the next round of RBMPs should start addressing stormwater pollution—in coordination with WSS utilities and local authorities. Valuable experiences can be drawn from stormwater management in the USA, where specific legislation has been in place since 1994 (with permits and long term control plans required for local utilities) and significant push in many cities for green infrastructure (less impervious areas, invisible basins, recreation space).

7.4.2. Floods Management: Implementing the FRMPs Should Be a No-Regret Investment

While Romania has complied with the requirements of the Floods Directive by submitting the FRMPs in 2016, implementing them should be a priority since Romania is one of the EU countries most at risk of floods, after Poland, the Slovak Republic, and the Czech Republic. Floods occur every year in different parts of the country. In the seven most exposed counties (out of 42)—namely Satu Mare, Arad, Iasi, Teleorman, Giurgiu, Calarasi and Ialomita—the average economic loss due to floods each year exceeds four percent of local GDP. Over 2000-16, about 140 million euros per year on average was lost due to floods nationwide.

In view of the magnitude of the recurrent costs of floods, the 3.7 billion euros of infrastructure identified under the FRMPS should be considered a "no regret" investment—and appropriate funding source needs to be found. The catastrophic floods that occurred in 2005 and 2010 generated combined economic losses estimated at 2.4 billion euros (with more than a hundred casualties). The total damages caused by floods during 2002-13 in Romania were 6.3 billion Euros. Considering that the proposed investments include many elements of infrastructure with a long life span, the economic rationale for implementing the FRMPs is solid. Still, funding for only 246.6 million euros of priority investment has been earmarked so far under EU Cohesion Funds (LIOP 2017-20 period). This appears especially urgent given that climate change is expected to bring even more floods to Romania (see the next sub-chapter). Given the current budget constraints, one option for financing the implementation of the FRMPs could be the **introduction of a flood charge for property holders in risk-prone areas**, inspired by the model that has been successfully put in place in The Netherlands many years ago (box 7.3). It is noteworthy that France also recently introduced a new flood tax to finance flood protection investments at the municipal level.

The fact that flood management is also affected by insufficient funding for O&M, as well as the lack of a predictable multi-year budgeting for investment, should also be addressed. ANAR revenues are not sufficient to cover full cost of O&M, resulting in a gradual deterioration of the flood protection infrastructure over the past two decades. Investments are not properly prioritized and are subject to the annual budgetary process that is not in line with proper long term assets management—and the lack of predictable multi-annual budgeting poses a major challenge to developing and implementing a coherent and effective multi-annual plan.

BOX 7.3. Institutional Arrangements for Water Resources Management in The Netherlands

The Netherlands is one of the most advanced European countries for flood protection. A total of 22 Water Boards prepare basin plans and are assigned two main tasks: (i) water quantity management through drainage, river and lake regulation, and flood protection; and (ii) the treatment of all municipal wastewater.

The flood management is financed from three sources. The activities of the Ministry of Infrastructure and Water Management are funded through the annual state budget (tax income). Roughly half of the resources are spent on the wastewater and water quality management tasks, and the other half on drainage, ditches, rivers and lakes management, and floods and drought management. The annual budget for flood management has fluctuated in the past decade around 1 billion Euros. This was arranged primarily through the multi-annual policies and plans that, currently, aim to extend flood protection to all citizens at a recurrence level of 1,250 years.

The Water Boards' annual investment and operations expenditure for flood management are mostly financed from the local **flood protection charges that are paid by all households, farmers and land owners** directly to the Boards. These charges are calculated based on land size and property value. The annual drainage and flood-related activities and investments at the municipal and to a much lesser extent provincial levels amount to an estimated 200-400 million Euros. These funds are generated from local taxation. **The aggregate total flood management expenditure represented close to 0.3 percent of annual GNP**.

Change in land ownership after 1990 is also affecting the implementation of flood risk protection measures. The legal framework established in the 1990s assigns ownership over the waters to ANAR, but excludes the land over and through which the waters flow. This contrasts with nearly all EU countries and the Romanian tradition, in which water management agencies held ownership or eminent domain rights over at least the river bed, floodplains or corridors of 5-25 m alongside waterways. The number of buildings erected in the flood plains has proliferated over the last two decades, as local governments often issue building permits without recognizing the inherent risks of flooding and obstructing flood flows. Finally, the way agricultural land on sloping terrain has been parceled after 1990 is reported to have significant negative impact on erosion, surface run-off and the frequency of flash floods.

The river basin agencies (ABAs) lack legal instruments to avoid that farmers, land developers and local governments make unrestrained use of floods protection infrastructure such as dikes, floodplains, drainage facilities, and river banks, causing damage and slowing or precluding proper investments. Land ownership especially near formerly public land is still often uncertain as cadaster registrations are yet to be completed, and enforcement of titles, once accorded, remains challenging. Implementation of flood protection investments on illegally occupied land is difficult. One improvement has been achieved recently nonetheless, regarding the links between land use plans (zoning plans) drafted by local authorities and water management. While no procedural link exists between the River Basin Management Plans and zoning plans, the building permitting regulations have been strengthened and permits issued by ANAR and the Environment Agency (EA) are now required.

Drainage of waterlogged areas and irrigation are the responsibility of ANIF, but coordination with ANAR has been challenging. ANIF has serious financial difficulties and has been unable to properly maintain drainage canals, siphons, pumping stations, small reservoirs and appurtenant structures. Because of lack of supervision, farmers often destroy canals, and equipment gets pilfered. Pumping stations, essential to lift drained water over a dike into a river, go unrepaired, and are often dysfunctional. As drainage structures often interface with or cross river beds and dikes, the local ABA often ends up carrying out necessary maintenance and repair works.

Transferring the responsibility for drainage infrastructure from ANIF to ANAR should be considered. ANIF activity is financed from the state budget (for drainage and soil erosion control) and from tariffs paid by farmers (for irrigation). With only a scarce budget allocated for drainage activities, ANIF does not carry out the required maintenance of the respective infrastructure, particularly the canals and pump stations that discharge in rivers. Thus, many canals suffer of severe siltation that reduces their transport and storage capacity while pump stations operate at low efficiency or are out of service. Since a well-functioning drainage network is of critical importance during floods, the lack of rehabilitation and good management of the drainage infrastructure by ANIF has been affecting ANAR capacity to properly manage floods risks. While irrigation now requires a more commercial market-driven model, drainage remains a public task, which would be better combined with ANAR tasks.

7.4.3. Dealing with Climate Change Will Require a Series of Actions

The climate in the southeastern part of the country—especially the lower Danube plain—is expected to become semi-arid, which much more frequent droughts. This is also where the majority of arable lands and high value farming are concentrated. The agro-climatic and economic conditions of agriculture will be heavily modified. With higher temperature, new crops will become possible, and crops may also bring higher yields—but only if irrigation can be provided.

As a consequence, a shift in the need for irrigation can be expected—enhancing the rationale for rehabilitating the many irrigation perimeters that are deemed economically viable but are currently under-used and deteriorating. Water policies will also need to be better linked with agricultural policies, as water will increasingly become a major constraint. Romania can benefit from the hard-learned lessons from water scarce countries, including EU Mediterranean countries such as Spain, France, Italy, Malta, Greece and Cyprus. More efforts should be put in promoting the adoption by farmers of efficient low volume irrigation technologies such as mini-sprinklers and drip irrigation.

Wastewater reuse should become a key factor in Romania's strategy of adaptation to climate change. Its potential has been so far totally unexploited. Romania is already investing massively in wastewater treatment to comply with the UWWTD and has declared all its territory as sensitive area requiring a more stringent treatment. The additional investments necessary to reuse in agriculture the treated wastewater that will be produced by the many WWTPs currently under construction would be relatively modest (as long as reuse takes place in the vicinity of the WWTP). Reusing this treated wastewater instead of discharging it into the environment would generate both economic (agricultural development, drought resilience) and environmental (zero discharge) benefits. The experience from EU countries more advanced in wastewater reuse (especially Spain and Cyprus) shows that it is important to start with well-chosen pilot projects that must be used to demonstrate to farmers the innocuity of treated wastewater and benefits of its use.

Enhancing the knowledge base on the expected contribution of irrigation to mitigate the impact of climate change on agriculture is desirable. This would involve: (i) Multi-criteria assessments of what levels and types of irrigated agriculture can be sustained in each river basin should be conducted, accounting for climate change impacts. This exercise would entail refining quantitative assessments of water availability and crop water needs under different climate scenarios for each river basin, particularly for those with high drought incidence, and the involvement of local stakeholders; (ii) Make full use of the existing gravity-fed irrigation schemes where water is cheaper, in accordance with water availability; (iii) Analysis of the technical options and economic returns should be conducted for converting pumped-irrigation to gravity-based schemes wherever technically and economic feasible and in areas with confirmed and steady demand for irrigation services; (iv) wastewater and rain water reuse in irrigation should be encouraged, especially in water-scarce basins based upon thorough biological, chemical and environmental studies to secure that the chemical and biological content of (treated or untreated) wastewater used does not harm human health.

There will also be an increase in the frequency and magnitude of floods, and since the FRMPs were developed based on historical data, they would need to be updated to properly account for climate change, especially for flash floods. Additional studies on the link of climate change with flash floods are desirable, to improve the design parameters for the flood hazard and risk maps that would need to be updated during the preparation of the second cycle of the FRPM, taking into account climate change impacts on hydrology. It will also be necessary to revise the methodology for identifying areas with potential risks for slow-onset floods, based on the current technical state of dykes and dams.

The potential impact of climate change on achieving good ecological status under the WFD should also be taken into consideration for the next (third) RBMPs cycle. Although the WFD does not address the quantitative status of surface water, the reduction in overall rainfalls will result in a lower dilution of pollutants, and could therefore negatively affect the ecological status of rivers and lakes—effectively canceling some of the gains made by investing in pollution abatement under the UWWTD and Nitrates Directive. In addition, the next round of RBMPs should also make more room for drought planning, explicitly developing specific Drought Management Plans (DMPs) as some of the most water-scarce countries of the EU (e.g., Cyprus) already did in the second RBMPs round.

Increasing the water storage capacity in all river basins wherever technically and economically feasible is probably necessary—to deal with both increased droughts and increased floods. Dams are key to handling variability, and Romania still has a large untapped potential, but there are also opportunities for increasing water storage capacity in already existing dams through rehabilitation, as well as completion of the few dams the construction of which was stopped in the 1990s. However, no comprehensive studies have yet been developed.

Climate resilient utilities need to be put on the agenda of the WSS sector. The catastrophic consequences that prolonged rationing under droughts can cause for cities have been illustrated by the recent cases of Limassol in Cyprus in 2008-09, and Sao Paulo in Brazil in 2014-16. In Italy, the capital Rome narrowly escaped a severe water rationing during the summer of 2017. As cases of extreme droughts have been increasingly affecting cities around the world in recent years, it would be wise for Romania to launch some practical initiatives to develop climate resilient utilities. This could start with 2-3 pilot projects focused on WSS utilities that are especially exposed to drought (e.g., diversification of water sources and water losses reduction programs) and flood risks (storm water, protection of strategic assets).

Further development of climate change knowledge and instruments is desirable to enable implementation of efficient policies in the water sector. The recently adopted National Climate Change Strategy and Action Plan for 2016-20 developed with the technical support of the WB, stresses the urgent need for strengthening the knowledge base and capacity building in the water sector, as well as for the following actions: (i) periodical updating of climate evolution scenarios for Romania based on in-depth studies and quantitative assessments of water resource demand; and (ii) developing capacity building actions for researching the use of global climate models to provide more localized assessments of climate impacts in water basins and regions. None of these actions have yet started to be implemented.

7.4.4. Dams: Investments in Safety, Retrofitting and New Storage Must Be Addressed

7.4.4.1. Total Storage Capacity Should Probably Be Increased

Romania's water storage capacity currently stands at 607 m3 per capita—which is relatively high compared to other EU countries but average for Danube basin countries (table 7.6). Among EU countries, only Bulgaria, Greece, Finland, Portugal, Spain and Sweden have a higher storage capacity per capita. However, when compared to other countries within the Danube basin, all countries except Serbia (plus Austria and Germany) have a higher storage capacity per capita.

While no specific studies have yet been carried out, **Romania should consider further increasing its total water storage capacity, as part of adaptation to climate change—starting with**

TABLE 7.6. Dam Storage Capacity across Various Countries

	Country	Population (mill.)	Dam Storage		Year
			Per capita (m3)	Total (mill. m3)	
EU members	Austria	8.6	248	2,130	2015
	Belgium	11.3	12	140	2015
	Bulgaria	7.2	906	6,520	2015
	Croatia	4.2	227	960	2015
	Cyprus	0.9	471	400	2015
	Czech Republic	10.4	305	3,180	2015
	Denmark	5.7	No Data	No Data	2015
	Estonia	1.3	137	180	2015
	Finland	5.5	3400	18,600	2015
	France	66.4	150	9,980	2015
	Germany	82.7	48	4,000	2008
	Great Britain	64.8	81	5,270	2015
	Greece	10.9	1135	12,320	2015
	Hungary	9.9	26	260	2015
	Ireland	4.8	183	870	2015
	Italy	61.4	126	7,720	1970
	Latvia	2.0	508	1,010	2015
	Lithuania	2.9	623	1,820	2015
	Luxemburg	0.6	107	60	2015
	Malta	0.4	0	0	2015
	Netherlands	17.2	538	9,230	2015
	Poland	38.0	78	2,960	2015
	Portugal	10.4	1122	11,630	2015
	Romania	**19.9**	**607**	**12,060**	**2015**
	Slovakia	5.4	320	1,730	2015
	Slovenia	2.1	15	30	2015
	Spain	46.4	1159	53,810	2015
	Sweden	9.8	3673	35,960	2015
EEA	Norway	5.2	6407	33,280	2015
	Iceland	0.3	6979	2,310	2015
	Lichtenstein	0.0	No Data	No Data	-
EFTA	Swizerland	8.3	404	3,340	2015
Non-EU Balkans & Danube areas	Albania	2.9	1396	4,030	2015
	Ukraine	42.9	1295	55,500	2012
	BiH	3.8	776	2,910	2015
	Moldova	3.6	724	2,580	2009
	FYR Macedonia	2.1	1106	2,290	2015
	Belarus	9.5	130	1,230	2015
	Serbia	7.1	320	2,270	2015
	Turkey	74.8	2102	157,300	2015
	Montenegro	0.6	1661	1,030	2010
	Russian Fed.	144.0	5565	801,500	2015
Non Europe	Canada	36.3	23177	841,000	2015
	USA	323.1	2244	725,000	2015

Source: World Bank's elaboration.

Note: EEA = European Environment Agency.

the rehabilitation of existing dams. As already discussed in this report, the many Romanian dams currently operate with restrictions, so that the safety conditions are always met. As a consequence, the operating levels of these dams are maintained well below their original design, and the dams cannot achieve their full storage potential. Rehabilitation of such dams should be a priority, both for reasons of public safety and because such investment appears as the lowest cost and fastest option for increasing the total water storage capacity.

There is also a total of 32 dams for which construction was stopped in the 1990s, and remains to be completed. The rationale for these dams should be revisited based on the new demand patterns. Completing their construction would also probably be the lowest cost and fastest option for increasing storage capacity, while also improving public safety.

Construction of new dams may be considered, but should be based on a clear rationale for cost-benefits, and be in full compliance with EU legislation. This includes especially the need for proper environmental flows, preservation of natural habitats and limiting hydromorphologic alterations. The case for any new dam would need to be very solid.

7.4.4.2. Potential for Retrofitting of Dams to New Multipurpose Uses

The undertaking of a major rehabilitation program for existing dams offers the opportunity to review their operating regulations to harmonize them with the changing socio-economic environment, namely the changing water demand, climate change and the need to ensure that the concept of environmental flow is applied, as briefly explained further.

The first opportunity for dam re-operationalization lies in adapting to changes in demand. As mentioned earlier, water demand has steadily decreased in Romania since the 1990s, because of structural changes in the economy, including a reduction in industrial activity, shut-down of economically unviable irrigation schemes, introduction of metering and tariffs in domestic water supply, and reducing system losses. The total demand, in terms of volume of water made available to users, has decreased from approx. 20 BCM/year in the early 1990s to approx. 6.5 BCM/year now. As a result, there is currently a degree of overcapacity in the system at the national level. Two situations stand out for adapting to change in demand and are described in the following two paragraphs.

If the main use of the stored water is for population supply, as it is the case of dams under ANAR management, the normal operation level could be lowered thus providing additional storage capacity for flood control. The downstream area will be subjected to more reduced discharges. In many cases the operation of the bottom outlets required to provide pre-emptying the reservoir in order to increase flood control capacity will be no longer needed thus protecting the river bed downstream. Additional benefit could be the increase of the environmental discharge downstream from the dam as a consequence of new reduced water demand from the users.

If the main use of the reservoir water is for hydropower production, the reduction of the amplitude of the filling—emptying cycle of the reservoir could bring a higher average level in the reservoir thus increasing the head and consequently the energy output. Preserving the initial water management agreement, the authorities may increase the environmental discharge downstream the dam on the basis of the lower demand of water supply.

The second opportunity for dam re-operationalization lies in the adaptation to climate change. As the frequency and magnitude of drought and flood events is expected to increase, the operation rules of many dams should be adapted. New hydrological studies are required in order to reevaluate the peak flows corresponding to probabilities in accordance with Romanian standards concerning the dam safety. If the new values are significantly larger than the ones used at the design stage, an extended study is required to balance between lowering the operational level in the reservoir and increasing the spillway capacity by adding overflowing sections in the dam or by providing emergency spillways. New operation rules are also imposed by the flash floods, that have proved to be part of the climate change. They are a source of increased siltation of the reservoirs.

The third opportunity for dam re-operationalization is linked to improving the implementation of environmental flows. Currently in Romania, environmental flows are not applied in all dams. The value of the reserved flow is currently established by ANAR based on hydrological or statistic values,[16] instead of being based on ecologically-based flow regimes. An update appears important in view of ensuring the good ecological status of rivers all year long in the context of compliance with the WFD.

The most serious problem is related to private micro-hydropower plants, where the environmental flow has a direct impact on the owner's income, by decreasing the turbine supply and the energy output. In spite of the rules imposed by the operating manual in many cases the river bed downstream of the intake is usually completely dry. The water inspection has no possibility to provide a strict surveillance due to the difficulties of covering the large number of small isolated plants. The problem is compounded by the fact that many of these new micro plants have been installed in normally protected areas which hold valuable natural habitats and river wildlife.

7.4.5. ANAR Financial and Institutional Capacity Must Be Strengthened

While ANAR is a solid national water agency with strong experience in integrated river basin management, it is affected by a series of institutional and financial shortcomings. There are two main issues which affect its capacity to carry out its mission efficiently and manage water resources at national level in a sustainable manner. The first one is related to the level of bulk water tariffs, which are currently too low to cover the full costs of maintenance of the water resources infrastructure (especially for flood protection). The second key issue is the lack of visibility for investment funding, which prevents implementing proper assets management and affects its capacity for prioritization.

The overall level of bulk water tariffs should be gradually increased, so as to provide sufficient revenues for proper O&M and harmonize with other EU countries. As previously discussed, ANAR bulk water tariffs (abstraction charges and wastewater discharge fees) are low when compared to other EU countries. In addition, bulk water tariffs have not been updated since

2010—with no adjustment for inflation for seven years now. The MWF should consider implementing a study of the financial situation of ANAR, to quantify the needs for increased revenues to fully cover O&M needs, identify potential sources of cost savings, and how the various bulk water charges should be increased in order to ensure that the O&M responsibilities of ANAR can be fully self-financed through tariff revenues. The option of introducing different levels of bulk water tariffs depending on each river basin should be considered, so as to have better economic incentives for users in basins suffering from water stress or water scarcity. Also, the option of introducing a new surcharge for flood protection could be considered (as developed in the sub-chapter on implementing the RFMPs).

Moving towards multi-annual budgets for investment would be essential for improving prioritization of investment and the implementation of EU water legislation. Currently, ANAR investment decision is dependent on the annual budgetary decision by the central government, which restricts its ability to develop a long-term vision for assets management. It also creates disincentives for proper prioritization, as budgetary allocations for capex are largely conditioned by political economy considerations. Efficient water investment would require more predictable transfers from the central budget, preferably through multi-annual financing and budgeting plans replacing the current annual financial planning. This could be implemented through for instance a five-year contract between ANAR and the government, parallel with the implementation of the RBMPs, with a financing commitment from the government in exchange for a performance commitment by ANAR measured by appropriate indicators.

7.5. Irrigated Agriculture Is in Need of a Strategic Vision

7.5.1. Key Pillars of a New Vision for the Irrigation Sub-Sector

Addressing the climate risks through irrigation can play a key role in meeting the strategic objectives of Romania in the agriculture sector—that is, development and strengthening of the market-oriented farming sector, and enhancing the share of high value crops. Irrigated agriculture is expected to become ever more relevant in the context of the expected impact of climate change.

The new vision for irrigation sub-sector development should address the legacy of over-investment, define the exit strategy and become the guiding document for any further policy action. This vision should integrate the interventions needed for the development of public irrigation infrastructure with the ones that are owned or managed by WUOs. It would lead to a national irrigation strategy that would rest on the following five pillars.

Pillar one: ensuring the technical and economic viability of irrigation schemes reflected in the capacity to recover the investment costs from the economic benefits brought about by the stability of production quality and volume, as well as in the capacity of farmers to bear the recurrent expenses of the irrigation services (of which 80 percent is energy). A special attention needs to be given to full use of the gravity-fed schemes—which represent a total area of about 250,000 hectares and which in many cases have been barely used in the past 20 years.

Pillar two: fostering the economic capacity of farmers. In Romania irrigation is costly because of the high-energy component, and the costs have to be recovered from farmers. Therefore, irrigation has proved affordable mostly to commercial farms but mostly out of reach of small semi-subsistence farms. In addition, farmers need to have adequate organizational, technical (equipment and staff), and financial capacity. Water user organizations (WUOs) can help maximize the efficiency of irrigation infrastructure use through a better water distribution, reduction of specific costs, and close monitoring of pump stations activity parameters.

Pillar three: adopting a demand driven approach. Priority should be given to schemes where there is a demonstrated interest in and experience of constant practice of irrigated agriculture. Those farmers need to express a clear commitment to substantially expand the irrigated areas and also provide a reasonable financial contribution to the capital costs, both for the infrastructure under their management (through the EC-funded National Rural Development Program) and for the public infrastructure, together with budgetary funds. Thus, a strong sense of ownership over the infrastructure would be built leading to a more stable use of irrigation and more concern for its good and long lasting operation.

Pillar four: rehabilitation and modernization should aim at both financial and environmental benefits, and be combined with demand management. It is important that the vision shows a strong commitment to significant savings of water and energy that would reflect further in a reduced impact on environment and respond to the challenges of climate change. Further, these savings would entail stable reduction of water price in each scheme after rehabilitation and modernization, thus increasing profits for farmers. Promoting the adoption of efficient low volume irrigation technologies, such as mini-sprinklers and moisture-sensitive drip irrigation, along with technical support to farmers, should be an integral part of a modern irrigation strategy.

Pillar five: institutional strengthening and capacity building is also needed for addressing the unfinished institutional reform agenda and building strong institutional arrangements for irrigation planning and O&M, including by WUOs and the service provider (ANIF).

7.5.2. Implementing the Strategic Irrigation Rehabilitation Program

Priority needs to be given to investment in rehabilitation and modernization of the viable irrigation infrastructure. Given the current budget shortage, it might be desirable for the government to start in the first phase with a reduced investment envelope focusing on the rehabilitation of the most viable irrigation perimeters and those which could have the most impact on economic development and poverty reduction in rural areas. Since the implementation of the program is yet to start, there are four following strategic directions that could be considered for building a sound investment program that holistically provides for the revitalization of a sustainable irrigation sector.

Strategic direction 1: Strategic Planning and Programming Support. Irrigation should support future agriculture demands, and irrigation infrastructure, institutions and information management will need to be adjusted to reflect the current circumstances, and also meet challenges at hand to transform the sector sustainably. This requires firstly a rigorous assessment of the specific agricultural directions and how irrigation can support various "business lines" under a diversified agricultural system. Horticulture, fruticulture and cereal crops require fundamentally different irrigation support. This also requires an updated prioritization framework for guiding investments in system rehabilitation, modernization and organizational change. To maximize effects, this could be further harmonized with the support under the NRDP and the prioritization areas could be rapidly updated. Schemes proposed for modernization could be subjected to a prioritization exercise where the economic assessment is updated and corroborated with the actual demand for irrigation (in the last five years, which included drought and wet years), stability of demand, and areas with projected agricultural growth. In addition, priority should be given to schemes where complementary investment in on-farm irrigation (infrastructure and field equipment) was financed from NRDP (2007–13) or applications for funding under the current NRDP (2014–20) are being received. This planning exercise would increase impact of investments and leverage support programs for maximum output.

Strategic direction 2: Information and Knowledge Support. Sector strategic planning would highly benefit from a thorough but rapid sector diagnostic building on the recent past experience in rehabilitation, impact of previous investment programs, lessons learned on scheme utilization rates, cost structures, service standards and management capacity, and, not least, the technical, organizational, economic and financial capacity of users to afford stable use of irrigation. A diagnostic of current cropping patterns, a mapping of water users and future agriculture scenarios at scheme level will assist Water Users' Association (WUAs) and ANIF to make credible predictions of future water demand and improve accordingly, reducing the risk of non-utilization revealed by past investments. Updated information should also be available on current status of infrastructure and its functional condition. The sector diagnostic would ideally also lead to the development of a system of sector monitoring and evaluation (M&E), creating an information base fed with regular data collection, validation and reporting and enabling the development of knowledge products, (GIS) spatial analysis, and continued reprogramming to support adaptive management at all levels: scheme, regional and national.

Strategic direction 3: Institutional Reform Support. Restructuring and revitalizing the sector depends on strong institutional arrangements for irrigation planning, management and operation, including by WUOs and the service provider (ANIF). Despite sector reforms undertaken since 2004, there is still a need for further institutional strengthening and capacity building. The existing WUAs would need improvement of their management capacity, better rules for self-regulation, but also improved external oversight to avoid exclusion and free-riding by non-members, and support fair pricing of internal irrigation services. In parallel, ANIF's technical capacity and capability should be strengthened addressing the current lack of staff. The institutional disconnect between water users and service provider needs to be bridged, improving ANIF's service orientation and accountability to water users in order to meet the mutual goal to address the current performance gap. In addition, there should be more flexibility in responding to the demands for irrigation management transfer to WUAs and federations. Last but not least, advisory services should be available for WUAs and farmers for improving their capacity to better manage the water.

Strategic direction 4: Investment Support. In addition to prioritization and improving institutional performance, a key objective of a revitalization program would be improving technical efficiency and manageability of schemes, which will translate into reduced water prices and improved service reliability. Technical innovation, climate proofing and new service standards should all be part of irrigation modernization design. Modernization should be based on expressed and demonstrated demand and incorporate farmers' technical, functional and financial concerns. In addition, investments would ideally be based on reciprocity arrangements between the service provider and farmers, where all commit to successful scheme management through co-payment and also through co-management to empower farmers and build ownership. Special attention should be given to revitalization of irrigation activity in the gravity-fed schemes where the demand for water was very low in the past decades, understanding and addressing the farmers' reluctance to irrigate even at lower costs.

Notes

1. Many agglomerations originally included in the 2004 Implementation Plan have since fallen below this threshold.
2. At this location, the hydropower generation capacity is shared with Serbia, that owns and operates a similar hydropower plant on the other side of the river.
3. https://circabc.europa.eu/sd/a/e0352ec3-9f3b-4d91-bdbb-939185be3e89/CIS_Guidance_Article_4_7_FINAL.PDF.
4. DWD court of auditors.
5. The management of the two large investment programs for water and sanitation infrastructure—LIOP and PNDL—has just been consolidated through the creation in January 2017 of the Ministry of Regional Development, Public Administration and European Funds (MRDPAEF), through the merger of the former Ministry of Regional Development and Public Administration with the Ministry of European Funds.
6. with thus far 134 projects equivalent to 0.2 billion euros under construction.
7. Based on the billed volume of large operators of 575 million m^3 (2015), an average water tariff of 0.74 Euros, and collection rate of 95 percent, the total revenues from water services of large operators stand at more than 400 million Euros.
8. It must also be mentioned that Romania is in a much better shape for compliance with EU directives in wastewater than in solid waste management—testimony that the various national actors in the WSS sector have made major efforts, that the issue is being taken seriously and that compliance is moving forward.
9. This is consistent with the findings from the WB 2017 household survey in rural areas that found that even in villages with new sewer systems, few households are connecting. The interviews indicate that the priority for households seems to be improving from outdoor pits to indoor flush toilets, but not to connect to a new sewer collection system.
10. Data on piped potable water access in Romania under the JMP of WHO-UNICEF indicates a connection rate of 56 percent in 2000, and 63 percent in 2015—i.e. does not take into account the households with in-house piped water through self-supply.
11. The experience of EU countries with social water tariff targeted at the poor will be documented in detail in an upcoming WB publication, to be published in 2018.

12. Portugal WSS sector shares many similarities with Romania: the regulator there deals with a large number of utilities; when the country joined the EU in 1986 it was by then its poorest member state, with a significant access gap in WSS services and considerable challenges for complying with the UWWTD.

13. Directive 2006/11/EC on dangerous substances, Directive 91/676/EEC on nitrates pollution.

14. Gov. Decision (GD) 188/2002 on discharge conditions, GD 351/2005 on Program to gradually stop discharges, emissions and losses of priority dangerous substances.

15. Flood maps require both fluvial and pluvial flooding risks based on 100-year period.

16. The value refers to the average flow rate (MQ) of the river at a given cross section, or to the minimum mean flow (MNQ) in the river. The values calculated can vary from 33 to 100 percent of MNQ.

Chapter 8 What to Do Next? Speeding Up the Pace towards Water Security

*As a final wrap-up, and based on the analysis of the previous chapters and the various issues identified for policy actions, this chapter takes a practical view by discussing what can be done next by the various decision-makers within the Romanian Government. It starts with underlining the need to **improve prioritization of investments** across all aspects of water management—so as to deal with the financial and institutional gaps—while also modernizing the financial frameworks and continuing the efforts to strengthen the institutional capacity of Romanian water players. It then defines four over-arching priority themes for actions—namely **UWWTD compliance, pursuing the WSS utilities reform, modernizing hydraulic assets management, and leveraging the water sector for green growth**—with 16 specific actions being proposed to the consideration of the Romanian Government to help move the compliance, inclusion and water security agenda in the short term.*

8.1. Prioritization to Address Financial and Institutional Gaps

When consolidating the various sub-sectors of water management, **the total financial gap for financing required investments for compliance, inclusion and water security is considerable**. The remaining cost of compliance has been estimated at 29 billion euros (second RBMPs) for the next decade—that is, 1,450 euros per capita (or 145 euros per year per capita over the next decade). Yet only about 6 billion euros (20 percent) have been allocated so far from the EU grant funds (mostly LIOP) until 2020. For flood protection, the 246.6 million euros allocated for the same period represents a mere 7 percent of the required flood protection investment under the Flood Risk Management Plans (FRMPs). As for the rehabilitation investments for dams and irrigation, they have not yet been fully quantified, and no funding sources have yet been identified.

Money is not the only key constraint, as **institutional weaknesses of the various Romanian water players also generate major bottlenecks**. While a lot has been done over the past decade by Romanian water institutions to reform and harmonize with their peers in other EU countries, much remains to be done. Capacity gaps negatively affect the water sector in two ways: large delays in design and execution of investments resulting in slow absorption of EU funds (and loss of grant money), and also slow decision making at political level resulting in delays for key actionable reforms. Also, the limited capacity of the Romanian construction industry, in view of the huge investment and rehabilitation needed in the water sector (Water Supply and Sanitation [WSS], dams, floods, irrigation) should not be under-estimated, as it played a notable role in the slow absorption rate experienced in the previous EU funding cycle (2007-13).

In this context, **there is a crucial need for better prioritization of investments—across all the spectrum of water management.** First, because it would be unrealistic to expect that Romania would be able to fund such a significant investment backlog over the next decade—especially in a context of potentially declining EU cohesion funds. And second, because even if the money were to be available, it would be equally unrealistic to expect that such a massive investment could be properly executed in less than a decade (at best). It is therefore crucial for the Romanian Government to engage in a prioritization exercise for the water sector on a large scale.

Capex prioritization should be based on a sound cost-benefit analysis considering the triple goals of compliance, inclusion and water security. It should also be carried out in parallel with **modernizing the financial framework, so as to gradually close the financial gaps** for capex and operations and maintenance (O&M) in the various sub-sectors. It should take a realistic view of the implementation capacity of both public executing agencies and the construction industry, and include actions to be carried out in parallel to increase the capacity of the key Romanian water players and gradually close the institutional gap.

8.2. Focus on UWWTD Compliance, WSS Reforms, Hydraulic Assets and Green Growth

Based on the overall analysis in this report, four thematic priorities can be suggested for the Romanian Government to focus its public policies efforts over the next three to five years. Considering the manifold challenges faced by the Romanian water sector over the next decade, difficult decisions will have to be made by the Romanian authorities to prioritize actions in the face of limited budget resources. These involve obvious trade-offs which may sometimes make the three goals of compliance, inclusion and water security compete for scarce funding. As such decisions will involve political choices, this report is not in a position to make specific recommendations in that regard. Still, based on the comprehensive analysis of the previous chapters, and matching the multiple challenges with what could be realistically achieved in the short term, **four thematic priorities are proposed for the Romanian Government to focus its upcoming actions** in the water sector for the next three to five years.

8.2.1. Thematic Priority 1: Achieve UWWTD Compliance by 2027

The impending infringement procedure by the EC against Romania for non-compliance requires urgent actions. The Ministry of Waters and Forests (MWF), as well as the other relevant players, will be subject to increased scrutiny, and pressures to show progress in the face of the threat of hefty financial penalties that could be imposed on Romania by the EC.[1]

The country will need to demonstrate to the EC that it has a credible strategy to address past shortcomings and achieve compliance under a revised deadline, and is firmly committed to making the necessary decisions—in particular to effectively address the existing bottlenecks for compliance. This shall include *inter alia* prioritizing investments under an updated implementation plan (IP) (including a detailed inventory of the current situation in rural agglomerations), developing a specific strategy for compliance in smaller rural agglomerations (which pose different and more complex challenges than larger urban agglomerations), as well as putting in place a database with periodic (every six months) reporting to the EC.

8.2.2. Thematic Priority 2: Revisit WSS Reform to Ensure Sustainable Access for All

A new national WSS strategy involving all actors and addressing the various challenges and blockages of the reform needs to be developed. Despite all the progress achieved, Romania is still halfway into establishing viable utilities that can sustainably deliver affordable WSS services to all. Tariffs do not yet cover the investment and depreciation costs, and there remains significant scope for improving operational performance. The regionalization process has been somewhat stalled, with regional public utilities lacking incentives to incorporate small rural agglomerations, and households and local authorities in rural areas lacking incentives to join regional utilities. Waiting until 2040 or after for Romania to close the piped water access gap and ensure access to safe drinking water for all is hardly acceptable for an EU country. This national WSS strategy should address *inter alia* removing the bottlenecks that create resistance from households to connect, updating the financial framework to prepare for a reduction in grant funding for investment, and making the regionalization model evolve to reconcile the goal of creditworthiness with incentives to expand in rural areas.

Under this thematic priority, **there are several "low hanging fruits" that can help to close the WSS financial gap,** that have been already identified in this report. They should be considered as part of this new WSS strategy, but could also be independently implemented earlier. They include a national program for **commercial losses reduction** (under-metering and illegal consumption) to increase the WSS utilities revenues without having to increase customer tariffs, and **dropping the VAT rebate for piped potable water** (a regressive subsidy not benefiting the poor) to reallocate the additional proceeds for targeted investments in the sector through budget transfer, or for financing a social water tariff.

Analyzing the **need and feasibility of social WSS tariffs for the poor should be an integral part of this new WSS strategy.** In addition to ensuring social equity, such a social tariff (with reduced rates targeted at poor families) could also help reduce the overall resistances in rural areas towards connecting to WSS networks and joining regional utilities (data suggests that those poor families who are currently already connected to WSS services are likely to spend close to or more that the five percent threshold of their disposable income on their WSS bill).

8.2.3. Thematic Priority 3: Ensure Sustainable Hydraulic Assets Management, under Changing Needs

This third thematic priority would encompass the whole spectrum of hydraulic assets management—that is, dams, floods protection and irrigation infrastructure. While belonging to various aspects of water management, and involving different institutions (MWF, ANAR, Hidroelectrica, MARD, ANIF), they are confronted with similar challenges of having to adapt a legacy of infrastructure largely built before the 1990s to changing demand and needs, and of defining a sustainable financial framework to ensure their rehabilitation and subsequent O&M.

Improving the institutional capacity of National Administration "Romanian Waters" (ANAR)—as the operational arm of water resources management in Romania—must be one of the top items under this third thematic priority. ANAR's capacity to sustainably develop and manage dams and flood protection infrastructure, to deal efficiently with the large rehabilitation backlog (dams and floods) and with climate change and shifting needs, must be improved. The preparation of a financial and institutional diagnostic, along with an institutional modernization program, would be a first step to ensure that ANAR will be able to address the many upcoming water challenges for years to come. Such study should consider the needs for bulk tariff increases, automatic indexation, and differentiating the charges by river basin, while also exploring the option of adopting a new multi-annual budget approach to improve asset management.

Given Romania's high exposure to floods**, implementing the measures identified in the FRMP should be a "no regret" investment—yet there are no funding sources so far. Introducing a new dedicated floods charge** paid by land and property owners should be considered so that investments in flood protection can be financed and implemented without further delays. This could be done by following the successful approach carried out in The Netherlands, and the annual proceeds from this new flood charge could be monetized through a green bond issue without affecting the budget and debt capacity of the government.

The issue of dam safety and rehabilitation of old dams, along with their potential retrofitting to adapt to new multipurpose uses, must be addressed. Carrying out such investments would be the lowest cost option for increasing the total water storage capacity in the face of climate change. As a first step, the MWF and ANAR should carry out a comprehensive review to identify the dams that are most in need of rehabilitation. This should include looking at their potential re-operationalization for new multi-purpose uses, and improving the implementation of environmental flows under EU legislation.

Finally, a national reflection on the future of irrigation infrastructure needs to be initiated. Opportunities for economic development in poor rural areas are being lost because the existing irrigation infrastructure is not used and left to deteriorate. Yet, it is probably unrealistic to expect that the one billion euros of identified irrigation investment could be carried out in the near future given current budget constraints. Therefore, it would be advisable to identify, within the irrigation perimeters already identified as economically viable, a **sub-set of the irrigation schemes which are the most viable and which could have the highest impact on economic development and job creation in poor rural areas**—to be financed with priority.

8.2.4. Thematic Priority 4: Leveraging the Water Sector Development for Green Growth

This last thematic priority, albeit much smaller in scope, is nonetheless important, so as not to lose the perspective that **compliance with EU water legislation is not just a legal obligation, but can also bring valuable development opportunities if properly leveraged**. The investments required for compliance with EU water legislation could, with minimal additional spending, bring some valuable economic development and job creation including in poor lagging regions.

These potential projects would be best developed first on a pilot basis, relying on EU funding for TA, and be focused on hotspots for poverty (job creation) and water security. Those related to wastewater infrastructure (Urban Waste Water Treatment Directive [UWWTD]) investments include wastewater reuse, biogas generation, and sludge management. Those related to water resources quality (Water Framework Directive [WFD]) include promoting fishing tourism on protected rivers with active participation of local communities.

8.3. Next Steps for the Short Term: 16 Practical Actions

To implement these four thematic priorities, 16 practical actions have been identified and are proposed for the consideration of the Romanian Government. These are presented in table 8.1 below, along with the institutional actors that would be responsible. These actions

TABLE 8.1. Moving Romania towards Water Security: The "16 Practical Actions" and Responsible Actors

Thematic priority 1: Achieve UWWTD compliance by 2027	
MWF	1. Updated Implementation Plan (IP), based on field inventory;
MWF (with MRDPAEF)	2. Database for reporting progress to the EC every 6 months;
	3. Strategy for UWWTD compliance in rural agglomerations;
Thematic priority 2: Revisit WSS reform to ensure sustainable access for all	
MRDPAEF	4. Review feasibility of WSS social tariff (with PSIA study);
MRDPAEF & MOF	5. Launch a national program for commercial NRW reduction;
MWF & MoH	6. Develop a new national WSS utilities strategy involving all actors;
	7. Consider dropping the VAT rebate for potable water, and re-allocating proceeds for funding capex based on social-equity goals (territorial solidarity) or financing a new social water tariff for the poor;
	8. Develop a framework for ensuring monitoring and access to safe drinking water for self-supplied households in rural areas;
Thematic priority 3: Ensure sustainable management of hydraulic assets under changing conditions	
MWF and ANAR	9. Institutional and financial diagnostic of ANAR;
MARD	10. Introduction of a new floods protection charge to accelerate implementation of floods protection investments under the FRMPs;
	11. Inventory of dams in need of rehabilitation and retrofitting;
	12. Prepare a pilot water security integrated program in one water security hotspot (at basin or county level);
	13. Prioritization of irrigation perimeters rehabilitation investments;
Thematic priority 4: Leverage water sector development for green growth	
MWF and MARD	14. Pilot for wastewater reuse in one water scarce area;
MWF	15. Local development pilot on river water tourism (no-kill fishing zone);
ANAR & Hidroelectrica	16. Develop an enhanced framework for environmental flows.

Source: World Bank elaboration.
Note: ANAR = National Administration "Romanian Waters"; EC = European Commission; FRMP = Flood Risk Management Plans; IP = Implementation Plan; MARD = Ministry of Agriculture and Rural Development; MOF = Ministry of Finance; MRDPAEF = Ministry of Regional Development and European Funds; MWF = Ministry of Waters and Forests; NRW = Non-Revenue Water; PSIA = Poverty and Social Impact Assessment; UWWTD = Urban Waste Water Treatment Directive; VAT = Value-added Tax; WSS = Water Supply and Sanitation.

TABLE 8.2. Potential Topics for Knowledge Partnerships between Romania and Other Countries

Water challenge to be addressed	Potential partner countries for know-how exchange
Achieve UWWTD compliance	
Strategy for compliance in rural areas	France, Portugal, Lithuania, Czech Republic
Developing viable IAS	France, Portugal, Finland, Sweden, Austria
Optimizing the cost of compliance	France (low-cost extensive treatment)
Revisit WSS Reforms	
Closing the piped water access gap	Portugal (rural), Brazil (urban slums)
Regionalization challenge	Portugal, Greece, Italy, Hungary, Slovak Republic
Improving utilities performance	Spain (Madrid), Germany, Portugal (AdP), Greece (Thessaloniki and Athens), Hungary, The Netherlands
Strengthening regulation	Scotland, Portugal
Introducing social water tariffs	Belgium (Flanders), Italy, Portugal, Spain
Strategy to close the WSS financial gap	Bulgaria
Improving drinking water monitoring of self-supplied rural households	Austria
Hydraulic assets management	
Adapting to increased scarcity and droughts (hotspots)	Spain, Cyprus, Malta, Israel
Floods protection: introducing a new flood charge	The Netherlands, France
ANAR institutional strengthening	River basin agencies in France and Spain
Dams retrofitting to new multipurpose uses	Italy
Wastewater reuse pilots	Spain, Cyprus, Greece (Thessaloniki), Israel
Water for local development	
Local development projects around river fishing tourism	Slovenia, Croatia, Poland

Source: World Bank elaboration.
Note: ANAR = National Administration "Romanian Waters"; IAS = Individual and/or Appropriate System; UWWTD = Urban Waste Water Treatment Directive; WSS = Water Supply and Sanitation.

were identified on the basis of three criteria: (a) relevance for the compliance, inclusion and water security agenda, (b) impact for speeding up the pace of moving towards water security, and (c) ability to be implemented over the next one to three years (i.e., "low-hanging fruits").

To support the implementation of these 16 practical actions, institutional strengthening of the various Romanian water players should be carried out in parallel, through **peer-to-peer exchanges with other EU countries that can bring relevant expertise**. Capacity building is inherently a long process, and the experience of the World Bank is that well-structured peer-to-peer exchanges and twinnings, with other water agencies and players from more advanced countries, can be an efficient approach. Table 8.2 below is based on the WB international experience in EU countries as well as MICs from other continents. Although it does not intend to be exhaustive, and does not necessarily cover all of above-mentioned 16 practical actions, it provides a broad outline of which specific lessons could be learned from specific countries, for a variety of water challenges under the four thematic priorities.

Note

1. For instance, France's final deadline for UWWTD compliance was 2005 (interim deadlines 1998 and 2000) but in 2006 it had not fully complied (largely for rural agglomerations). In 2007, an infringement procedure was initiated and the country was at the threat of a 400 million euros fine. The level of non-compliance was much lower than Romania's current situation.

Appendix A Nitrates Directive

Available Financing Sources for the Implementation of the Nitrates Directive

National Rural Development Program: According to the first official version of the National Rural Development Program 2014-20, published in July 2014, in the current programming period through NRDP, support will be given primarily to:

- Investing for micro and non-agricultural small enterprises in rural areas
- Improving local infrastructure, education and health care, water supply systems, sewerage, local roads
- Restoration and preservation of cultural heritage
- Support for locally generated strategies that ensure integrated approach to local development
- Advisory and knowledge transfer activities for business development in rural areas.

Building of communal platforms for manure management can be financed through **LEADER**

Operational Program Large Infrastructure: According to the official version of Operational Program Large Infrastructure 2014-20, in the current programming period OPLI address development needs in four sectors: transport infrastructure, environmental protection, risk management and adaptation to climate change, energy and energy efficiency, contributing to the Union Strategy for a smart, sustainable and inclusive growth by funding 4 of the 11 thematic objectives set out in Regulation no. 1303/2013. Under SO 6.1, "Increasing energy consumption from renewable resources by new production capacities of energy from renewable resources less exploited" actions may be supported for development and modernization of production capacities of electricity or thermal energy in biomass and biogas power stations as well as investments in extension and modernization of electricity distribution networks, to pick up electricity produced from renewable resources safe to National Energy System (NES).

Through **SO 6.1** the building of biogas facilities can be financed

Operational Program Administrative Capacity: Under OPAC 2014-20 central public authorities involved in the implementation of the Nitrates Directive in Romania can access funding for activities under:

- Specific Objective 1.1 Development and implementation of systems and standards in the public administration which optimize decision-making processes geared towards citizens and business in accordance with the Strategy for Consolidating Public Administration (SCPA)
- Specific Objective 1.2 Development and implementation of policies and unitary and modern instruments of human resources management.

Through **SO 1.1** and **SO 1.2** interventions aimed at strengthening the administrative capacity can be financed.

Biogas stations and awareness campaigns can be financed through Environment Fund.

Environment Fund: The Environment Fund was created in order to provide financial support to create projects and programs for environmental protection from revenue made by applying the European principles "polluter pays" and "producer responsibility" to economic and social activities having environmental impact. This program could be used to finance measures, even partially, included in the Action Plan regarding the nutrients pollution. The following two types of interventions could be supported:

- Manure management through Waste Management Program, including hazardous waste
- Awareness campaigns through Education Program and public awareness on environmental protection.

TABLE A.1. Estimated Intervention Costs for Implementing the Nitrates Directive

Intervention	Estimated cost (EUR)	Estimated cost (RON)
Updating the Code of Good Agricultural Practices	159,100	706,404
Preparing Local Action Plans	2,765,200	12,277,488
Reporting and monitoring activities	16,777,000	74,489,880
Information and training sessions	4,990,165	22,156,332
Sub-total	24,691,465	109,630,104
Building communal platforms	271,757,273	1,206,602,293
Operating the communal platforms for a period of 4 years	98,389,603	436,849,840
Sub-total	370,146,877	1,643,452,133
Buffer zone for surface waters recorded in the cadaster	609,740	2,707,250
Buffer zone for surface waters unrecorded in the cadaster	1,662,286	7,380,550
Sub-total	2,272,027	10,087,800
Grand total	**397,110,369**	**1,763,170,038**

Source: INPCP—Ernst & Young—Analysis Report: results of diagnosis, analysis and prioritization of actions to be taken for the implementation of the EU Nitrates Directive over the 2015-19 period.

Appendix B ANAR Water Fees (valid as of 2010)

TABLE B.1. ANAR Water Fees (valid as of 2010)

Water service		U.M.	Fee	
			RON/UM	Euro/UM
1. Abstraction of water from various sources				
1.a. Surface sources				
1.a.1 Economic agents (communal services, livestock)		1,000 m^3	50.00	11.21
1.a.2 Energy production – thermic, nuclear		1,000 m^3	24,00	5.39
1.a.3 Energy production hydro		1,000 m^3	1.10	0.25
1.a.4 Irrigation, aquaculture	Irrigation	1,000 m^3	3.00	0.67
	Aquaculture	1,000 m^3	0.50	0.11
1.b. Underground sources				
1.b.1 Industry		1,000 m^3	57.52	12.93
1.b.2 Communal services, other for drinking purpose		1,000 m^3	57.52	12.93
1.b.3 Irrigation, aquaculture	Irrigation	1,000 m^3	57.52	12.93
	Aquaculture	1,000 m^3	11.00	2.47
1.b.4 Livestock farms		1,000 m^3	57.52	12.93
2. Reception of waste water				
2.1. General chemical indicators				
- Suspensions, total		Tons	11.38	2.56
- Chlorides, sulfates		Tons	46.65	10.48
- Na, K, Ca, Mg		Tons	46.65	10.48
- Nitrates		Tons	46.65	10.48
- Free residual chorine		Tons	46.65	10.48
- Ammonium, Nitrogen		Tons	186.10	41.82
- BOC-5		Tons	46.53	10.45
- OCCMn		Tons	46.53	10.45
- Phosphates (PO_4)		Tons	9.20	2.07
- Phosphorous		Tons	186.10	41.82
- Manganese		Tons	465.39	104.58
- Aluminum, Total Ionic Iron		Tons	558.44	125.49
- Petroleum products		Tons	348.94	78.41
- Biodegradable detergents		Tons	186.10	41.82
2.2. Specific chemical indicators				
- Sulfites, fluorides, phenols		Tons	186.10	41.82
- Nickel, chromium		Tons	11,637.40	2,615.15

table continues next page

TABLE B.1. continued

Water service	U.M.	Fee	
		RON/UM	Euro/UM
- Ammonia	Tons	11,637.40	2,615.15
- Barium, Zinc, Cobalt	Tons	558.44	125.49
- Sulfides, hydrogen sulphide	Tons	581.83	130.75
2.3. Toxic chemical indicators			
- Arsenic	Tons	36,196.13	8,133.96
- Cyanide	Tons	36,196.13	8,133.96
- Mercury, Cadmium	Tons	46,549.74	10,460.62
- Lead, silver, chrome, copper	Tons	11,637.40	2,615.15
2.4. Bacterial indicators			
- Total coliform bacteria	10^9 bact./ 100 cm^3	3.84	0.86
- Faecal coliform bacteria	10^7 bact./ 100 cm^3	67.35	15.13
- Faecal streptococci	5x10^6 str./ 100 cm^3	173.31	38.95
3. Water height for hydropower			
- Median height for hydropower plants < 4 MW	m/month @ funct. hours	230.07	51.70
- Median height for hydropower plants > 4 < 8 MW	m/month @ funct. Hours	293.99	66.07
- Median height for hydropower plants > 8 MW	m/month @ funct. hours	370.67	83.30
4. Ballast, sand harvesting from rivers and reservoirs	m^3	4.47	1.00

Source: ANAR.

Appendix C Flood Protection

TABLE C.1. List of Priority Flood Protection Investments Selected by ANAR

No	River Basin (ABA)	Project name	Proposed investment with POIMa (thousand euros without TVA)
1	Someș-Tisa	Works for increasing the safety of Colibița reservoir	10,685
2	Someș-Tisa	Increasing the capacity of flood attenuation for Călinești reservoir and flood flow routing till the Hungarian border, Satu Mare county	28,950
3	Jiu	Complex works on the Jiu River for flood protection of Craiova city	11,574
4	Jiu	Complex improvement works on the West and East Jiu River, for flood protection of all settlements along the river, including the rehabilitation of the reservoir Valea de Pești in Hunedoara county	8,426
5	Mureș	PPDEI Mureș, second phase	6,519
6	Mureș	Rehabilitation and raising the class importance of flood protection construction works	11,503
7	Siret	Management of flood risk in the Suceava River Basin, Suceava county	28,000
8	Banat	Planning and works for flood defense on the Bârzava River on reach between Bocșa and Gătaia, Caras Severin and Timiș county	8,730
9	Olt	Complex works on the tributaries of the River Olt, on the northern side of Făgăraș Mountains, in view of improving flood protection against flash floods	14,918
10	Buzau-Ialomița	Flood risk reduction works in the Ialomița basin, downstream of the Pucioasa reservoir, component 1 on the Superior Ialomița	10,970
11	Buzau- Ialomița	Flood risk reduction works in the Ialomița basin, downstream of the Pucioasa reservoir, component 2 on the Prahova basin	54,580
12	Crișuri	Construction works on the Crișul Repede River for flood protection of Oradea city, and the downstream settlements - Improvement of the safety of the Leșu Dam	6,145
13	Prut-Bârlad	Flood protection measures for the population of Bâlteni, Vaslui county	1,792
14	Prut-Bârlad	The Jijia River rehabilitation and reconnection with the flood plain	4,100
15	Prut-Bârlad	Flood risk reduction for cities of Bârlad and Tecuci	3,089
16	Prut-Bârlad	Flood risk reduction for Dorohoi city	5,129
17	Dobrogea Litoral	Complex protection works for flood protection of Danube delta villages	17,580
18	Dobrogea Litoral	Flood risk protection works for Babadag	13,920
	Total flood protection investments proposed for POIM		**246,610**
19	Dobrogea-Litoral	Reduction of coastal erosion-Phase II (2014–20)	184,873
	Total proposed investments by ANAR for POIM		**431,483**

Note: ANAR = National Administration "Romanian Waters"; POIM = Large Infrastructure Operational Program (*Program Operational Infrastructura Mare*—Rom).

Appendix D Population Served and Access Rate in the Various Areas of Service of the Various ROCs

TABLE D.1. Population Served with Water Supply Services in 2015

Nr. crt.	Județ	Nr. soc.	Company name	Population served - water			Total population in operating area	%
				Total	Urban	Rural		
1	ALBA	1	S.C.APA-C.T.T.A. S.A. ALBA IULIA	237,768	181,769	55,999	292,583	81.27
2	ARAD	2	S.C.COMPANA DE APA ARAD S.A.	273,556	195,397	78,159	341,337	80.14
3	ARGES	3	S.C.APA-CANAL 2000 S.A. PITESTI	248,000	204,425	43,575	275,581	89.99
4	BACAU	4	SC COMPANIA REGIONALA DE APA SA BACAU	248,106	204,564	43,542	318,839	77.82
5	BIHOR	5	S.C.COMPANIA DE APA ORADEA S.A.	228,551	193,254	35,297	243,924	93.70
6	BISTRITA NASAUD	6	S.C."AQUABIS" SA BISTRITA NASAUD	153,570	100,522	53,048	232,592	66.03
7	BOTOSANI	7	S.C. NOVA APA SERV SA BOTOSANI	136,526	110,810	25,716	255,933	53.34
8	BUZAU	8	S.C. COMPANIA DE APA S.A. BUZAU	212,712	163,051	49,661	247,537	85.93
9	BRASOV	9	S.C. COMPANIA APA SA BRASOV	346,330	312,438	33,892	356,317	97.20
10	BRAILA	10	S.C. COMP DE UT. PUB.DUNAREA SA BRAILA	262,206	188701	73,505	300,818	87.16
11	CALARASI	11	S.C. ECOAQUA SA CALARASI	102,827	102,827	0	119,959	85.72
12	CARAS SEVERIN	12	S.C. AQUACARAS S.A. RESITA	139,737	139,737		160,548	87.04
13	CLUJ - SALAJ	13	S.C. COMPANIA DE APA SOMES S.A CLUJ-NAPOCA	632,010	486,841	145,169	735,839	85.89
14	CLUJ	14	S.C. APA ARIES S.A. TURDA	96,500	78,890	17,610	100,240	96.27
15	CONSTANTA	15	S.C. RAJA CONSTANTA S.A	696,453	538,391	158,062	733,713	94.92
16	COVASNA	16	S.C. GOSPODARIRE COMUNALA S.A SF. GHEORGHE.	85,357	81,457	3,900	104,281	81.85
17	DAMBOVITA	17	S.C. COMPANIA DE APA TARGOVISTE DAMBOVITA SA	257,005	144,512	112,493	358,727	71.64
18	DOLJ	18	S.C. COMP. DE APA OLTENIA S.A.CRAIOVA	295,305	272,710	22,595	391,053	75.52
19	GORJ	19	S.C APAREGIO GORJ S.A. TG. JIU	120,910	119,630	1,280	125,058	96.68
20	GIURGIU	20	S.C. APA SERVICE S.A. GIURGIU	77,147	75,080	2,067	90,875	84.89
21	GALATI	21	S.C. APA CANAL S.A. GALATI	350,797	314,894	35,903	419,129	83.70
22	HUNEDOARA	22	S.C. APA -PROD S.A. DEVA	179,771	146,025	33,746	205,852	87.33
		23	SC APA SERV VALEA JIULUI SA - PETROSANI	112,040	112,040	0	120,734	92.80
23	HARGHITA	24	SC HARVIZ SA - MIERCUREA CIUC	64,158	44,213	19,945	93,738	68.44
24	IASI	25	S.C. APA VITAL S.A. IASI	419,274	297,012	122,262	654,552	64.06
25	ILFOV	26	SC APA CANAL ILFOV SA	50,277	23,440	26,837	94,846	53.01
		27	EURO APAVOL	24,399	15,639	8,760	76,583	31.86
26	MARAMURES	28	S.C. VITAL S.A. BAIA MARE	192,957	180,315	12,642	240,553	80.21
27	MEHEDINTI	29	S.C. SECOM S.A. DR.TR.SEVERIN	132,419	117,634	14,785	144,248	91.80
28	MURES	30	S.C. COMP. AQUASERV S.A.TG.MURES	299,741	250,332	49,409	353,035	84.90
29	NEAMT	31	S.C COMP. JUD. APA SERV PIATRA NEA	229,340	164,969	64,371	287,567	79.75
30	OLT	32	S.C COMPANIA DE APA OLT S.A.	109,244	106,321	2,923	157,034	69.57
31	PRAHOVA	33	S.C. HIDRO PRAHOVA S.A.PLOIESTI	222,783	145,092	77,691	270,990	82.21
32	SATU-MARE	34	S.C. APASERV SATU MARE S.A.	200,289	141,747	58,542	253,170	79.11
33	SIBIU	35	S.C. APA-CANAL S.A. SIBIU	267,214	241,701	25,513	288,194	92.72
		36	S.C. COMPANIA "APA TARNAVEI MARI" SA	58,066	51,033	7,033	72,730	79.84
34	SUCEAVA	37	S.C. ACET S.A. SUCEAVA	174,268	171,918	2,350	221,066	78.83
35	TELEORMAN	38	S.C. APA SERV S.A. ALEXANDRIA	97,600	97,600	0	125,316	77.88
36	TIMIS	39	S.C. AQUATIM S.A. TIMISOARA	408,492	355,123	53,369	464,025	88.03
37	TULCEA	40	S.C AQUASERV S.A. TULCEA	95,278	94,813	465	99,521	95.74
38	VALCEA	41	S.C. APAVIL S.A. RM. VALCEA	209,194	170,699	38,495	252,297	82.92
39	VASLUI	42	S.C. AQUAVAS S.A. VASLUI	133,859	129,654	4,205	223,668	59.85
40	VRANCEA	43	S.C COMP DE UTILITATI PUBLICE SA FOCSANI	169,790	136,640	33,150	230,224	73.75
	TOTAL			**10,989,003**	**9,341,037**	**1,647,966**	**13,449,426**	81.71

Source: ANRSC 2015 data.

Appendix E

Irrigation Activity in Romania during 1996–2016

TABLE E.1. Irrigation Activity in Romania during 1996–2016

Romania

Irrigation Activity 1996 - 2016

Year	Irrigated area (ha)		Irrigation	Water used (000 mc)		Application	Water	Energy consumed (MWh)			Specific Cons. (kWh/1000mc)		
	Physical	Multiple	intensity	Abstracted	Delivered	(mc/ha)	Efficiency	Total	Main syst.	SPP	Total	Main syst.	SPP
1996	622,710	1,169,138	1.88	1,830,964	985,243	1,582	53.8%	737,477	518,380	219,096	748.5	526.1	222.4
1997	114,885	161,444	1.41	305,196	156,473	1,362	51.3%	79,481	57,869	21,544	508.0	369.8	137.7
1998	234,391	429,184	1.83	705,200	336,977	1,438	47.8%	260,560	187,528	73,030	773.2	556.5	216.7
1999	84,938	158,877	1.87	315,721	116,662	1,373	37.0%	101,691	77,358	24,333	871.7	663.1	208.6
2000	216,056	423,697	1.96	726,237	248,881	1,152	34.3%	263,662	189,357	74,305	1059.4	760.8	298.6
2001	327,701	497,688	1.52	903,638	338,665	1,033	37.5%	398,384	290,945	107,438	1176.3	859.1	317.2
2002	457,572	701,386	1.53	1,141,494	461,276	1,008	40.4%	500,447	377,334	123,378	1084.9	818.0	267.5
2003	569,077	998,405	1.75	1,291,416	504,809	887	39.1%	525,765	370,716	155,049	1041.5	734.4	307.1
2004	327,349	435,575	1.33	699,981	230,788	705	33.0%	238,631	190,900	47,731	1034.0	827.2	206.8
2005	45,719	74,232	1.62	191,153	74,932	1,639	39.2%	31,895	21,059	10,836	425.7	281.0	144.6
2006	96,224	156,180	1.62	298,100	131,462	1,366	44.1%	49,568	32,708	16,860	377.1	248.8	128.2
2007	323,844	653,592	2.02	1,227,386	519,386	1,604	42.3%	399,326	199,362	199,964	768.8	383.8	385.0
2008	208,218	478,475	2.30	1,088,401	415,769	1,997	38.2%	262,302	132,166	130,136	630.9	317.9	313.0
2009	294,137	667,853	2.27	1,363,965	582,413	1,980	42.7%	351,619	174,565	177,054	603.7	299.7	304.0
2010	74,503	157,048	2.11	588,144	217,025	2,913	36.9%	111,546	27,123	84,423	514.0	125.0	389.0
2011	103,295	203,491	1.97	389,075	176,738	1,711	45.4%	101,094	43,654	57,440	572.0	247.0	325.0
2012	165,355	370,395	2.24	798,319	337,820	2,043	42.3%	198,300	77,023	121,277	587.0	228.0	359.0
2013	180,931	376,336	2.08	746,238	329,837	1,823	44.2%	168,940	75,736	93,204	512.2	229.6	282.6
2014	145,398	287,888	1.98	618,771	271,022	1,864	43.8%	110,036	49,329	78,654	472.2	182.0	290.2
2015	173,185	441,497	2.55	820,617	353,686	2,042	43.1%	214,588	96,200	137,186	659.9	272.0	387.9
2016	153,014	306,890	2.01	596,703	255,389	1,669	42.8%	128,018	57,390	79,563	536.3	224.7	311.5
Total	4,918,502	9,149,272	1.86	16,050,017	7,045,253	1,432	43.9%	5,233,330	3,246,702	2,032,501	742.8	460.8	288.5
Average	234,214	435,680		764,287	335,488			249,206	154,605	96,786			

Source: WB elaboration, based on MARD data.

Appendix F Details of Irrigation Rehabilitation Investments under SIPRMII

TABLE F.1. Details of Irrigation Rehabilitation Investments under SIPRMII

Irrigation Infrastructure Rehabilitation Program
Schemes proposed

Scheme name	County	Area (Ha)		Initial Program	Extended Program
		Total	Viable		
Terasa Viziru	Brăila	32,673	32,658	32,658	32,658
Terasa Brailei	Brăila	72,686	72,686	63,821	67,441
Semlac-Pereg	Arad	8,392	8,392	8,392	8,394
Tabara-Trifesti-Sculeni	Iasi	17,258	13,092	13,092	17,258
Campu Frumos	Covasna	2,998	2,998	2,998	2,998
Campia Covurlui	Galați	117,304	26,363	26,363	115,396
Calmatui-Gropeni-Chiscani	Brăila	11,403	11,403	11,403	12,879
Braila-Dunare-Siret	Brăila	3,655	3,655	3,655	0
IMB	Brăila	64,663	64,663	64,663	64,663
Bratesul de Sus	Galați	4,136	4,136	4,136	5,083
Luciu-Giurgeni	Ialomița	5,140	5,140	5,140	5,140
Sud Razelm	Tulcea	13,459	1,980	1,980	13,454
Sarichioi	Tulcea	7,011	5,445	5,445	7,011
Titu-Ogrezeni	Dâmbovița	40,647	40,647	40,647	40,647
Campia Buzaului (V)	Buzău-Prahova	35,860	35,860	35,860	35,860
LR Buzau	Brăila	3,037	3,037	3,037	6,453
Gradistea-Faurei-Jirlau	Brăila	21,499	6,888	6,888	14,606
Babadag	Tulcea	23,612	0	5,775	24,449
Peceneaga-Turcoaia-Macin	Tulcea	20,173	1,202	6,289	19,024
Ialomita-Calmatui	Brăila	137,291	21,664	21,664	137,291
Slobozia-Dunare	Ialomița	2,853	2,853	2,853	2,853
Terasa Bordusani	Ialomița	22,836	6,772	6,772	22,836
Boianu-Sticleanu	Călărasi	23,486	23,486	23,486	19,296
Borcea de Sus	Călărasi	11,404	11,404	11,404	11,404
Viisoara	Teleorman	96,559	14,882	14,882	96,481
M. Kogalniceanu	Constanța	26,532	0	15,579	26,481
Basarabi	Constanța	5,911	0	5,911	5,903
Bistret-Nedeia-Jiu	Dolj	12,350	12,350	12,350	12,326
Letea	Bacău	1,118	1,118	1,118	1,118
Arges km23	Giurgiu	1,553	300	1,553	1,691
Gostinu-Greaca-Arges II	Călărasi	10,663	10,663	10,663	10,663
Ciobanu-Garliciu	Constanța	2,489	2,489	2,489	0
Putna	Vrancea	2,385	2,385	2,385	2,385
Albita-Falciu	Vaslui	16,937	16,937	16,937	16,937
Bucsani-Cioroiu	Vâlcea-Olt	34,147	25,497	25,497	34,382
CDMN/PAMN	Constanța	3,341	3,341	3,341	3,341
Ricefield Harsova	Constanța	1,581	1,581	1,581	2,854
Calarasi-Raul	Călărasi	6,845	6,845	6,845	6,845
Damienesti	Bacău	2,276	0	2,276	2,499
Gostinu-Greaca-Arges	Giurgiu	15,055	15,055	15,055	0
Galatui-Calarasi	Călărasi	75,241	1,448	67,534	75,197
Jegalia	Călărasi	22,269	1,519	20,750	22,269
Galesu	Constanța	4,755	4,755	4,755	4,726
Tiganasi-Perieni	Iasi	3,368	0	1,128	3,368
BH Calmatui	Brăila	23,460	1,111	1,111	23,426
Mostistea	Călărasi	20,000	20,000	20,000	20,000
Lita-Olt	Teleorman	4,871	1,461	1,461	4,871
Namoloasa-Maxineni	Brăila	40,426	25,018	35,526	29,938
Nadeia-Macesu	Dolj	55,367	4,299	4,299	55,387
Terasa Corabia	Olt	35,795	23,426	29,286	35,795
Terasa Zimnicea	Teleorman	2,930	337	2,339	2,930
Calafat-Bailesti	Dolj	54,134	44,301	44,301	31,611
Pietroiu-St. cel Mare	Călărasi	52,428	13,804	13,804	52,428
Seimeni	Constanța	22,846	4,666	3,256	22,784
Sinoe	Constanța-Tulcea	60,617	0	10,000	60,474
Nicolae Balcescu	Constanța	29,176	0	7,815	29,813
Total 1		**1,450,901**	**666,012**	**814,248**	**1,386,017**

Scheme name	County	Area (Ha)		Extended Program
		Total	Viable	
Sascut-Valea Seaca	Bacău	5,028	0	5,028
Calmatui II	Brăila	1,624	1,624	1,620
Calmatui V	Brăila	1,105	1,105	1,105
Carasu Movilita	Constanța	36,969	8,043	8,043
Sadova-Corabia	Dolj-Olt	71,835	71,835	31,525
Terasa Caracal	OT	75,739	8,199	75,739
Gostinu-Greaca-Arges	GR	15,055	15,055	15,055
Dabuleni-Potelu-Corabia	OT	10,928	10,928	10,928
Olt-Calmatui	TR	46,600	0	46,553
Giurgiu-Rasmiresti (B)	GR-TR	37,254	11,781	36,942
Beibugeac-Sarinasuf	TL	14,703	0	14,694
Ciorasti-Maicanesti	VN	10,434	10,434	10,434
Fantanele-Sagu	AR	6,920	6,920	6,920
Stefanesti-Leordeni	AG	5,675	5,675	5,675
Havarna	BT	804	804	804
Curtesti	BT	437	437	437
Latinu-Vadeni	Brăila	12,422	12,422	12,422
Ianca-Surdila-Greci	Brăila	26,803	0	26,762
Campia Buzaului (E)	BZ	9,941	9,941	9,941
Nicoresti-Tecuci	GL	16,349	10,499	5,850
Borcea de Jos	IL	5,677	0	5,677
Crivina-Vanju Mare	MH	26,592	24,732	26,592
Stoenesti-Visina	OT	25,814	25,814	25,814
Galicea	VL	736	736	736
Dragoiesti	VL	1,494	1,494	1,494
Biliesti-Slobozia-Ciorasti	VN	15,009	3,523	14,980
Suraia-Vadu Rosca	VN	2,795	2,795	2,795
Oltenita-Surlari-Dorobantu	CL	9,788	9,788	9,788
Cetate-Galicea	DJ	38,053	0	38,053
Facaeni-Vladeni	IL	2,224	2,224	2,224
Sculeni-Tutora-Gorban	IS	21,009	21,009	21,009
Izvoarele-Cujmir	MH	63,889	0	63,889
Draganesti-Olt	OT	6,233	6,233	6,233
Mihaesti-Babeni	VL	1,112	1,112	1,112
Total 2		**627,050**	**285,162**	**546,873**

Notes:
1. The areas in red represent area considered for rehabilitation that exceeds the area considered economically viable
2. The schemes in green have been partially rehabilitated under the previous WB financed Irrigation Project and the area is the portion that remained unrehabilitated

Source: WB elaboration, based on MARD data.
Note: 1. The areas in red represent area considered for rehabilitation that exceeds the area considered economically viable.
2. The schemes in green have been partially rehabilitated under the previous WB financed Irrigation Project and the area is the portion that remained unrehabilitated.

Appendix G Spatial Analysis Methodology

Background

The methodology was developed starting from the approach used by MWF-ANAR in undertaking a similar exercise for the Danube River Basin Management Plan (RBMP) based on statistical data valid from 2011 to 2013. This analysis not only updates the previous exercise but also includes a different approach to estimating future demand from various users. Most of the information used was collected from the official statistics available on the website of the National Institute of Statistics (NSI) and only sporadically data available from MWF-ANAR was used. For conversion of county-referenced data (as in NSI databases) to river basin, the same RBMP methodology was used, for consistency.

The resulting water demand estimates have been then consolidated by river basin and year of reference, keeping year 2016 as reference. Further, the water demand was compared with estimated water availability to determine the water security situation in each river basin. Estimated future change in water stock in each river basin due to climate change was based on the results of the National Institute of Hydrology and Water Management (INHGA) study conducted on 11 important rivers in seven basins, which would, hopefully be continued and expanded to the other important rivers in other river basins. It is important to note that INHGA study estimated the changes in water stock until 2050 and no intermediate changes have been estimated. At the end, the methodology presents a discussion on how the results can be interpreted in the light of these constraints.

Estimating Water Demand Projections for Domestic Consumption

The base data for assessing the water demand for population for reference year 2016, as recorded in NSI database, per county, included the following (as shown in table G.1: (a) Population, urban and rural, as of January 1, 2017, (b) Population connected to water, sewerage and waste water treatment services, as of December 31, 2016, (c) Water consumption by population in 2016. Then, the conversion of county population to river basin was done both with respect to urban-rural and connection to WSS services parameters (shown in table G.2 A–C). The future population number was calculated using the future population estimated by the World Population Prospects 2017 Revision (WPP-2017) for Romania in 2020 and 2030; it was assumed that the same trend will be valid for all counties/river basins (table G.2 D–G). It is to be mentioned that the trend in population change estimated by WPP-2017 differs from the one estimated in 2012 (used in RBMP), as do population numbers in the reference year.

TABLE G.1. Water Demand for Population in 2017; Population Connected to WSS Services and Consumption of Drinking Water in 2016

Water Demand for Population

Population by region, county, and location 2017

County	Total	Urban	Rural	Urban/Rural
Bihor	566,235	275,440	290,795	49%
Bistrita-Nasaud	281,401	107,078	174,323	38%
Cluj	702,806	458,932	243,874	65%
Maramures	465,293	265,821	199,472	57%
Satu Mare	336,367	150,143	186,224	45%
Salaj	215,855	84,777	131,078	39%
Alba	330,847	192,620	138,227	58%
Brasov	550,547	389,730	160,817	71%
Covasna	204,878	96,595	108,283	47%
Harghita	305,612	129,195	176,417	42%
Mures	540,608	267,413	273,195	49%
Sibiu	399,624	261,232	138,392	65%
Bacau	595,455	256,080	339,375	43%
Botosani	390,354	158,936	231,418	41%
Iasi	789,901	364,501	425,400	46%
Neamt	451,383	159,561	291,822	35%
Suceava	627,494	255,374	372,120	41%
Vaslui	384,323	155,634	228,689	40%
Braila	299,048	184,637	114,411	62%
Buzau	425,717	162,472	263,245	38%
Constanta	678,185	459,475	218,710	68%
Galati	514,154	278,698	235,456	54%
Tulcea	200,688	93,136	107,552	46%
Vrancea	328,046	118,413	209,633	36%
Arges	590,423	270,168	320,255	46%
Calarasi	292,744	105,362	187,382	36%
Dambovita	501,159	141,742	359,417	28%
Giurgiu	273,940	78,359	195,581	29%
Ialomita	261,816	115,164	146,652	44%
Prahova	732,582	356,714	375,868	49%
Teleorman	349,574	112,301	237,273	32%
Ilfov	460,355	204,812	255,543	44%
Bucuresti	1,826,506	1,826,506	0	100%
Dolj	635,364	327,211	308,153	51%
Gorj	323,545	145,051	178,494	45%
Mehedinti	249,379	112,774	136,605	45%
Olt	407,584	157,429	250,155	39%
Valcea	356,595	158,487	198,108	44%
Arad	421,864	231,975	189,889	55%
Caras-Severin	279,027	148,391	130,636	53%
Hunedoara	393,052	291,517	101,535	74%
Timis	697,979	418,617	279,362	60%
Total	**19,638,309**	**10,528,473**	**9,109,836**	
%		**53.6%**	**46.4%**	

Population connected to WSS Services in 2016 (INS Data)

County	Population Total	Water (WS) Number	Water (WS) %	Sewerage (S) Number	Sewerage (S) %	Sewerage+WWT (S+WWT) Number	Sewerage+WWT (S+WWT) %
Bihor	566,235	352,811	62.31	14,956	2.64	237,464	41.94
Bistrita-Nasaud	281,401	167,672	59.58	3,965	1.41	100,537	35.73
Cluj	702,806	616,732	87.75	484	0.07	489,726	69.68
Maramures	465,293	240,473	51.68	1,175	0.25	158,201	34.00
Satu Mare	336,367	225,820	67.14	2,005	0.60	143,255	42.59
Salaj	215,855	118,434	54.87	0	0.00	89,948	41.67
Alba	330,847	255,515	77.23	8,035	2.43	158,365	47.87
Brasov	550,547	492,104	89.38	36,405	6.61	361,392	65.64
Covasna	204,878	107,342	52.39	6,731	3.29	94,963	46.35
Harghita	305,612	191,037	62.51	580	0.19	157,678	51.59
Mures	540,608	344,104	63.65	3,542	0.66	259,677	48.03
Sibiu	399,624	317,927	79.56	1,800	0.45	298,777	74.76
Bacau	595,455	325,516	54.67	3,328	0.56	244,400	41.04
Botosani	390,354	145,366	37.24	7,456	1.91	110,762	28.37
Iasi	789,901	432,590	54.77	0	0.00	305,185	38.64
Neamt	451,383	239,123	52.98	17	0.00	144,753	32.07
Suceava	627,494	213,927	34.09	2,620	0.42	173,226	27.61
Vaslui	384,323	143,809	37.42	1,591	0.41	115,098	29.95
Braila	299,048	277,517	92.80	8,500	2.84	167,805	56.11
Buzau	425,717	259,725	61.01	0	0.00	166,218	39.04
Constanta	678,185	554,357	81.74	3,075	0.45	413,685	61.00
Galati	514,154	386,179	75.11	12,379	2.41	309,174	60.13
Tulcea	200,688	156,780	78.12	26,981	13.44	61,007	30.40
Vrancea	328,046	201,669	61.48	226	0.07	111,618	34.03
Arges	590,423	411,867	69.76	1,401	0.24	284,887	48.25
Calarasi	292,744	147,348	50.33	510	0.17	89,745	30.66
Dambovita	501,159	336,216	67.09	2,950	0.59	124,773	24.90
Giurgiu	273,940	84,809	30.96	0	0.00	64,832	23.67
Ialomita	261,816	151,931	58.03	0	0.00	83,157	31.76
Prahova	732,582	582,939	79.57	12,311	1.68	296,901	40.53
Teleorman	349,574	113,781	32.55	0	0.00	92,537	26.47
Ilfov	460,355	141,308	30.70	61,746	13.41	93,925	20.40
Bucuresti	1,826,506	1,738,970	95.21	0	0.00	1,736,184	95.05
Dolj	635,364	311,468	49.02	11,492	1.81	242,428	38.16
Gorj	323,545	199,531	61.67	13,008	4.02	87,774	27.13
Mehedinti	249,379	170,912	68.54	3,474	1.39	115,384	46.27
Olt	407,584	179,253	43.98	0	0.00	116,932	28.69
Valcea	356,595	204,824	57.44	0	0.00	135,737	38.06
Arad	421,864	293,664	69.61	192	0.05	160,385	38.02
Caras-Severin	279,027	171,914	61.61	31,747	11.38	109,396	39.21
Hunedoara	393,052	327,358	83.29	1,528	0.39	307,030	78.11
Timis	697,979	518,488	74.28	1,005	0.14	400,603	57.39
Total	**19,638,309**	**12,853,110**	**65.45**	**287,215**	**1.46**	**9,415,524**	**47.94**

Cunsumption of drinking water in 2016 (INS Data)

County	Population Connected	('000mc) 2016	mc/person
Bihor	352,811	19,727	55.91
Bistrita-Nasaud	167,672	8,186	48.82
Cluj	616,732	32,943	53.42
Maramures	240,473	16,435	68.34
Satu Mare	225,820	9,146	40.50
Salaj	118,434	7,333	61.92
Alba	255,515	11,540	45.16
Brasov	492,104	28,434	57.78
Covasna	107,342	7,380	68.75
Harghita	191,037	10,041	52.56
Mures	344,104	19,998	58.12
Sibiu	317,927	19,211	60.43
Bacau	325,516	14,202	43.63
Botosani	145,366	6,230	42.86
Iasi	432,590	24,143	55.81
Neamt	239,123	10,475	43.81
Suceava	213,927	11,949	55.86
Vaslui	143,809	8,867	61.66
Braila	277,517	10,490	37.80
Buzau	259,725	11,766	45.30
Constanta	554,357	37,519	67.68
Galati	386,179	17,631	45.65
Tulcea	156,780	10,053	64.12
Vrancea	201,669	10,065	49.91
Arges	411,867	22,116	53.70
Calarasi	147,348	9,232	62.65
Dambovita	336,216	11,371	33.82
Giurgiu	84,809	4,367	51.49
Ialomita	151,931	8,562	56.35
Prahova	582,939	26,154	44.87
Teleorman	113,781	7,294	64.11
Ilfov	141,308	8,738	61.84
Bucuresti	1,738,970	129,138	74.26
Dolj	311,468	23,634	75.88
Gorj	199,531	13,047	65.39
Mehedinti	170,912	8,576	50.18
Olt	179,253	9,602	53.57
Valcea	204,824	13,991	68.31
Arad	293,664	23,236	79.12
Caras-Severin	171,914	9,761	56.78
Hunedoara	327,358	14,848	45.36
Timis	518,488	33,287	64.20
Total	**12,853,110**	**740,718**	**57.63**

Note: WSS = Water Supply and Sanitation.

TABLE G.2. Data Inputs for the Spatial Analysis Methodology

A. Population connected to WSS services - 2016; Water Consumption 2016

River Basin	WS Number	WS %	Sewerage Number	Sewerage %	S+WWT Number	S+WWT %	Total (mill. m3)	Per capita m3
Somes-Tisa	1,116,383	62.3%	6,352	0.4%	801,880	44.8%	62.02	55.55
Crisuri	622,615	77.7%	16,188	2.0%	406,124	50.7%	35.43	56.91
Mures	1,304,391	72.4%	13,900	0.8%	981,245	54.4%	72.70	55.74
Banat	694,564	71.2%	32,751	3.4%	511,685	52.4%	43.42	62.51
Jiu	755,147	57.7%	27,174	2.1%	523,055	40.0%	47.85	63.37
Olt	1,264,386	67.1%	44,808	2.4%	965,302	51.2%	76.19	60.26
Arges-Vedea	2,687,078	71.2%	56,689	1.5%	2,354,874	62.4%	178.74	66.75
Ialomita-Buzau	1,553,653	68.4%	31,415	1.4%	845,023	37.2%	70.22	45.20
Siret	1,083,843	49.5%	6,877	0.3%	746,692	34.1%	52.09	48.06
Prut-Bârlad	1,056,304	53.6%	20,894	1.1%	802,771	40.7%	53.88	51.01
Dobrogea	714,745	81.2%	30,167	3.4%	476,873	54.2%	47.71	66.75
Total	**12,853,110**	**65.40%**	**287,215**	**1.46%**	**9,415,524**	**47.91%**	**740.24**	**57.63**

B. Distribution of county population by river basin

River Basin	Current status (2017) Total	Urban	Rural	
Somes-Tisa	1,791,014	980,759	810,255	55%
Crisuri	801,243	346,457	454,786	43%
Mures	1,802,797	1,011,910	790,887	56%
Banat	976,024	578,782	397,242	59%
Jiu	1,307,911	703,395	604,517	54%
Olt	1,885,278	1,043,690	841,588	55%
Arges-Vedea	3,760,736	2,530,223	1,230,513	67%
Ialomita-Buzau	2,270,189	1,041,335	1,228,853	46%
Siret	2,191,635	870,737	1,320,899	40%
Prut-Bârlad	1,971,686	913,285	1,058,401	46%
Dobrogea	879,796	556,823	322,973	63%
Total	**19,638,309**	**10,577,397**	**9,060,912**	
		54%	**46%**	

C. Urbanization Process (%)

River Basin	Current 2017	Future 2020	Future 2030
Somes-Tisa	54.76	55.86	58.72
Crisuri	43.24	44.11	46.37
Mures	56.13	57.26	60.19
Banat	59.30	60.49	63.59
Jiu	53.78	54.86	57.67
Olt	55.36	56.48	59.36
Arges-Vedea	67.28	68.64	72.15
Ialomita-Buzau	45.87	46.79	49.19
Siret	39.73	40.53	42.60
Prut-Bârlad	46.32	47.25	49.67
Dobrogea	63.29	64.57	67.87
Total	**53.86**	**54.95**	**57.76**

D. Urbanization factors

2020	2030	Trend/year
1.002	1.007	0.05%

E. Scenarios of population growth

	Original (RBMP 2015) / 2011 data Minimal	Basic	Maximal	Revised - 2017/WPP 2017 data Basic	Pop. Estimated
2020	1.030982066	1.054890205	1.078798345	**0.987272479** of 2017 pop.	**19,388,362**
2030	0.952333411	1.005488966	1.058859464	**0.940215219** of 2017 pop.	**18,464,237**

F. Water Consumption m3/capita

	Norm (m3/cap)	Reduced -30%
Urban	95	66.5
Rural	128	89.6

See RBMP 2016, page 293-294)

G. Targets of pop. connected

Year	%
2020	80
2030	90

H. Future trends (World Population Prospects - 2017 Revision)

River Basin	2020 Total	2020 Urban	2020 Rural	2030 Total	2030 Urban	2030 Rural
Somes-Tisa	1,768,219	987,788	780,431	1,683,938	988,814	695,125
Crisuri	791,045	348,940	442,105	753,341	349,303	404,038
Mures	1,779,852	1,019,162	760,690	1,695,017	1,020,220	674,797
Banat	963,602	582,930	380,672	917,673	583,536	334,137
Jiu	1,291,265	708,436	582,829	1,229,718	709,171	520,547
Olt	1,861,283	1,051,169	810,113	1,772,567	1,052,261	720,306
Arges-Vedea	3,712,871	2,548,356	1,164,515	3,535,901	2,551,003	984,898
Ialomita-Buzau	2,241,295	1,048,798	1,192,496	2,134,466	1,049,888	1,084,578
Siret	2,163,741	876,977	1,286,764	2,060,609	877,888	1,182,721
Prut-Bârlad	1,946,592	919,830	1,026,761	1,853,809	920,786	933,024
Dobrogea	868,599	560,814	307,785	827,198	561,396	265,802
Total	**19,388,362**	**10,653,200**	**8,735,162**	**18,464,237**	**10,664,265**	**7,799,972**
		55%	**45%**		**58%**	**42%**

I. Future population connected (World Population Prospects - 2017 Revision) - %

River Basin	2020 - 80% connected (avg) Total	Urban	Rural	2030 - 90% connected (avg) Total	Urban	Rural
Somes-Tisa	1,414,575	55.86%	44.14%	1,515,545	58.72%	41.28%
Crisuri	632,836	44.11%	55.89%	678,007	46.37%	53.63%
Mures	1,423,881	57.26%	42.74%	1,525,515	60.19%	39.81%
Banat	770,881	60.49%	39.51%	825,905	63.59%	36.41%
Jiu	1,033,012	54.86%	45.14%	1,106,746	57.67%	42.33%
Olt	1,489,026	56.48%	43.52%	1,595,310	59.36%	40.64%
Arges-Vedea	2,970,297	68.64%	31.36%	3,182,311	72.15%	27.85%
Ialomita-Buzau	1,793,036	46.79%	53.21%	1,921,019	49.19%	50.81%
Siret	1,730,993	40.53%	59.47%	1,854,548	42.60%	57.40%
Prut-Bârlad	1,557,273	47.25%	52.75%	1,668,428	49.67%	50.33%
Dobrogea	730,231	64.57%	35.43%	744,478	67.87%	32.13%
Total	**15,546,042**	**54.95%**	**45.05%**	**16,617,813**	**57.76%**	**42.24%**

Note: WSS = Water Supply and Sanitation; RBMP = River Basin Management Plan.

TABLE G.3. Water Consumption Scenarios for the Spatial Analysis Methodology

	Scenario 1 - Water consumption based on Unit Norms				Scen.2 Water consumption based on Unit Norms reduced by 30%				Scenario 3 - Water consumption at 2016 unit cons. average				Scenario 4 - Water consumption at 2016 unit cons. Average +10%			
	2020		2030		2020		2030		2020		2030		2020		2030	
River Basin	Total (mill. m3)	Per capita m3	Total (mill. m3)	Per capita m3	Total (mill. m3)	Per capita m3	Total (mill. m3)	Per capita m3	Total (mill. m3)	Per capita m3	Total (mill. m3)	Per capita m3	Total (mill. m3)	Per capita m3	Total (mill. m3)	Per capita m3
Somes-Tisa	154.99	109.57	164.62	108.62	108.49	76.70	115.24	76.04	78.58	55.55	84.19	55.55	86.44	61.11	92.61	61.11
Crisuri	71.79	113.44	76.41	112.70	50.25	79.41	53.49	78.89	36.01	56.91	38.58	56.91	39.61	62.60	42.44	62.60
Mures	155.35	109.10	164.97	108.14	108.75	76.37	115.48	75.70	79.36	55.74	85.03	55.74	87.30	61.31	93.53	61.31
Banat	83.28	108.04	88.39	107.02	58.30	75.63	61.87	74.91	48.19	62.51	51.63	62.51	53.01	68.76	56.79	68.76
Jiu	113.52	109.89	120.60	108.97	79.47	76.93	84.42	76.28	65.46	63.37	70.13	63.37	72.01	69.70	77.15	69.70
Olt	162.84	109.36	172.95	108.41	113.99	76.55	121.06	75.89	89.72	60.26	96.13	60.26	98.70	66.28	105.74	66.28
Arges-Vedea	312.92	105.35	331.57	104.19	219.05	73.75	232.10	72.93	198.28	66.75	212.43	66.75	218.11	73.43	233.68	73.43
Ialomita-Buzau	201.82	112.56	214.71	111.77	141.27	78.79	150.30	78.24	81.04	45.20	86.83	45.20	89.15	49.72	95.51	49.72
Siret	198.42	114.62	211.31	113.94	138.89	80.24	147.92	79.76	83.20	48.06	89.14	48.06	91.52	52.87	98.05	52.87
Prut-Bârlad	175.05	112.41	186.21	111.61	122.53	78.68	130.35	78.13	79.43	51.01	85.10	51.01	87.37	56.11	93.61	56.11
Dobrogea	0.00	0.00	0.00	0.00	54.54	74.69	55.03	73.92	48.74	66.75	49.69	66.75	53.62	73.42	54.66	73.42
Danube	77.91	106.69	78.62	105.60												
Total[a]	**1,630**	**109.86**	**1,732**	**108.94**	**1,195.53**	**76.90**	**1,267.25**	**76.26**	**888.01**	**57.12**	**948.87**	**57.10**	**976.81**	**62.83**	**1,043.75**	**62.81**
Compared to 2016	**220%**	**191%**	**234%**	**189%**	**162%**	**133%**	**171%**	**132%**	**120%**		**128%**		**132%**	**109%**	**141%**	**109%**
Compared to 2016‹	**167%**		**166%**													

a. The total includes only the values for internal river basins and excludes Danube River.

Further, the future trend in the urban-rural distribution of population was estimated using the urbanization factors published by the World Urbanization Prospects 2014 Revision (WUP-2014); a steady annual increase of urban population by 0.05 percent is estimated for the entire period until 2030 and 0.07 percent per year from 2030 to 2045. Urbanization factors for 2020 and 2030 have been calculated to estimate the change in the urban-rural ratio (table G.2 H–I). This calculation was necessary for consistency with RBMP, given that different water consumption was used for urban and rural populations in the RBMP calculations. However, as the proposed **norms for unit consumption rate** for both rural (128 m^3/year) and urban (95 m^3/year) appeared to be very high compared with the 2016 consumption rate shown in table G.1 C, we proposed some other options, which are explained below.

Considering that Romania committed to reach 100 percent connection to water supply as soon as possible and that the currently (2016) only 65.45 percent of total population are connected to water supply services, it was estimated that the connection rate would rise to 80 percent (on average) by 2020 and to 90 percent by 2030, benefitting of the current financing opportunities and, hopefully, from further investment in water supply and sewerage (with waste water treatment) will continue. Without significant reduction in the level of water losses in distribution (which is unlikely given the massive investments that would be required and the need for Romania to focus on UWWTD compliance in the next decade), this results in significant increases in demand from domestic users.

Since the norms for unit consumption rate have been considered too high and difficult to attain at the same pace of increasing the connection rate, four scenarios have been developed for the calculation of future water demand, table G.4 as follows: (a) Using the differentiated norms for unit consumption for urban and rural, as the maximum; (b) Using the consumption norms for urban and rural, reduced by 30 percent; (c) Using the unit consumption rates recorded in 2016; and (d) Using the unit consumption rates recorded in 2016 increased by 10 percent. The results showed that the highest demand would occur in scenario (a), exceeding by 130 percent in 2020 and by 145 percent in 2030 the demand of 2016, while in scenario (b) the demand would exceed the demand of 2016 by 32 percent in 2020 and 41 percent in 2030. Indeed, the lowest increase would occur in scenario (c). We carried forward in the consolidated estimates for 2020 and 2030 the results of scenario (d), which are more credible.

Estimating Water Demand Projections for Industry

The calculation of water demand for industrial use was taken from the RBMP with one amendment: the water demand quoted for Dobrogea in the reference year 2011, of 2,600.56 mill. m^3 was considered excessive because it exceeded by 564.83 mill. m^3 the total consumption in the other 10 river basins. The specific water consumption per capita appeared also excessive (at 2,884.95 m^3/year) compared with all other river basins. Therefore, it was considered that, due to an editorial error, the figure quoted for Dobrogea was, actually, the country total and the difference of 564.83 mill. m^3 was considered as the valid figure for Dobrogea (even so, this would be the second highest industrial consumption after the Jiu River Basin). All calculations remained the same as in the RBMP, but the totals changed accordingly, as shown in table G.4.

TABLE G.4. Forecast of Water Demand for Industry for the Spatial Analysis Methodology

Forecast of Water Demand for Industry (ANAR 2016)

River Basin	Base 2011	Forecast - Base scenario		Demand increase	
	(mill. M3)	2020	2030	2020	2030
Somes-Tisa	48.36	91.77	113.50	190%	235%
Crisuri	42.96	50.26	52.15	117%	121%
Mures	550.39	722.06	803.50	131%	146%
Banat	34.40	43.65	47.19	127%	137%
Jiu	789.12	1,006.11	1,051.06	127%	133%
Olt	107.70	136.34	146.53	127%	136%
Arges-Vedea	198.01	432.18	584.87	218%	295%
Ialomita-Buzau	126.26	161.69	179.20	128%	142%
Siret	64.63	81.67	89.34	126%	138%
Prut-Bârlad	73.90	95.45	105.33	129%	143%
Dobrogea[a]	0.00	0.00	0.00		
Danube	2,501.00	6,860.00	9,400.00	274%	376%
Total[b]	**2,036**	**2,821**	**3,173**		

Source: WB elaboration based on ANAR 2016 data.
Note: ANAR = National Administration "Romanian Waters."
a. The demand is reflected in Danube River.
b. The Total includes only the internal rivers, without Danube.

Estimating Water Demand Projections for Agriculture

Water Demand for Livestock. The base data used for calculation included: (a) INS data on livestock population, by main species, as of December 31, 2016 (table G.5 A) (b) Daily average water consumption, recommended by Romanian agriculture literature, by species, used in RBMP (table G.5 B.1); (c) Daily average water consumption recommended by international practice, by species (which proved slightly smaller than the Romanian recommendations) (table G.5 B.2). The trend in livestock change to 2020 was calculated assuming that the trend registered between 2010 and 2016 will be maintained (downward for pigs and chicken) and a slight upward change, between 0.5 percent and 1.5 percent annually) would occur between 2020 and 2030 for all species (table G.5 C). The conversion of livestock population from county to river basin was done using a similar algorithm as for human population considering that the number of livestock per human population remains constant, by species;

TABLE G.5. Data Inputs for the Spatial Analysis Methodology

Water consumption for agriculture

A. Livestock population 2016

County	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Bihor	85,844	180,859	255,094	1,941,028	**2,462,825**
Bistrita-Nasaud	93,422	69,452	428,123	894,814	**1,485,811**
Cluj	76,241	82,175	421,576	1,366,602	**1,946,594**
Maramures	91,769	81,562	214,626	827,614	**1,215,571**
Satu Mare	52,312	130,589	226,450	1,557,593	**1,966,944**
Salaj	34,046	79,803	235,830	969,366	**1,319,045**
Alba	71,117	102,329	330,606	2,674,510	**3,178,562**
Brasov	68,141	104,424	395,014	2,406,444	**2,974,023**
Covasna	47,258	39,056	222,729	236,549	**545,592**
Harghita	91,885	31,173	220,365	660,275	**1,003,698**
Mures	83,362	118,515	513,422	1,626,876	**2,342,175**
Sibiu	43,640	61,318	604,427	698,129	**1,407,514**
Bacau	83,024	85,351	239,626	3,694,940	**4,102,941**
Botosani	123,118	56,540	339,202	1,208,128	**1,726,988**
Iasi	102,418	113,784	287,738	2,773,655	**3,277,595**
Neamt	85,688	109,896	230,372	1,484,253	**1,910,209**
Suceava	171,027	57,777	282,233	1,158,273	**1,669,310**
Vaslui	84,504	65,073	253,844	3,980,046	**4,383,467**
Braila	52,651	199,433	302,697	1,670,058	**2,224,839**
Buzau	71,209	128,024	270,718	6,040,071	**6,510,022**
Constanta	44,655	112,098	412,039	1,352,477	**1,921,269**
Galati	50,315	73,153	276,070	1,792,904	**2,192,442**
Tulcea	36,691	96,641	406,545	730,296	**1,270,173**
Vrancea	56,205	130,379	188,819	1,890,826	**2,266,229**
Arges	73,523	180,185	227,519	2,598,644	**3,079,871**
Calarasi	32,223	132,350	172,937	3,461,228	**3,798,738**
Dambovita	43,831	79,289	88,912	1,992,545	**2,204,577**
Giurgiu	27,890	87,481	93,882	2,322,136	**2,531,389**
Ialomita	36,129	125,768	188,132	2,190,873	**2,540,902**
Prahova	46,761	96,594	215,597	3,246,284	**3,605,236**
Teleorman	47,052	131,114	207,641	2,053,531	**2,439,338**
Ilfov	10,109	32,956	43,601	516,131	**602,797**
Bucuresti	269	127	1,168	4,607	**6,171**
Dolj	54,359	145,446	325,617	2,282,632	**2,808,054**
Gorj	58,051	94,418	140,575	1,272,000	**1,565,044**
Mehedinti	39,018	86,302	171,912	1,086,378	**1,383,610**
Olt	55,864	171,704	192,959	1,931,743	**2,352,270**
Valcea	54,014	90,212	138,307	1,744,840	**2,027,373**
Arad	46,050	190,564	389,744	818,989	**1,445,347**
Caras-Severin	46,111	45,992	365,652	1,087,346	**1,545,101**
Hunedoara	49,154	51,716	202,469	1,476,953	**1,780,292**
Timis	48,669	656,097	633,840	1,967,267	**3,305,873**
Total	**2,569,619**	**4,707,719**	**11,358,629**	**75,689,854**	**94,325,821**

B. Water consumption per livestock species

B.1 Used in RMBP 2015

Species	Daily L/head	Annual m3/head
Pigs	28	10
Sheeps-Goats	9	3
Cattle	100	36
Chicken	30	11

B.2 Revised as per "Farmer's Manual"

Species	Daily L/head	Annual m3/head
Pigs	9	3.3
Sheeps-Goats	7.5	2.7
Cattle	70	25.6
Chicken	23	8.4

C. Estimated change in livestock population 2020-2030

Species	Change Factor		
	Annual	2020	2030
Cattle	1.01	1.041	1.149
Pigs	0.97 / 1.01	0.885	1.105
Sheeps-Goats	1.015	1.061	1.232
Chicken	0.98 / 1.005	0.922	1.051

D. Distribution of county livestock by river basin

River Basin	Current Livestock population - 2016				
	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Somes-Tisa	234,349	429,344	1,035,907	6,902,915	**8,602,515**
Crisuri	104,840	192,075	463,432	3,088,146	**3,848,493**
Mures	235,891	432,169	1,042,722	6,948,329	**8,659,110**
Banat	127,710	233,974	564,524	3,761,786	**4,687,993**
Jiu	171,137	313,534	756,485	5,040,944	**6,282,100**
Olt	246,683	451,941	1,090,428	7,266,226	**9,055,279**
Arges-Vedea	492,082	901,528	2,175,177	14,494,607	**18,063,395**
Ialomita-Buzau	297,048	544,212	1,313,058	8,749,747	**10,904,065**
Siret	286,769	525,381	1,267,623	8,446,988	**10,526,762**
Prut-Bârlad	257,990	472,655	1,140,406	7,599,261	**9,470,312**
Dobrogea	115,119	210,906	508,867	3,390,905	**4,225,797**
Total	**2,569,619**	**4,707,719**	**11,358,629**	**75,689,854**	**94,325,821**

the result is shown in table G.5 D. Then, the expected change in livestock population was calculated for 2020 and 2030, as shown in table G.6 A. Further, the water demand for livestock in 2016 was calculated (table G.6 B). The calculation of water demand was done for both sets of unit rates recommended by the Romanian and international practice, resulting in a 25 percent difference, as shown in table G.7.

Water Demand for Irrigation. The calculation of water demand for irrigation was based on the area economically viable and marginally viable for irrigation, as documented in technical studies developed by international and local consultants in 2009 and the Investment Strategy for Rehabilitation of Irrigation Infrastructure (ISRII) prepared in 2011 and approved by the Ministry of Agriculture and Rural Development (MARD) in 2013. In this proposal, the current commitments of MARD to complete the rehabilitation of irrigation infrastructure covering 1.9 million ha until 2020 was not considered feasible and, thus, ignored. Since ISRII included the list of irrigation schemes to be rehabilitated but not the sequence of implementation, a phasing of the rehabilitation program was proposed considering the implementation status of the investment program, the implementation and financial capacity, as shown in table G.8. The implementation program also considered that the entire area economically

TABLE G.6. Expected Change in Livestock Population for 2020–2030 and Water Demand for Livestock Population

A. Expected change in livestock population 2020 - 2030

River Basin	Estimated livestock population - 2020				
	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Somes-Tisa	243,865	380,095	1,099,474	6,367,029	**8,090,463**
Crisuri	109,097	170,043	491,870	2,848,408	**3,619,417**
Mures	245,469	382,596	1,106,707	6,408,917	**8,143,689**
Banat	132,896	207,135	599,165	3,469,751	**4,408,947**
Jiu	178,085	277,569	802,905	4,649,606	**5,908,167**
Olt	256,700	400,100	1,157,341	6,702,135	**8,516,276**
Arges-Vedea	512,063	798,116	2,308,654	13,369,364	**16,988,197**
Ialomita-Buzau	309,109	481,787	1,393,631	8,070,488	**10,255,016**
Siret	298,413	465,116	1,345,409	7,791,233	**9,900,171**
Prut-Bârlad	268,465	418,438	1,210,386	7,009,317	**8,906,606**
Dobrogea	119,793	186,713	540,092	3,127,663	**3,974,262**
Total	**2,673,956**	**4,167,710**	**12,055,635**	**69,813,911**	**88,711,212**

River Basin	Estimated livestock population - 2030				
	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Somes-Tisa	269,378	419,861	1,275,984	6,692,639	8,657,864
Crisuri	120,511	187,833	570,835	2,994,076	3,873,255
Mures	271,151	422,624	1,284,379	6,736,670	8,714,823
Banat	146,799	228,806	695,356	3,647,195	4,718,156
Jiu	196,717	306,609	931,804	4,887,388	6,322,519
Olt	283,556	441,959	1,343,141	7,044,884	9,113,541
Arges-Vedea	565,636	881,617	2,679,287	14,053,075	18,179,615
Ialomita-Buzau	341,449	532,193	1,617,366	8,483,214	10,974,222
Siret	329,634	513,778	1,561,402	8,189,677	10,594,491
Prut-Bârlad	296,553	462,216	1,404,702	7,367,774	9,531,245
Dobrogea	132,326	206,248	626,799	3,287,612	4,252,986
Total	**2,953,711**	**4,603,744**	**13,991,056**	**73,384,204**	**94,932,716**

B. Water demand for livestock population

River Basin	Current water consumption by livestock - 2016 (m3)				
	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Somes-Tisa	8,436,573	4,293,440	3,107,721	75,932,062	**91,769,795**
Crisuri	3,774,256	1,920,749	1,390,296	33,969,606	**41,054,908**
Mures	8,492,077	4,321,686	3,128,166	76,431,615	**92,373,544**
Banat	4,597,562	2,339,736	1,693,572	41,379,643	**50,010,513**
Jiu	6,160,919	3,135,341	2,269,454	55,450,387	**67,016,100**
Olt	8,880,603	4,519,410	3,271,285	79,928,486	**96,599,784**
Arges-Vedea	17,714,953	9,015,282	6,525,532	159,440,677	**192,696,445**
Ialomita-Buzau	10,693,726	5,442,123	3,939,173	96,247,218	**116,322,240**
Siret	10,323,701	5,253,814	3,802,869	92,916,865	**112,297,249**
Prut-Bârlad	9,287,631	4,726,550	3,421,219	83,591,875	**101,027,275**
Dobrogea	4,144,282	2,109,058	1,526,600	37,299,960	**45,079,899**
Total	**92,506,284**	**47,077,190**	**34,075,887**	**832,588,394**	**1,006,247,755**

TABLE G.7. **Estimated Water Demand by Livestock**

A. Estimated water demand by livestock (using RMBP unit rates)

River Basin	Estimated water demand by livestock - 2020 (mill. m3)				
	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Somes-Tisa	9	4	3	70	**86**
Crisuri	4	2	1	31	**38**
Mures	9	4	3	70	**86**
Banat	5	2	2	38	**47**
Jiu	6	3	2	51	**63**
Olt	9	4	3	74	**90**
Arges-Vedea	18	8	7	147	**180**
Ialomita-Buzau	11	5	4	89	**109**
Siret	11	5	4	86	**105**
Prut-Bârlad	10	4	4	77	**95**
Dobrogea	4	2	2	34	**42**
Danube					
Total	**96**	**42**	**36**	**768**	**942**

River Basin	Estimated water demand by livestock - 2030 (mill. m3)				
	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Somes-Tisa	10	4	4	74	**91**
Crisuri	4	2	2	33	**41**
Mures	10	4	4	74	**92**
Banat	5	2	2	40	**50**
Jiu	7	3	3	54	**67**
Olt	10	4	4	77	**96**
Arges-Vedea	20	9	8	155	**192**
Ialomita-Buzau	12	5	5	93	**116**
Siret	12	5	5	90	**112**
Prut-Bârlad	11	5	4	81	**101**
Dobrogea	5	2	2	36	**45**
Total	**106**	**46**	**42**	**807**	**1,002**

B. Estimated water demand by livestock (using Farmer's Manual unit rates)

River Basin	Estimated water demand by livestock - 2020 (mill. m3)				
	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Somes-Tisa	6	1	3	53	**64**
Crisuri	3	1	1	24	**29**
Mures	6	1	3	54	**64**
Banat	3	1	2	29	**35**
Jiu	5	1	2	39	**47**
Olt	7	1	3	56	**67**
Arges-Vedea	13	3	6	112	**134**
Ialomita-Buzau	8	2	4	68	**81**
Siret	8	2	4	65	**78**
Prut-Bârlad	7	1	3	59	**70**
Dobrogea	3	1	1	26	**31**
Total	**68**	**14**	**33**	**586**	**701**

River Basin	Estimated water demand by livestock - 2020 (mill. m3)				
	Cattle	Pigs	Sheeps-Goats	Chicken	Total
Somes-Tisa	7	1	3	56	**68**
Crisuri	3	1	2	25	**30**
Mures	7	1	4	57	**68**
Banat	4	1	2	31	**37**
Jiu	5	1	3	41	**50**
Olt	7	1	4	59	**72**
Arges-Vedea	14	3	7	118	**143**
Ialomita-Buzau	9	2	4	71	**86**
Siret	8	2	4	69	**83**
Prut-Bârlad	8	2	4	62	**75**
Dobrogea	3	1	2	28	**33**
Total	**75**	**15**	**38**	**616**	**745**

Note: The water consumption per each specie calculated using the values used by ANAR in the RBMP—Annex 8.1. The change in livestock numbers was calculated by extrapolation of the trend in the past 10 years and considered a slight number increase in all cases. ANAR = National Administration "Romanian Waters"; RBMP = River Basin Management Plan.

viable would be rehabilitated by or before 2040. Two intermediate implementation stages were considered before 2030, namely 2020 and 2025, and a future stage between 2030 and 2040.

The irrigation schemes have been aligned with the counties of location to link their rehabilitation with the current irrigation activity without rehabilitation. The list of counties with irrigation activity and schemes subject to rehabilitation, with total area equipped, area viable, phasing of rehabilitation program and water sources is presented in table G.9. The calculation of water demand was done assuming a daily irrigation time of 16 hours, with 30 days per month and 3.67 months per year. Also, it was assumed that, after rehabilitation, the water consumption would diminish from the current annual average of 4,578 m^3/ha to 2,419 m^3/ha.

Further, the calculation was conducted by river basin, where the total area equipped, area viable, area subject to rehabilitation and schedule, estimated degree of utilization after

TABLE G.8. Irrigation Rehabilitation Phases According to Strategy 2011

Rehabilitation Phases - according to Strategy 2011

Stage 1 - 2020

Scheme	County	Viable area (ha)	Water source
Terasa Viziru	BR	12,473	Danube
Terasa Brailei	BR	58,551	Danube
Semlac-Pereg	AR	8,392	Mures
Tabara-Trifesti-Sculeni	Iasi	13,092	Prut
Campu Frumos	CV	2,998	Olt
Campia Covurlui	GL	26,363	Siret
Total Stage 1		**121,869**	

Stage 2 - 2025

Scheme	County	Viable area (ha)	Water source
Calmatui-Gropeni	BR	11,403	Danube
BDS	BR	3,655	Danube
IMB	BR	64,663	Danube
Bratesul de Sus	GL	4,136	Danube
Luciu-Giurgeni	IL	5,140	Danube
Sud Razelm	TL	1,980	Razelm (D-L)
Sarichioi	TL	5,445	D-L
Titu-Ogrezeni	DB-GR	40,647	Arges
Campia Buzau	BZ	35,860	Buzau
LR Buzau	BR	3,047	Buzau
Gradistea-Faurei-Jirlau	BR	6,888	Buzau/Danube
Babadag	TL	5,775	Babadag (D-L)
Peceneaga-Turcoaia-Macin	TL	6,289	Danube
Ialomita-Calmatui	BR	21,664	Danube
Slobozia-Dunare	IL	2,853	Ialomita
Terasa Bordusani	IL	6,772	Danube
Boianu-Sticleanu	CL	23,486	Danube
Borcea de Sus	CL	11,404	Danube
Viisoara	TR	14,882	Danube
M. Kogalniceanu	CT	15,579	Danube CDMN
Basarabi	CT	5,911	Danube CDMN
Bistret-Nedeia-Jiu	DJ	12,350	Danube
Total Stage 2		**309,829**	

Stage 3 - 2030

Scheme	County	Viable area (ha)	Water source
Letea	BC	1,118	Siret
Arges km23	GR	1,553	Arges
Gostinu-Greaca	CL	10,663	Danube
Ciobanu-Garliciu	CT	2,489	Danube
Putna	VN	2,385	Putna
Albita-Falciu	VS	16,937	Prut
Bucsani-Cioroiu	VL+OT	25,497	Olt
CDMN/PAMN	CT	3,341	Danube CDMN
Ricefield Harsova	CT	1,581	Danube
Calarasi-Raul	CL	6,845	Danube
Damienesti	BC	2,276	Siret
Gostinu-Greaca-Arges	GR	15,055	Danube
Galatui-Calarasi	CL	67,534	Danube
Jegalia	CL	20,750	Danube
Galesu	CT	4,755	D-L
Tiganasi-Perieni	IS	1,128	Prut
BH Calmatui	BR	1,111	Danube
Mostistea	CL	20,000	Danube
Lita-Olt	TR	1,461	Olt
Namoloasa-Maxineni	BR	35,526	Buzau
Nadeia-Macesu	DJ	4,299	Danube
Terasa Corabia	OT	29,286	Danube
Terasa Zimnicea	TR	2,339	Danube
Calafat-Bailesti	DJ	44,301	Danube
Pietroiu-St. cel Mare	CL	13,804	Danube
Seimeni	CT	3,256	Danube
Sinoe	CT	10,000	D-L
Nicolae Balcescu	CT	7,815	Danube CDMN
Total Stage 3		**357,105**	

rehabilitation was used to estimate the water demand. The degree of utilization is important because it governs the functional efficiency (hydraulic and energetic) of any scheme; it was assumed that the degree of utilization will gradually increase, factoring also the alternation of wet and dry years. The results of water demand calculations are shown in table G.10. It should be mentioned that the Danube River would remain the main water source for irrigation after rehabilitation, while water supply to irrigation from internal rivers including by gravity would be reactivated.

Water Demand for Aquaculture. In the absence of any detailed information on the locations of aquaculture farms, the water demand for this activity or distribution of demand by river

TABLE G.9. Data Inputs for the Spatial Analysis Methodology

Romania

Water demand for Irrigation

County	Area Equipped for Irrigation (ha)	Area Viable for Irrigation (ha)	Area subject to rehabilitation (ha)				2010-2016	Split source (Ha)		Water Abstracted (mill.m3)	
			Phase 1 - 2020	Phase 2 - 2025	Phase 3 - 2030	Phase 4	Irrigated area avg.	Internal river	Danube	Internal river	Danube
Bihor	9,951	2,894	0	0	0	2,894	0			0.0	0.0
Bistrita-Nasaud	182	0	0	0	0	0	0			0.0	0.0
Cluj	7,500	5,720	0	0	0	5,720	0			0.0	0.0
Satu Mare	4,398	2,195	0	0	0	2,195	0			0.0	0.0
Alba	4,522	0	0	0	0	0	0			0.0	0.0
Brasov	2,632	0	0	0	0	0	0			0.0	0.0
Covasna	4,758	4,298	2,998	0	0	1,300	384	384		1.8	0.0
Mures	689	0	0	0	0	0	0			0.0	0.0
Sibiu	2,454	0	0	0	0	0	0			0.0	0.0
Bacau	20,905	15,079	0	0	3,394	11,685	101	101		0.5	0.0
Botosani	20,232	11,237	0	0	0	11,237	45	45		0.2	0.0
Iasi	50,433	40,922	13,092	0	1,128	26,702	3,436	3,436		15.7	0.0
Neamt	10,414	2,429	0	0	0	2,429	0			0.0	0.0
Suceava	3,778	0	0	0	0	0	0			0.0	0.0
Vaslui	29,662	25,386	0	0	16,937	8,449	1,764	1,764		8.1	0.0
Braila	358,985	235,591	71,024	111,320	36,637	16,610	89,993		89,993	0.0	412.0
Buzau	50,663	50,663	0	35,860	0	14,803	1,426	1,426		6.5	0.0
Constanta	422479	109,297	0	21,490	33,237	54,570	1,241		1,241	0.0	5.7
Galati	155,745	54,759	26,363	4,136	0	24,260	11,986	1,500	10,486	6.9	48.0
Tulcea	162,802	34,290	0	19,489	0	14,801	2,671		2,671	0.0	12.2
Vrancea	40,759	24,728	0	0	2,385	22,343	493	493		2.3	0.0
Arges	32,698	27,646	0	0	0	27,646	0			0.0	0.0
Calarasi	349,764	237,238	0	34,890	139,596	62,752	7,402		7,402	0.0	33.9
Dambovita	49,338	49,338	0	40,647		8,691	0			0.0	0.0
Giurgiu	161,942	45,627	0	0	16,608	29,019	447		447	0.0	2.0
Ialomita	203,162	64,084	0	14,765		49,319	13,975		13,975	0.0	64.0
Prahova	23,659	7,693	0	0	0	7,693	57	57		0.3	0.0
Teleorman	231,459	30,463	0	14,882	3,800	11,781	868		868	0.0	4.0
Ilfov	49,746	49,746	0	0	0	49,746	0			0.0	0.0
Dolj	299,581	125,090	0	12,350	48,600	64,140	5,048		5,048	0.0	23.1
Gorj	4,073	2,492	0	0	0	2,492	0			0.0	0.0
Mehedinti	76,820	1,166	0	0	0	1,166	0			0.0	0.0
Olt	184,332	151,356	0	0	29,286	122,070	1,902	400	1,502	1.8	6.9
Valcea	11,686	9,036	0	0	6,430	2,606	0			0.0	0.0
Arad	27,993	15,387	8,392	0	0	6,995	202	203		0.9	0.0
Hunedoara	9,588	2,679	0	0	0	2,679	0			0.0	0.0
Timis	15,097	11,461	0	0	0	11,461	58	58		0.3	0.0
Total	**3,094,881**	**1,449,990**	**121,869**	**309,829**	**338,038**	**680,254**	**143,500**	**9,867**	**133,633**	**45**	**612**

basin could not be estimated, so either the calculations of RBMP could be taken for granted (as country total) or additional information should be collected for each river basin. From the RBMP evidence and calculations, the water demand was and would continue to be substantial given that the 1020 aquaculture (nursery and breeding) farms cover over 97,500 ha. The water consumption registered in 2008–12 is presented in table G.10.

TABLE G.10. Data Inputs for the Spatial Analysis Methodology, 2008–12

Year	2008	2009	2010	2011	2012
Water demand (mill. m^3)	479	423	487	606	705

TABLE G.11. Data Inputs for the Spatial Analysis Methodology

River Basin	Area Equipped for Irrig. (ha)	Area Viable for Irrig. (ha)	Subject to rehabilitation (ha)				Area Rehab. (ha)	Estimated degree of utilization (%)				Water demand for irrigation (mill. m3)				Current Irr. (ha)
			2020	2025	2030	>2030-2040		2020	2025	2030	>2030-2040	2020	2025	2030	>2030-2040	
Somes-Tisa	7,682	5,720	0	0	0	5,720	0	0	0	5	15	0	0	0	2	0
Crisuri	14,349	5,089	0	0	0	5,089	0	0	0	5	15	0	0	0	2	0
Mures	57,889	29,527	8,392	0	0	18,809	0	10	15	25	35	3	4	6	24	261
Banat	0	0	0	0	0	2,326	0	0	0	0	30	0	0	0	2	0
Jiu	4,073	2,492	0	0	0	2,492	0	0	3	8	15	0	0	0	1	0
Olt	205,862	164,690	2,998	0	35,716	125,976	0	10	20	25	35	4	5	27	143	784
Arges-Vedea	82,444	77,392	0	40,647	0	77,392	0	5	15	35	45	0	15	34	129	0
Ialomita-Buzau	482,645	343,285	71,024	147,180	36,637	47,797	0	10	15	30	35	24	86	192	263	1,483
Siret	75,856	42,236	0	0	5,779	36,457	11,000	10	20	35	35	12	15	24	55	2,094
Prut-Bârlad	256,072	132,304	39,455	4,136	18,065	70,648	0	15	25	40	40	38	50	84	152	5,245
Dobrogea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Danube	1,908,009	647,255	0	117,866	241,841	287,548	82,000	22	35	45	45	655	781	1,093	1,406	133,633
Total	**3,094,881**	**1,449,990**	**121,869**	**309,829**	**338,038**	**680,254**	**93,000**					**738**	**956**	**1,460**	**2,178**	**143,500**

Note: The current water consumption was calculated considering the average water abstraction 2010–16 divided by the average irrigated area in the same period. The future water consumption per hectare was calculated considering that the water losses would be reduced by 50% with rehabilitation. It was also assumed that the irrigation schemes with activity during 2010–16 will also be subject to rehabilitation. The phases of infrastructure rehabilitation have been accessed according to the interest demonstrated by farmers in the recent past (2010–16) and climate aridity. The list of irrigation schemes subject to rehabilitation was taken from the Strategy for Irrigation Rehabilitation and includes about 820,000 ha.

In estimating the water demand, RBMP assumed that the expansion rate of 16 percent recorded between 2008 and 2012 or similar would be maintained until 2020 and 2030 and, thus, the area with aquaculture activity would reach 113,100 ha in 2020 and 131,200 ha in 2030 while the unit water consumption would not change. Hence, the water demand was estimated at 818 mill. m^3 in 2020 and 948 mill. m^3 in 2030. Beyond their indication of the order of magnitude of demand, these figures could not be carried forward in the river basin analysis.

Final Results

The estimated water demands from each of the main users considered have been consolidated, separately for 2020 and 2030, in table G.12 A. To enable a further comparison with the estimated water demand in RBMP, only the results of scenario (a) for the calculation of water demand by population have been carried forward to the total. For comparison, the water demand recorded in 2016 is shown in table G.12 B.

For a comprehensive image of the likely impact of the future water consumption to support Romania's economic and social development, the total estimated future demand of the three main users was compared with the future water resources utilizable in each river basin, which are likely to be affected by the climate change. As mentioned earlier, water availability forecasts for 2050 horizon have been developed by INHGA for seven river basins and show that most river basins in Romania would have a water stock diminished by about 10 percent in the coming 30 years, except the Somes-Tisa River Basin, where a slight increase (+2.5 percent) was calculated in the report on the basis of forecasted changes for three main rivers of the basin. For the remaining four river basins, a similar reduction of water availability by 10 percent was assumed. Moreover, in the absence of any reliable forecasts for the Danube River, it was assumed that its volume would not be affected in the lower section of the basin nor its' share utilizable by Romania would diminish.

The cross assessment showed in table G.12, led to the following observations:

1. Two river basins appeared at risk of scarcity in 2016, Mures and Buzau-Ialomița, where the demand reached 69 percent and 74 percent of utilizable resource, respectively. In all other river basins, demand was below 45 percent of utilizable resource. As a reminder, the utilizable share of total water stock does not exceed one-third of the potential natural resource.
2. The water availability in the Dobrogea-Litoral River Basin is extremely low and can satisfy only a limited demand. Thus, it is very likely that almost all water demand is satisfied from the Danube River and this assumption was used further.
3. The water demand would reach 95 percent of the availability, in 2020, in the same river basins, Mures and Buzau-Ialomita and would exceed 50 percent of availability in two other river basins: Jiu (61 percent), and Arges-Vedea (53 percent).
4. The situation would become more dramatic in 2030, when the demand in Buzau-Ialomita would exceed the availability by 44 percent and in Mures by 6 percent. The demand would exceed 50 percent of utilizable resources in three other river basins: Arges-Vedea (67 percent), Jiu (64 percent), Prut-Bârlad (59 percent).
5. In accordance with the above, one can define the river basins Mures and Buzău-Ialomita as hotspots for water scarcity, where actions would be needed to enhance the capacity for a better management of the natural potential (possibly through increasing storage of excess water during floods) and diversify the water sources.

For reference, comparing the results of our analysis with the water demand estimated for the Danube River Basin Management Plan (average scenario, shown in table G.12 D) one can note that the demand estimated in our analysis is more conservative than the RBMP. One source of the difference may come from the changed forecasts for population trends towards 2020–30. The overestimated demand for industrial water in Dobrogea would be a second factor. The third factor would be the much larger area assumed to be irrigated in 2020 and 2030 and used in the RBMP estimates, area difficult to realistically justify. To enable this comparison, the water demand for population estimated in scenario (a) was carried forward in table G.12 F.

The fourth element would be the inconsistency in calculating the water demand for livestock, which deviated from the initial principles and methodology, because the calculation was based on a proxy (population) and not on the actual livestock population and unit water consumption declared upfront. Therefore, the water demand that resulted is much lower.

TABLE G.12. Data Inputs for the Spatial Analysis Methodology

Romania

A. Summary Water demand forecast by River Basin, including Danube - scenario #4

River Basin	Water demand forecast - 2020 (mill. m3)				
	Population	Industry	Livestock	Irrigation	Total
Somes-Tisa	86	92	86	0	264
Crisuri[b]	40	50	38	0	128
Mures	87	722	86	3	899
Banat[b]	53	44	47	0	143
Jiu	72	1,006	63	0	1,141
Olt	99	136	90	4	330
Arges-Vedea	218	432	180	0	831
Ialomita-Buzau	89	162	109	24	384
Siret	92	82	105	12	291
Prut-Bârlad[b]	87	95	95	38	316
Dobrogea[b]	0	0	17	0	17
Danube[c]	54	6,860	25	655	7,594
Total[a]	**923**	**2,821**	**917**	**82**	**4,743**

River Basin	Water demand forecast - 2030 (mill. m3)				
	Population	Industry	Livestock	Irrigation	Total
Somes-Tisa	93	114	91	0	297
Crisuri[b]	42	52	41	0	135
Mures	94	804	92	6	995
Banat[b]	57	47	50	0	154
Jiu	77	1,051	67	0	1,195
Olt	106	147	96	27	375
Arges-Vedea	234	585	192	34	1,045
Ialomita-Buzau	96	179	116	192	582
Siret	98	89	112	24	323
Prut-Bârlad[b]	94	105	101	84	383
Dobrogea[b]	0	0	18	0	18
Danube[c]	55	9,400	27	1,093	10,574
Total[a]	**989**	**3,173**	**975**	**367**	**5,503**

B. Water Demand in 2016

River Basin	Water consumed 2016 (mill. m3)				
	Population	Industry	Livestock	Irrigation	Total
Somes-Tisa	62	48	92	0	202
Crisuri[b]	35	43	41	0	119
Mures	73	550	92	3	718
Banat[b]	43	34	50	0	128
Jiu	48	789	67	0	904
Olt	76	108	97	2	282
Arges-Vedea	179	198	193	0	569
Ialomita-Buzau	70	126	116	7	320
Siret	52	65	112	3	232
Prut-Bârlad[b]	54	74	101	31	260
Dobrogea[b]	0	0	18	0	18
Danube[c]	48	2,501	639	612	3,799
Total[a]	**693**	**2,036**	**979**	**45**	**3,753**

C. Water Demand / Availability - Scenario #4

River Basin	Water availability 2016 (mill m3)	Water forecasts 2050 (mill.		Demand vs. Availability (%)		
		Change	Estimated Stock (mill. m3)	2016	2020	2030
Somes-Tisa	971	2.50%	995	21%	27%	30%
Crisuri[b]	395	-10.00%	356	30%	36%	38%
Mures	1,044	-9.90%	941	69%	96%	106%
Banat[b]	608	-10.00%	547	21%	26%	28%
Jiu	2,109	-11.00%	1877	43%	61%	64%
Olt	2,010	-9.50%	1819	14%	18%	21%
Arges-Vedea	1,740	-9.20%	1580	33%	53%	66%
Ialomita-Buzau	731	-5.80%	688	44%	56%	85%
Siret	2,655	-9.60%	2400	9%	12%	13%
Prut-Bârlad[b]	726	-10.00%	653	36%	48%	59%
Dobrogea[b]	46	-10.00%	41	39%	41%	43%
Danube[c]	20,000	0.00%	20,000	19%	38%	53%
Total[a]	**13,035**	**-14%**	**11,265**	**29%**	**42%**	**49%**

D. Water Demand and Availability Assessment - 2020-2030 (RBMP calculations)

River Basin	Water demand forecast - 2020 (mill. m3)				
	Population	Industry	Irrigation	Livestock	Total
Somes-Tisa	190	92	0	17	300
Crisuri	86	50	0	10	146
Mures	191	722	4	20	937
Banat	103	44	2	12	161
Jiu	139	1,006	53	11	1,209
Olt	200	136	68	18	422
Arges-Vedea	396	432	61	17	906
Ialomita-Buzau	243	162	265	20	689
Siret	235	82	4	22	343
Prut-Bârlad	211	95	67	18	391
Dobrogea	0	0	0	8	8
Danube[c]	93	3,842	38	0	3,973
Total	**1,995**	**2,821**	**523**	**172**	**5,511**

River Basin	Water demand forecast - 2030 (mill. m3)				
	Population	Industry	Irrigation	Livestock	Total
Somes-Tisa	191	114	1	17	322
Crisuri	87	52	3	10	153
Mures	191	804	12	19	1,025
Banat	103	47	6	12	168
Jiu	140	1,051	158	10	1,359
Olt	201	147	203	17	567
Arges-Vedea	390	585	184	16	1,175
Ialomita-Buzau	246	179	794	19	1,238
Siret	241	89	12	20	362
Prut-Bârlad	208	105	202	17	532
Dobrogea	0	0	0	8	8
Danube[c]	92	4,210	115	0	4,417
Total	**1,999**	**3,173**	**1,575**	**163**	**6,909**

River Basin	Water availability 2016 (mill m3)	Water forecasts 2050 (mill.		Demand vs. Availability (%)	
		Change	Estimated Stock (mill. m3)	2020	2030
Somes-Tisa	971	2.50%	995	30%	32%
Crisuri[b]	395	-10.00%	356	41%	43%
Mures	1,044	-9.90%	941	100%	109%
Banat[b]	608	-10.00%	547	29%	31%
Jiu	2,109	-11.00%	1877	64%	72%
Olt	2,010	-9.50%	1819	23%	31%
Arges-Vedea	1,740	-9.20%	1580	57%	74%
Ialomita-Buzau	731	-5.80%	688	100%	180%
Siret	2,655	-9.60%	1768	19%	20%
Prut-Bârlad[b]	726	-10.00%	653	60%	81%
Dobrogea[b]	46	-10.00%	41	19%	19%
Danube[c]	20,000	0.00%	20,000	20%	22%
Total[a]	**13,035**	**-14%**	**11,265**	**49%**	**61%**

F. Summary Water demand forecast by River Basin, including Danube - scenario #1

River Basin	Water demand forecast - 2020 (mill. m3)				
	Population	Industry	Livestock	Irrigation	Total
Somes-Tisa	155	92	86	0	333
Crisuri[b]	72	50	38	0	160
Mures	155	722	86	3	967
Banat[b]	83	44	47	0	174
Jiu	114	1,006	63	0	1,182
Olt	163	136	90	4	394
Arges-Vedea	313	432	180	0	926
Ialomita-Buzau	202	162	109	24	496
Siret	198	82	105	12	397
Prut-Bârlad[b]	175	95	95	38	403
Dobrogea[b]	0	0	17	0	17
Danube[c]	78	6,860	25	655	7,619
Total[a]	**1,630**	**2,821**	**917**	**82**	**5,450**

River Basin	Water demand forecast - 2030 (mill. m3)				
	Population	Industry	Livestock	Irrigation	Total
Somes-Tisa	165	114	91	0	369
Crisuri[b]	76	52	41	0	169
Mures	165	804	92	6	1,067
Banat[b]	88	47	50	0	185
Jiu	121	1,051	67	0	1,238
Olt	173	147	96	27	443
Arges-Vedea	332	585	192	34	1,143
Ialomita-Buzau	215	179	116	192	701
Siret	211	89	112	24	436
Prut-Bârlad[b]	186	105	101	84	476
Dobrogea[b]	0	0	18	0	18
Danube[c]	79	9,400	27	1,093	10,598
Total[a]	**1,732**	**3,173**	**975**	**367**	**6,246**

G. Water Demand / Availability - Scenario #1

River Basin	Water availability 2016 (mill m3)	Water forecasts 2050 (mill.		Demand vs. Availability (%)		
		Change	Estimated Stock (mill. m3)	2016	2020	2030
Somes-Tisa	971	2.5%	995	21%	33%	37%
Crisuri[b]	395	-10.00%	356	30%	45%	48%
Mures	1,044	-9.90%	941	69%	103%	113%
Banat[b]	608	-10.00%	547	21%	32%	34%
Jiu	2,109	-11.00%	1877	43%	63%	66%
Olt	2,010	-9.50%	1819	14%	22%	24%
Arges-Vedea	1,740	-9.20%	1580	33%	59%	72%
Ialomita-Buzau	731	-5.80%	688	44%	72%	102%
Siret	2,655	-9.60%	2400	9%	17%	18%
Prut-Bârlad[b]	726	-10.00%	653	36%	62%	73%
Dobrogea[b]	46	-10.00%	41	39%	41%	43%
Danube[c]	20,000	0.00%	20,000	19%	38%	53%
Total[a]	**13,035**	**-9%**	**11,897**	**29%**	**44%**	**53%**

a. The total refers only to internal river basins, and excludes Danube River.

b. The change estimated by the WB team, subject to further confirmation by studies.

c. The water demand in Dobrogea River Basin supplied from Danube River.

Comparing the RBMP values for water demand by river basin with the availability of utilizable resource, one would note that the pressure on all river basins would be much higher and require stronger actions to mitigate the risk of severe water restrictions.

The data base built for this assessment also helped checking whether there is any correlation between the ecological status of surface water bodies and the development of sewerage and waste water treatment facilities in all river basins. During this analysis it was noted that, although the connection rate to sewerage and waste water treatment in Arges-Vedea basin is the highest in the country, this is due to Bucharest which, with 74 percent of population and 95 percent access to such services, is located in this basin. If Bucharest is excluded, the connection rate drops to the country lowest of 16 percent.

In other terms, it was difficult to find a direct correlation between the sewerage connection and ecological status. For example, the ecological status of only 10 percent of surface water bodies in Dobrogea-Litoral basin is good while the sewerage connection rate is over 54 percent (second highest in the country together with Mures). On the other hand, in the Jiu River Basin, the ecological status is the best while the sewerage connection rate is, with 40 percent, below the country average, similar to Prut-Bârlad where only 34 percent of water bodies reach good quality status.

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