

INTOSAI WGEA Work Plan 2017-2019

Project 2.1 (d)

Research Project on Wastewater

EXPOSURE DRAFT

Further information contact: wgea@bpk.go.id

Website: www.wgea.org

Twitter ID: @WGEASecre

Foreword and acknowledgment

Since its start, WGEA has always attached particular interest in water issues. Thus, the theme of water was adopted as the central theme of its work plan for 1996-2001 and the first document was carried out in 2004 on "Auditing water issues", the same document was updated in 2013.

The relevance of the theme remains appropriate, particularly because of the challenges faced by water resources, challenges of scarcity and pollution and abuse in its utilization/consumption. In this context, the WGEA decided, within its current work plan (2017-2019), to carry out a study focusing on certain water related area, that of wastewater and water sanitation.

The issue of wastewater management has become a very interesting field for many SAIs around the world. By auditing wastewater management, the SAIs aim to assist national and local governments to optimize efforts and policies engaged for improve the performance of wastewater treatment and use systems.

In order to be of use to all INTOSAI members, this research paper aims to provide information on wastewater and wastewater management worldwide in a sustainable perspective; identifies opportunities and potential efforts in designing, implementing government policies and developing government programs that provide adequate and effective responses to waste water issues; and provides, based on SAIs experiences, a comprehensive and possible audit topics on wastewater issues and examples of how SAIs have addressed these issues in their audits.

The work on this document was led by the SAI of Morocco. In particular, we would like to acknowledge the efforts of the authors, Mohammed DIYER, Hassan NAMRANI and Abdelkarim JRHILIFA. Many thanks go also to experts from Moroccan water and electricity Office (ONEE) for their excellent support in preparing the paper. Similarly, we would like to acknowledge the contributions made by the SAIs worldwide, especially the project sub-committee members: Chad, China, Czech Republic, Iraq, Lesotho, Malaysia, Nigeria, Philippines, Sri Lanka and United States of America. A special thanks also to the INTOSAI WGEA and its Steering Committee members for their valuable help in various stages of the project.

We hope you will find this research paper useful.

Driss Jettou
First President
Court of Accounts of Morocco
Project Leader

Prof. Dr. Moermahadi Soerja Djanegara, CA, CPA
Chairman
The Audit Board of the Republic of Indonesia
Chair of INTOSAI WGEA

Table of Contents

Foreword and acknowledgment	2
Table of Contents.....	3
Executive Summary	7
Methodology.....	9
Introduction	10
Chapter I: Background on wastewater	11
1. Wastewater definition.....	11
2. Wastewater origins.....	12
2.1 Domestic wastewater: Blackwater and Greywater.....	12
2.2 Industrial Wastewater	12
2.3 Stormwater	12
3. Associated risks of wastewater and their impact.....	12
3.1 Health risks.....	12
3.2 Environmental risks	12
3.3 Risks on economic activities.....	12
4. Wastewater management and treatment.....	13
4.1. Centralized wastewater management.....	13
4.2. Decentralized wastewater management.....	14
4.3. Combined wastewater management.....	14
4.4. The wastewater treatment cycle	15
5. Wastewater as a resource	15
5.1. Agriculture uses: irrigation and fertilization.....	16
5.2. Industry uses	16
5.3. Urban uses	16
5.4. Energy uses	17
Chapter II: Government's responses to wastewater.....	18
1. Wastewater as a component of of the Sustainable Development Goals.....	18
1.1. SDG 6 and wastewater	18
1.2. The relationship between wastewater and others SDGs.....	19
2. Setting up and / or strengthening national legislation and regulatory framework.....	20
3. Institutional aspects (role of national bodies, local government, private sector ...)	21
4. Key Policies and/or programs taken by governments worldwide to address wastewater issues ..	22
4.1 Designing and implementing wastewater policies and/or programs.....	22

4.2. Financial mechanisms and instruments.....	23
4.3. Support to R&D.....	24
Chapter III: Role of International Cooperation in the development of wastewater technologies.....	25
1. International conventions related to wastewater	25
2. Funds to support wastewater projects.....	25
3. Transfer of knowledge.....	26
Chapter IV. Auditing Wastewater	27
1. Overview about wastewater auditing practices.....	27
1.1 Wastewater is a progressive priority for SAIs	27
1.2 Type of audit: The relevance of performance auditing.....	28
2. Wastewater audit topics	28
2.1. Auditing wastewater management and treatment	28
2.2 Auditing specific wastewater programs and projects.....	32
2.3 Linking wastewater to water resources management and safety drinking	36
2.4 Wastewater as component of the sanitation services.....	39
2.5 Wastewater Environmental impact	41
Appendices.....	45
Appendix n°1: Institutional aspects (role of national bodies, local government, private sector ...), based on the mini-survey results.....	45
Appendix n°2: Key policies, programs or measures adopted, based on the mini-survey results.....	48
Appendix n°3: Financial mechanisms and instruments, based on the mini-survey results.....	50
Bibliography.....	51

List of Tables:

- Table n°1: Examples of potential negative impacts of wastewater on human health, the environment and productive activities
- Table n°2: Comparison between centralized, decentralized and combined wastewater management
- Table n°3: Audit Reports on Wastewater Published by SAIs from WGEA Community

List of figures:

- Figure n°1: Wastewater management approaches among WGEA community
- Figure n°2: Wastewater to Energy System
- Figure n°3: Percentage of untreated wastewater in 2015 in countries with different income levels and aspirations for 2030 (50% reduction over 2015 baseline)
- Figure n°4: Are the government policies and programs in line with target 6.3 of SDGs?
- Figure n°5: Has your SAI carry out audits on wastewater issues?

List of Boxes:

- Box n°1: Wastewater in numbers
- Box n°2: The Tamuda-Bay WWTP (Morocco)
- Box n°3: In Morocco: a multi-stakeholder institutional framework to manage wastewater
- Box n°4: Successful Wastewater Management Policy
- Box n°5: The Caribbean Regional Fund for Wastewater Management (CRwW)

Abbreviations and acronyms

AECID	Spanish Agency for International Development Cooperation
AUWSSC	Afghanistan Urban Water Supply and Sewerage Corporation
DENR	Department of Environment and Natural Resources
DOST	Department of Science and Technology
EPHC	Environment Protection and Heritage Council
FAO	Food and Agriculture Organization
GLAAS	Water Global Analysis and Assessment of Sanitation and Drinking-Water
INTOSAI	International Organization of Supreme Audit Institutions
IUCN	International Union for Conservation of Nature
IWMI	International Water Management Institute
LINAW	Local Initiatives for Affordable Wastewater Treatment
MDGs	Millennium Development Goals
NAO	National Audit Office
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
ONEE	Moroccan water and electricity Office
PAB	Pollution Adjudication Board
QMP	Quality Management Plant
R&D	Research and development
SAIs	Supreme Audit Institutions
SDGs	Sustainable Development Goals
SOP	Standard Operating Procedures
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCWA	United Nations Economic and Social Commission for Western Asia
UNICEF	United Nations International Children's Emergency Fund
UNITAR	United Nations Institute for Training and Research
WHO	World Health Organization
WGEA	Working Group on Environmental Auditing
WWDR	World Water Development Report
WWTP	Waste water Treatment Plant

Executive Summary

The objectives of this research paper are: (1) to provide information on wastewater and wastewater management worldwide in a sustainable perspective; (2) to identify opportunities and potential efforts in designing, implementing government policies and developing government programs that provide adequate and effective responses to waste water issues; and (3) to provide, based on SAIs experiences, a comprehensive and possible audit topics on wastewater issues and examples of how SAIs have addressed these issues in their audits.

Based on literature review, it is easy to notice that wastewater has a large number of definitions. However, there is no universally recognized definition between the different actors interested in this concept: (engineers, town planners, researchers, United Nations organizations ...).

It is commonly accepted that wastewater comes from three main sources namely domestic activities, industrial activities and stormwater sources. However, to manage wastewater, there are generally three approaches that are most common. This is about centralized, decentralized and combined management. The choice between these approaches depend upon a number of factors: the nature of the area (urban or rural), the size and density of the population, level of economic development, technical capacity and system of governance in place. Approaches may also vary depending on the services quality required by end-users or required for safe disposal. The mini-survey conducted by the research shows that combined process has become by far the favorite way. Thus 58% among Countries who responded to the questionnaire use this process.

There are a number of opportunities for reusing wastewater as a resource. Properly treated, wastewater can act as a: source of irrigation and fertilization for agriculture, source of affordable water for urban and industry uses and source of energy.

However, the issue of wastewater poses numerous constraints and challenges for public decision-makers. The discharge of untreated wastewater into the natural environment could have negatives, sometimes irreparable, effects on the ecological system, human health and economic activities. For these reasons, public decision-makers have to carry out policies and measures that allowed, on the one hand, the mitigation of the risks generated by wastewater, and on the other hand, the creation of an enabling environment for maximizing the potential of wastewater as a valuable and sustainable resource. These measures have several dimensions, including appropriate legal and regulatory frameworks, effective institutional bodies, policies and programs adapted to the socio-economic context of the country, appropriate funding mechanisms, and the encouragement of research and development in this area.

In this regard, At the national level, many legal and regulatory provisions and policies directly addressing wastewater issue were set up. In this context, it is important to note that the majority of countries have put in place regulatory, and institutional frameworks, programs and or policies. These policies reflect the awareness of public authorities.

At the institutional level, for example, based on the responses to the questionnaire submitted to the WGEA community, it should be noted that, commonly, wastewater governance is split between two levels of institutions: central / federal institutions and local institutions.

At international level, Wastewater issues are gaining increasing importance. Many agreements, whether at global level or regional level, that have been made and ratified could provide an appropriate framework to help countries to promote policy development and the implementation of the necessary measures, regarding wastewater management processes, which should benefit from technology transfer mechanisms, capacity building, and other means of implementation.

In addition, through the responses to the mini-survey conducted among the INTOSAI community, it appears that governments consider UN SDGs Agenda as a good opportunity to give more attention to wastewater issues. Therefore, based on mini-survey results, almost 62% of the SAIs who responded to the questionnaire (31 countries) consider that they are undertaking measures to meet the target 6.3 of Goal 6 about wastewater.

With regards to audit practices, based on responses to the mini-survey submitted to the WGEA community, wastewater appears like an emerging topic for most of SAIs. Indeed, 21 SAIs (almost 42% of the 50 respondents) indicated that they had conducted audits on this field, and 4% of respondents mentioned that they have ongoing audit work on this topic. On another side, several SAIs have indicated that they intend to schedule wastewater audits in the future as part of their annual audit programs.

Therefore, the analysis of the various audit reports of the SAIs (which responded to the questionnaire) and the summary of the reports extracted from the WGEA website made it possible to highlight that the aspects audited touch a wide variety of heterogeneous topics. These topics can be broadly categorized into five major topics: (i) wastewater management and treatment; (ii) wastewater specific programs and projects; (iii) Linking wastewater to water resources management and safety drinking; (iv) wastewater as component of the sanitation services and (v) wastewater environmental impact.

Methodology

To achieve this research project, the adopted methodology is based on the following steps:

1. Literature Review : this includes academic literatures, papers and publication from international organization such as United Nations, World Bank, the Organization for Economic Co-operation and Development (OECD), FAO, UNEP, etc., and any reports recommended by the SAIs;
2. Mini-survey: a questionnaire on wastewater management has been sent, in cooperation with the INTOSAI WGEA secretariat, to WGEA community. 50 SAIs from responded to the questionnaire; a response rate of 64%;
3. Study of Different Countries' Audit Reports: The source of these reports from the INTOSAI WGEA database as well as requesting from SAIs to provide a summary of audit report that had not been inputted in on the database;
4. Discussion Panels with Related Experts manly from Moroccan water and electricity Office (ONEE);
5. Information and case of practices collected by mini-survey to the WGEA members;
6. Information exchange, by email, and by other means of communications, with the members of the subgroup;
7. Workshops and work sessions programmed during the meetings of the WGEA.

Introduction

The UN General Assembly has adopted in 2015 the “2030 agenda”, on Sustainable Development Goals (SDGs), and among them, goal 6 is dedicated to water and sanitation. Target 6.2 provides that "by 2030, provide adequate and equitable access to sanitation and hygiene for all and end open defecation, paying particular attention to the needs of women, girls and vulnerable people ". Similarly, target 6.3 states that "By 2030, improving water quality by reducing pollution, eliminating waste deposits and reducing emissions of chemicals and hazardous materials, by halving the proportion of untreated wastewater and significantly increasing the recycling and reuse of these waters safely, globally ". This emphasis on wastewater in the SDGs is inherent to the fact that global indicators at this level are still low in spite of the efforts made in the implementation of the United Nations Millennium Development Goals (UN MDGs). Thus, the evaluation report of the WHO / UNICEF Joint Program (UN-Water Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS 2015 and GLASS 2017 Reports)) show that only 68% of the world's population has access to sanitation but 2.4 billion people still lack basic sanitation facilities, such as toilets or latrines. Of these, 946 million people defecate in the open air. The proportion of people practicing open defecation globally has fallen almost by half, from 24% to 13%.

In addition, wastewater has become more and more a real worrying source of pollution. This is due in particular to the negative effects resulting, among other factors, from the urbanization, the rapid growth of cities and the unsustainable industrialization. According to the United Nations World Water Development Report (2017), up to 80 % of the global wastewater is being discharged untreated into the world's waterways. This percentage could be largely exceeded in the case of low-income countries, which have only 8% of the required capacity to treat wastewater effectively. The risks and impacts related to the infiltration of the wastewater in waterways are very significant for both human health, biological diversity of aquatic ecosystems and economic opportunities. It is for this reason that policy makers around the world are more aware than ever of the economic, social, health, and environment losses caused by an untreated wastewater. Several countries have started in recent decades to implement national measures and policies specifically dedicated to wastewater management in order to make wastewater a real strategic resource that could be a potential source of water, energy, fertilizer and other valuable materials and services. This trend requires the mobilization of huge funds to finance investment projects that are generally sustainable. As a result, the issue of wastewater management has become a very interesting field for many SAIs around the world. By auditing wastewater management, the SAIs aim to assist national and local governments to optimize efforts and policies engaged for improve the performance of wastewater treatment and use systems.

This paper is structured in four chapters. Foremost, the first chapter is dedicated to background on wastewater, associated risks and wastewater management; the second chapter identifies best practices on wastewater management worldwide and the opportunities and potential efforts in designing and implementing development policies that provide adequate and effective responses to wastewater issues and explore about what types of instruments used at the national and international level in this field. The third chapter discusses the role of international cooperation in the promotion and development of solutions and technologies for optimizing the management and use of wastewater through three mechanisms, namely, international conventions and treaties, mobilization of funding and knowledge transfer. Finally, in the fourth chapter, based on SAIs experiences, relevant audit topics on wastewater issues are identified. SAIs experiences give emphasis how they effectively play their roles to ensure that instruments and government programs and policies work through the use of case studies.

Chapter I: Background on wastewater

In a world where the demand for freshwater is constantly increasing, and where limited water resources are under constant pressure and constraints, it has become unthinkable to neglect the opportunities offered by wastewater reuse. As such, wastewater will not be managed as "waste". It needs to be seen as a resource, rather than a burden to be disposed of. They are potentially a sustainable and affordable source of water, energy, nutrients, organic materials and other valuable by-products throughout the year. According to The United Nations WWRD (2017), for successful wastewater reuse, it is important to move from the "treatment and disposal" wastewater management paradigm to one based on "reuse, recycling and resource recovery". The objective of this chapter is to clarify the concept of wastewater, its origins and its potential risks. It also aims to address the various opportunities made possible through the reuse of wastewater.

1. Wastewater definition

From the literature review on the topic of wastewater, it is easy to notice that wastewater has a large number of definitions. But, there is no universally recognized definition between the different actors interested in this concept: (engineers, town planners, researchers, United Nations organizations ...). Each actor approaches this concept with a perspective and vocabulary specific to him. In addition, it must be recognized that wastewater is sometimes confused with other neighboring terms such as 'reused water', 'recycled water' and 'reclaimed water'. In general, wastewater can be defined as the byproduct of many uses of water. For USA EPA, wastewater is "water that has been used and contains dissolved or suspended waste materials". In the same vein Culp and Culp (1971) equate wastewater as water that has been adversely affected in quality by anthropogenic activity.

In a broader perspective, Corcoran et al (2010) proposes to define wastewater as "a combination of one or more of: domestic effluent consisting of blackwater (excreta, urine and faecal sludge) and greywater (kitchen and bathing wastewater); water from commercial establishments and institutions, including hospitals; industrial effluent, stormwater and other urban run-off; agricultural, horticultural and aquaculture effluent, either dissolved or as suspended matter". Given its broader and more inclusive character, this definition remains by the most answered in the reports of many international and UN organizations.

Box n°1:

1. The Wastewater is roughly composed of 99% water and 1% suspended, colloidal and dissolved solids. **(WWRD; 2017)**
2. Globally, over 80% of the wastewater generated by society flows back into the ecosystem without being treated or reused. **(WWRD; 2017).**
3. *1.8 billion people use a source of drinking water contaminated with faeces, putting them at risk of contracting cholera, dysentery, typhoid and polio. Unsafe water, poor sanitation and hygiene cause around 842,000 deaths each year. (WHO/UNICEF; Progress on drinking water and sanitation: 2014 update).*
4. Worldwide, the annual capital expenditures on wastewater infrastructure by utilities have been estimated at US\$104 billion **(Heymann and al., 2010).**
5. For every US\$1 spent on sanitation, the estimated return to society is US\$5.5. **(WWRD; 2017).**
6. In 2010, the FAO estimated that 10% of the world's population consume crops produced with sewage. This figure up to 80% in Vietnam. **(Winpenny and al; 2010).**

2. Wastewater origins

In general, wastewater comes from three main sources namely domestic activities, industrial activities and stormwater sources.

2.1 Domestic wastewater: Blackwater and Greywater

Domestic wastewater includes two main types: greywater and blackwater. Greywater is wastewater from the hand basin, shower, spa bath, washing machine, laundry tub, kitchen sink and dishwasher. Blackwater is wastewater containing, or likely to be contaminated by, human waste matter (e.g. toilet wastewater or waters contaminated by toilet wastewater).

2.2 Industrial Wastewater

All discharges resulting from non-domestic water use are classified as industrial releases. This definition concerns the discharges of factories, that is to say, water discharged after being used in, or produced by, industrial production processes. It also concerns the discharges of artisanal, commercial and institutional activities. These waters have a wide variety and can be toxic to aquatic life, or to humans.

2.3 Stormwater

Stormwater is water from rain and other sources that drains into a street drainage system where it flows to streams and creeks. It is, in fact, runoff water (rainwater, irrigation water, runoff from roads, washwater gutters, markets ...).

3. Associated risks of wastewater and their impact

Around the world, most of the wastewater is directly discharged into the environment without any treatment or proper treatment. Since the wastewater contains a number of pollutants and contaminants (e.g. nutrients, hazardous substances and pathogenic microorganisms: viruses, bacteria, protozoa and helminths), the consequences of the emission of untreated or poorly treated wastewater are alarming. According to UNEP, these consequences can be classified into three categories: (i) adverse effects on human health; ii) negative impact on the environment; and (iii) adverse effects on economic activities.

3.1 Health risks

Untreated wastewater can cause many diseases including cholera and some neglected tropical diseases, such as dengue fever, dracunculiasis and schistosomiasis. These diseases result from poor containment, leakage during emptying and transport, and inefficient treatment of wastewater. The risk affects not only workers who have direct contact with wastewater, but people who come into direct contact with water through drinking, bathing, or recreation. Also, consumers of food products from areas irrigated by wastewater can have indirect effects of poor or no wastewater treatment (WHO, 2006).

3.2 Environmental risks

Water safety is the most vulnerable aspect to the risks associated with the non-treatment of wastewater. The latter further promotes the degradation of the quality of surface water and groundwater worldwide, which in turn affects the amount of water resources available for direct use. In addition, the infiltration of contaminants and wastewater-borne pollutants into the natural environment causes disastrous damage to ecosystems and biodiversity. For example, the release of nitrogen, phosphorus and potassium can accelerate the eutrophication of freshwater resources and coastal marine ecosystems. Most large lakes in Latin America and Africa have increased anthropogenic phosphorus loads, which can accelerate eutrophication processes.

3.3 Risks on economic activities

The negative effects of wastewater do not only concern aspects of human health and the environment, but can also extend to negatively impact on economic activities. Poor water quality hinders agricultural productivity in rural and peri-urban areas. Pollutants (heavy metals, pesticides)

contained in wastewater promote phytotoxicity, which sometimes has a toxic effect on plant growth. Worse, contaminated water can directly affect water-consuming economic activities, such as industrial production, fisheries, aquaculture and tourism (UNEP, 2015), and may indirectly limit the export of certain commodities because of restrictions (or even prohibitions) on contaminated products. Water can indirectly affect the economy by lowering worker productivity through illness, hospitalization, or time taken to care for those who are ill from water borne diseases. In the seas and oceans, deoxygenated dead zones caused by untreated sewage discharge are increasing at a sustained rate, affecting approximately 245,000 km² of marine ecosystems, impacting marine fishing activities (Corcoran et al., 2010). In short, untreated sewage is a further obstacle to the economic development of countries. The table n°1 below summarizes all the risks mentioned above.

Table 1: Examples of potential negative impacts of wastewater on human health, the environment and productive activities (UNEP, 2015)

Impacts on:	Examples of Impacts
Health	Increased burden of disease due to reduced drinking water quality
	Increased burden of disease due to reduced bathing water quality
	Increased burden of disease due to unsafe food (contaminated fish, vegetables and other farm produce)
	Increased risk of diseases when working or playing in wastewater-irrigated area
	Increased financial burden on health care
Environment	Decreased biodiversity
	Degraded ecosystems (e.g. eutrophication and dead zones)
	Bad odors
	Diminished recreational opportunities
	Increased GHG (Greenhouse Gas) emissions
Economics activities	Reduced industrial productivity
	Reduced agricultural productivity
	Reduced market value of harvested crops, if unsafe wastewater irrigation
	Reduced number of tourists, or reduced willingness to pay for recreational services
	Reduced fish and shellfish catches, or reduced market value of fish and shellfish

4. Wastewater management and treatment

According to UN-Water (2015), wastewater management is the process of taking wastewater and treating/managing it in order to reduce the contaminants to acceptable levels so as to be safe for discharge into the environment. There are many wastewater management approaches available. However, there are generally three approaches that are most common. This is about centralized, decentralized and combined management. The choice between these approaches depend upon a number of factors: the nature of the area (urban or rural), the size and density of the population, level of economic development, technical capacity and system of governance in place. Approaches may also vary depending on the services quality required by end-users or required for safe disposal.

4.1. Centralized wastewater management

The Centralized wastewater approach is the traditional solution of the problems associated with wastewater. Most of the wastewater management in in well-developed urban environments has relied on centralized systems. It is a collective system that collects wastewater from a large number of users using a relatively large diameter collector, and then transports the wastewater over long distances through a pipe system to one (or more) centralized treatment plant. The treated effluent is typically discharged to a surface stream at one location. The treated is disposed in different ways,

most often discharged into natural water bodies. The treated effluent may also be used for useful purposes and in this case, it is referred as reclaimed water.

Centralized management benefits from economies of scale, but it may no longer be the most viable solution for wastewater management in many countries. It is expensive and difficult to adapt to different socio-economic situations. To keep the collection and treatment system operating properly, a large capital investment in infrastructure (large areas of land, large treatment plants, large diameter sewer lines, pump stations, etc.) is needed. Collection costs alone account for more than 60% of the total wastewater management budget in a centralized system, especially in low population density communities (Massoud and al., 2009). In addition, collection and processing systems require yearly a significant operation and maintenance requirements (trained full-time operators, power costs, equipment/infrastructure repair, solids handling, etc.).

4.2. Decentralized wastewater management

According to Tchobanoglous (1995), the decentralized wastewater management is defined as the collection, treatment, and disposal/reuse of wastewater at or near the point of wastewater generation. The use of wastewater at its source, or as close as possible to its source, generally improves the cost-effectiveness ratio due to the low cost of transportation. They also help recover nutrients and energy, save fresh water, and help make water access safer in times of scarcity. Decentralized systems often serve small estates, scattered and low-density communities and rural areas.

Decentralized wastewater management can be a reliable alternative to centralized wastewater management. It helps to offset some logistical and financial problems caused by centralized networks. According to WWRD (2017), it is estimated that investments in these processing facilities cost only 20-50% of those of conventional treatment plants, and their operating and maintenance costs are even lower (around 5 to 25% of conventional sludge treatment plants). However, it should be mentioned that decentralized systems have some limitations that make it difficult to optimize the exploitation of their benefits. On the one hand, to cover the main points of the city, decentralized systems remain a difficult solution to support financially (both for infrastructure and for maintenance) by the state / municipal budgets. On the other hand, because they are located near communities, this increases the risk that they become a potential pollution point in urban areas (especially in vulnerable areas).

4.3. Combined wastewater management

The combined wastewater management is a third way that aims to combine in a complementary way the advantages of both the centralized approach and the decentralized approach. Currently, many towns and cities, especially in developing countries, have begun to combine wastewater management systems (Hawkins and al; 2013). This can be at the initiative of householders or developers as it can be done by the municipality or utility. The combined approach is to link different centralized and decentralized systems as part of a group of interconnected systems. The ultimate goal is to cover large areas at an appropriate scale (as is the case in the centralized system), while benefiting from the advantages of decentralization, such as limited investment, reduced operating, maintenance costs, and a possibility of adaptation to local conditions. The table n°2 below illustrates the points of convergences and divergences between the approaches mentioned above.

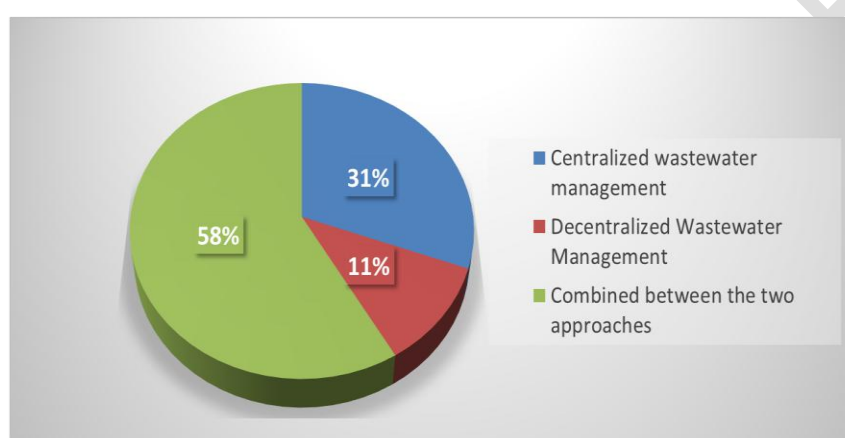
Table n°2: Comparison between centralized, decentralized and combined wastewater management

Centralized System	Decentralized System	Combined System
Discharge system	Can be a non-discharge system	Individual on- site

located far from wastewater source	at or near the point of wastewater generation	at the point of wastewater generation
Capital intensive required	Less capital required	limited capital required
Higher costs of maintenance	less maintenance costs	lower costs of maintenance.
Sufficient volume for reuse	Ability and access to potential water reuse options	Ability and access to potential water reuse options

The mini-survey results show that combined process has become by far the favorite way. Thus 58% among Countries who responded to the questionnaire use this process. This trend is due mainly to the advantages Offered by this process in terms of time, energy and costs, while producing positive externalities for the end user and the environment.

Figure n°1: Wastewater management approaches among WGEA community



4.4. The wastewater treatment cycle

Treating wastewater means removing pollutants and contaminants from the water before it is returned to the natural environment or reused. Four to five major steps are needed:

- **Pre-treatment (or preliminary treatment):** aims to remove from the water floating materials, such as rags, sticks ..., which can damage the technical installations during the treatment process;
- **The primary treatment:** allows to remove the materials (solid or organic) suspended in the wastewater;
- **Secondary treatment:** aims to remove biodegradable organic matter, suspended solids and nutrients (nitrogen and / or phosphorus), as well as bacteria;
- **Tertiary treatment:** aims to remove residual suspended solids after secondary treatment. This is the case of phosphorus and certain pathogens;
- **Quaternary treatment:** allows to disinfect the water of micropollutants whose conventional treatment processes (primary, secondary and tertiary treatment) can not eliminate them, such as, for example, drug residues, hormones, pesticides ...

5. Wastewater as a resource

There are a number of opportunities for reusing wastewater as a resource. Properly treated, wastewater can act as a: source of irrigation and fertilization for agriculture, source of affordable water for urban and industry uses and source of energy. However, untreated or poorly treated wastewater can contain heavy metals, bacteria, viruses, and other contaminants that need to be removed in order for reuse to be appropriate.

5.1. Agriculture uses: irrigation and fertilization

Irrigation is the major form of reuse of treated, untreated or partially treated wastewater throughout the world. It has been practiced for centuries. It is able to provide a reliable source of irrigation water for farmers. This practice is highly successful in urban and peri-urban areas, where wastewater is readily available, generally free, and where there is a nearby market for agricultural products.

Similarly, wastewater irrigation can in most cases provide all the nutrients (nitrogen, phosphorus ...) required for crop fertilization. The value of these substances has long been recognized by farmers around the world, which will help reduce (or eliminate) additional fertilizer requirements for some crops, resulting in increased income for farmers. In addition, the use of nutrients in the water reduces the environmental impacts associated with phosphorus mining and the production of artificial fertilizers.

5.2. Industry uses

Industrial reuse of wastewater is currently a technical and economic reality. It consists of recycling industrial wastewater for industrial purposes (as manufacturing water) and non-industrial wastewater (watering, non-drinking urban uses, etc.). In some countries, the industrial sector may also use treated municipal wastewater.

The largest consumers of wastewater are thermal and nuclear plants (cooling water), the textile industry, the paper industry, petroleum refineries, steel mills, as well as heating and air conditioning. Recently, new applications are also emerging for the reuse of industrial water, such as the use of treated wastewater as cooling water in large data centers. This is the case of Google, which has equipped its sites in Belgium and Georgia, in the United States, with cooling facilities based on the reuse of wastewater (WWDR, 2017).

5.3. Urban uses

The reuse of treated wastewater for urban purposes is developing rapidly and is becoming a cornerstone of integrated water management in large cities. In urban areas, reclaimed wastewater has been used mainly for non-potable applications.

The expected benefits are enormous. Urban uses of wastewater promote the reduction of the demand for drinking water that can reach 10-15% or even 40% in residential areas equipped with large areas of green space (Miller, 1990). The most common uses are the irrigation of green spaces (parks, golf courses, sports fields, recreation centers), landscaping (waterfalls, fountains, water bodies), washing of streets or vehicles and protection against fire. Another important application is building recycling with, for example, the use of treated household water for sanitary washing. The following box n°2, which deals with Tamuda-Bay in Morocco, illustrates the benefits of reusing wastewater for urban purposes.

BOX 2: THE TAMUDA-BAY WWTP (MOROCCO)

The Tamuda Bay wastewater Treatment Plants is part of the National Water Plan, which includes the installation of 300 WWTP in the 2025 Horizon. It is an average activated sludge type WWTP and treats wastewater, sludge and odors. It has been operational since July 2016. It has a pumping station with a capacity of 130 liters / s, a water storage tank with a capacity of 2,500 m³ and 20 km of pipes of delivery and distribution of various diameters. With a treatment capacity of up to 9 million m³ / year, the main purpose of this WWTP is to irrigate the green areas of the Mdiq-Fnideq zone, which will ensure a conservation saving of 2 million m³ of water per year.

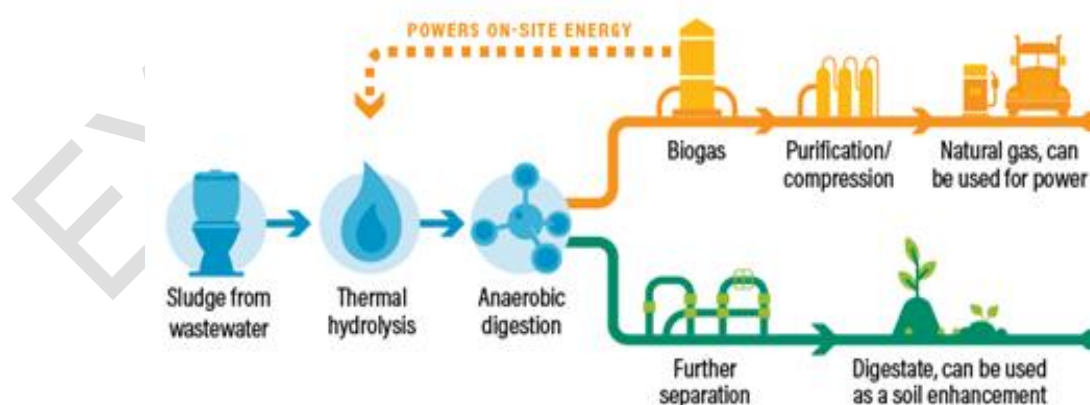
The volumes currently consumed between the two towns of M'diq and Fnideq are of the order of 30,000 m³ / month, particularly during the summer period, which represents about 10% of treated wastewater. The volume of sludge discharged from this WWTP is estimated at 4,230 m³ in 2016. As part of the sustainable development efforts, the Tamuda Bay WWTP has been equipped with a cogeneration unit to reduce 2,000 tons / year of greenhouse gases and to cover the equivalent of 35% of the needs of this WWTP in terms of electricity, to this is added the sludge recovery unit fertilizer product that will generate 9.5 tons / day of digested sludge.

Finally, it should be noted that the notable success of this station will encourage the transition to the extension phase to water the golf courses and green spaces in the cities of Tetouan, Martil and Cabo Negro with treated wastewater.

5.4. Energy uses

Wastewater has become a significant source of energy. Thanks to the treatment processes of sludge/biosolids of wastewater by anaerobic digestion, it has become possible to recover the chemical, thermal and hydraulic energy of wastewater in the form of biogas. Chemical energy consists of producing electricity through the biogas generated from the organic substances of wastewater. For thermal energy, it is based on the extraction of heat contained in wastewater for space heating or cooling. While hydropower is made possible by the production of electricity by installing turbines in wastewater flows. Due to this technology, several factories around the world have been successful in recovering the energy offered by wastewater. Some others have been able to transition to energy neutrality, or even become net energy producers. This is the case of the Terneuzen factory in the Netherlands (*World Water, 2013*).

Figure n°2: Wastewater to Energy



System

Source: World Resources Institute

Chapter II: Government’s responses to wastewater

The issue of wastewater poses numerous constraints and challenges for public decision-makers. The discharge of untreated wastewater into the natural environment could have negative, sometimes irreparable, effects on the ecological system, human health and economic activities. For these reasons, public decision-makers have to carry out policies and measures that allowed, on the one hand, the mitigation of the risks generated by wastewater, and on the other hand, the creation of an enabling environment for maximizing the potential of wastewater as a valuable and sustainable resource. These measures have several dimensions, including appropriate legal and regulatory frameworks, effective institutional bodies, policies and programs adapted to the socio-economic context of the country, appropriate funding mechanisms, and the encouragement of research and development in this area.

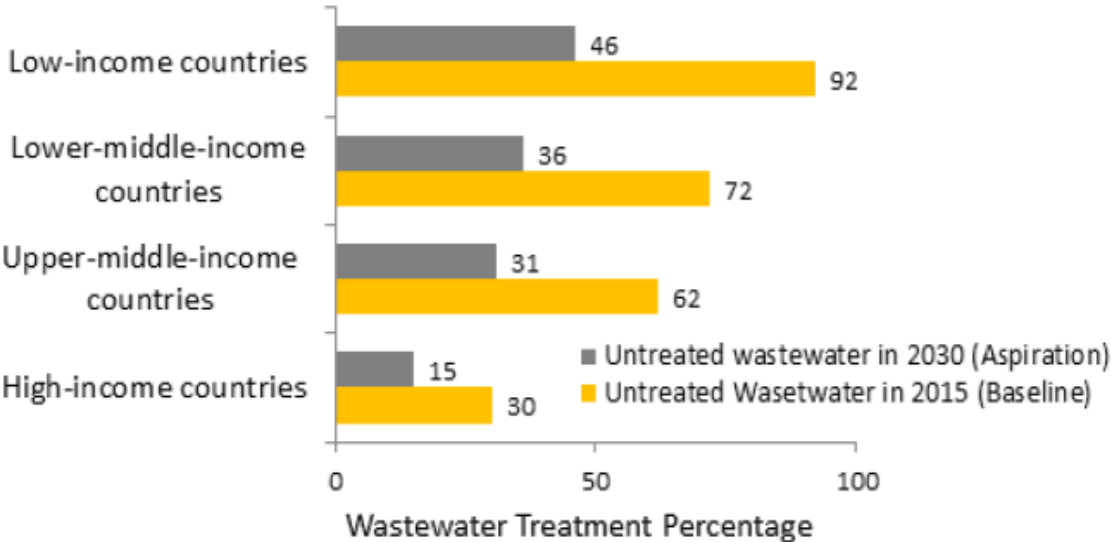
1. Wastewater as a component of of the Sustainable Development Goals

On 25 September 2015, 193 leaders of the Member States of the United Nations General Assembly met in New York to adopt the 2015-2030 Sustainable Development Program. It is based on a set of 17 goals to be achieved in order to eradicate poverty, protect the environment and ensure prosperity for all. With respect to water, the experience of previous UN program on the MDGs has shown that beyond the issues of supply and sanitation, a broader, more detailed and context-specific goal is needed for wastewater. This answer was provided by the Target 6.3 of Goal 6 of the SDGs; that invites policy makers to take full advantage of the benefits and opportunities offered by wastewater management.

1.1. SDG 6 and wastewater

The target 6.3. requires that by 2030 to “improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.” Figure n°2 below shows the expectations to be met for each category of countries.

Figure n°3: Percentage of untreated wastewater in 2015 in countries with different income levels and aspirations for 2030 (50% reduction over 2015 baseline)



Source: WWRD 2017

To facilitate monitoring of progress towards SDG 6; Target 6.3, two global level indicators have been proposed:

- 6.3.1 Proportion of wastewater safely treated: Safely treated wastewater generated by households (sewage and faecal sludge) and economic activities (e.g. industries) in proportion to total wastewater generated by households and economic activities;
- 6.3.2 Proportion of bodies of water with good ambient water quality: Proportion of water bodies (area) in a country with good ambient water quality compared to all water bodies in the country. 'Good' indicates an ambient water quality that does not damage ecosystem functions and human health according to core ambient water quality indicators.

Therefore, the completion of target 6.3 will largely contribute at the 2030 horizon to advanced pollution source reduction, the removing contaminants from water flows wastewater, the reuse of reclaimed water and the recovery of useful by-products. These entail social, environmental and economic benefits for society as a whole, and contribute to overall well-being and health, as well as to sustainable development.

1.2. The relationship between wastewater and others SDGs

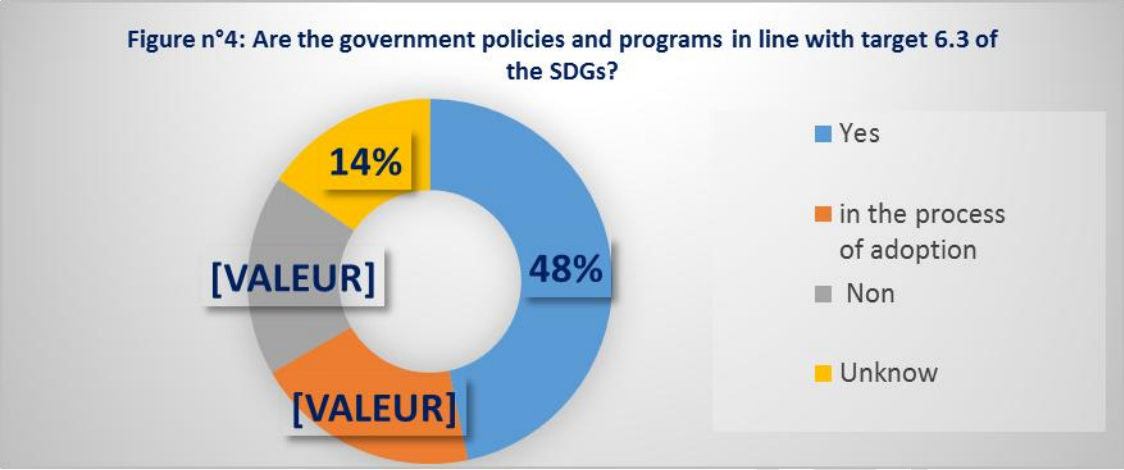
According to the United Nations WWDR 2017¹, the achievement of Target 6.3 is a precondition to the achievement of other SDGs and the overarching goal of eradicating poverty. Appropriate wastewater collection and treatment helps also to protect the water quality in river basins and the goods and services that these provide, while significantly reducing the number of people exposed to water-related diseases (SDG 3; Targets 3.3 and 3.9), providing related health and economic benefits and contributing to poverty alleviation (SDG 1; Targets 1.1 and 1.2).

Investing in wastewater management would provide particularly high returns by breaking the link between unsafe water and diseases that causes healthy problems, particularly in developing countries. Therefore, improved sanitary conditions and wastewater management contribute to the success of nutrition enhancement strategies (SDG 2; Target 2.2), reduces preventable deaths among children (SDG 3; Target 3.2) and enhances children's attendance and performance in school (SDG 4; Target 4.7). Reducing the burden of disease also reduces the time spent taking care of sick family members, leaving more time to participate in the formal economy (SDG 8) and in social and political decision-making. Women, who are often the main caregivers and who are responsible for the water supply within households, would also benefit from improved sanitation conditions and wastewater management, as they are frequently responsible for the management and use of greywater or wastewater in agriculture. Inclusive and gender sensitive water management policies also support the achievement of gender equality (SDG 5).

Improved wastewater treatment and the increase in water reuse, as called for in SDG Target 6.3, will support the transition to a circular economy by helping reduce water withdrawals and the loss of resources in production systems and economic activities. The exchanges of energy, water and material flows in wastewater by-products can allow businesses to enhance their environmental performance and competitive capacity. These exchanges are often mutually beneficial, favoring a reduction in production costs, water consumption and/or wastewater treatment costs (SDG 8; Targets 8.2 and 8.4). Building climate-resilient wastewater infrastructure networks can decrease the direct economic losses caused by disasters (SDG 11; Target 11.5), while increasing the capacity of human settlements to recover from natural hazards such as floods and droughts (SDG 13; Target 13.1). Improved wastewater management also has great potential for reducing GHG emissions (SDG 13; Target 13.2). Wastewater can be considered a reliable source of water in the planning and development of new settlements and water resource projects (SDG 11; Target 11.6). Globally, the achievement of SDG 6; Target 6.3 also contributes to the reduction of land-based pollution in terrestrial and marine ecosystems (SDGs 14 and 15).

¹ <http://unesdoc.unesco.org/images/0024/002471/247153e.pdf>

Finally, through the responses to the mini-survey conducted among the INTOSAI community, it appears that governments consider UN SDGs Agenda as a good opportunity to give more attention to wastewater issues. Therefore, based on mini-survey results, almost 62% of the SAIs who responded to the questionnaire (31 countries) consider that they are undertaking measures to meet the target 6.3 of Goal 6 about wastewater.



2. Setting up and / or strengthening national legislation and regulatory framework

The introduction of legal and regulatory provisions directly addressing wastewater issue is one of the main measures that help to reflect the level of political commitment to promote and regulate activities related to wastewater management. It is, in fact, a framework that generally relates to the use of permits and licenses, the application of emission and quality standards for wastewater, or zoning for the use of land (Sterner, 2003). The regulations also govern the establishment of collection systems and treatment facilities by setting appropriate standards for treatment and reuse for different purposes. In some cases, the regulation may also be "economic", that is used in urban services, which includes the supply of drinking water and the management of municipal wastewater.

Because the issue of wastewater is inseparable from the water issue, the majority of countries, according to the results of the mini-survey, prefer to address the legal aspects governing wastewater under the national laws of water. This is the case, for example, of Morocco where the entire water sector, including wastewater, is governed by Law 10-95 of the 20th of September 1995, commonly referred to as the "Water Act" which provides the framework for managing and creating the necessary tools for its implementation. Other countries have decided to adopt specific laws for wastewater. In this context, Russia passed in 2011 Federal Law No. 416-FZ, which regulates the issue of "water supply and wastewater disposal". In Australia, several States have set targets for wastewater use, and the Australian government provides detailed guidelines for water reuse (NRMCC / EPHC / NHMRC, 2009). For its part, New Zealand has a statutory / regulatory framework governing wastewater management, with several Acts of Parliament in place to regulate environmental and health effects of waste disposal and the Local Government Act 2002 their territories (cities and districts). At the Arab country level, at least 11 out of 22 Arab states have enacted legislation allowing for the use of treated wastewater developed by national bodies responsible for the use and disposal of wastewater (WHO, 2006). Some studies suggest that regulation of wastewater management could have a positive ripple effect in promoting private investment in wastewater. Spiller and al. (2012) looked at how the European Water Framework Directive is stimulating change in water and wastewater management by water and sewerage companies in England and Wales.

3. Institutional aspects (role of national bodies, local government, private sector ...)

National regulations and legislation alone are no longer sufficient to address the challenges posed by wastewater. It is also necessary to build an institutional framework that is homogeneous, effective and capable of transforming the measures taken by the public authorities into real actions in practice. Based on the responses to the questionnaire submitted to the WGEA community, it should be noted that, commonly, wastewater governance is split between two levels of institutions: central / federal institutions and local institutions.

Box n°3: In Morocco: a multi-stakeholder institutional framework to manage wastewater

The institutional framework governing the wastewater issue is made up of several heterogeneous actors. The Ministry of Equipment, Transport, Logistics and Water, responsible for the management, protection as well as for the quantitative and qualitative monitoring of water resources, happens to be a major factor in the water sector. As for the Ministry of Agriculture, it has reserved for itself the upper hand on irrigation. The Ministry of the Interior (MI), is the custodian of local communities and on the relevant modules the latter are managing, with respect to DWS and sanitation services, besides the ONEE. In addition, the Ministry of Interior oversees the implementation of the NAP (National Water Sanitation and Cleansing Plan). The Ministry of Economy and Finance has also an important role to play, as it finances investments through the state budget. Other ministries are involved according to their specificity: The Ministry of Health, through its mission of protecting public health; the Ministry of Trade and Industry, as the custodian of the Moroccan Department of Industrial Standardization (SNIMA), in charge of standardization.

In addition, there have been created over the years several organizations, placed under the supervision of the ministries, meant to become the tools of implementation of policies on the ground: the Water Basin Agencies (ABH), the National Agency for Energy and the Water (ONEE), ORMVA (Regional Office for the Agricultural Development, dealing with irrigation), the National Agency for Sanitary Safety of food products (ONSSA) (which ensures the quality of products of Wastewater Reuse (REU), the Superior Council for Water and Climate (CSEC) (advisory volume for the planning of water resources management) , etc.

Although the state is highly centralized, part of the water management is delegated to the Water Users Associations (WUA) – as far as water used for agricultural applications is concerned - or to the Local Government Units (Communes) – as far as AEP and sanitation applications are concerned; decentralization at the provincial level (Provincial or Prefectural Water Committees) has been provided for, for planning at the level of river basins (ABH) as well as for the management and protection of the resource.

Sources: adapted from “Review and analysis of the status of the implementation of strategies and / or action plans for wastewater- National report for morocco executive summary” (2013).

In the first level, wastewater management is assigned to one or more institutions that can be either a water authority or an environmental entity. Among the countries that embrace this perspective is Afghanistan, which has entrusted wastewater management to AUWSSC, which is responsible for managing the wastewater. In the case of FIJI, the Water Authority of Fiji has the responsibility for efficient and effective water supply and sanitation. As for Costa Rica, responsibility is shared between The Ministry of Health and the Institute of Aqueducts and Sewers. For Peru, Philippines and Thailand, the responsibility is spread over several ministerial departments and organization. This is also the case in Morocco as shown in Box 3 above.

Other countries have chosen to entrust the governance of wastewater at the local level, such as in the case of Brazil, Estonia and New Zealand. Concerning Brazil, for example, the local government (municipality) is responsible for formulating and implementing the local sanitation policy, which includes: the drafting of the basic sanitation plan; the provision (or delegation) of the service; the definition of the regulatory entity; the adoption of water quality standards that are protective of human health; the establishment of rights and duties of users; the establishment of social control mechanisms; and the establishment of an information system, which must be articulated with the federal system. For the case of Estonia, the local governments are responsible on collecting and

treating domestic wastewater; industrial companies have to treat their wastewater; National authorities give and control permits for wastewater treatment.

Lastly, it should also be noted that some countries adopt an hybrid institutional framework that combines central and local levels. That is the case of France, Greece and Pakistan. [Appendix n°1 presents in detail the different models of wastewater governance based on the mini-survey.](#)

4. Key Policies and/or programs taken by governments worldwide to address wastewater issues

4.1 Designing and implementing wastewater policies and/or programs

Certainly, wastewater management is expensive and capital-intensive, but all available evidence suggests that the costs of inadequate investment are far greater in terms of actual money spent and also both direct and indirect damages to health and socioeconomic development. In order to create a sustainable system, policies are needed to support more effective waste-water-pricing systems that permit sufficient cost recovery, ensure adequate investments and support long- term operation and maintenance (UN-Water, 2011).

With regard to the mini-survey results, in Jordan, for example, the issue of wastewater is addressed in national water policies and plans. It is also the same model that was adopted by Tunisia (WWDR, 2017). Jordan adopted the "Water Substitution and Reuse Policy" in February 2016, a formal policy that formalizes the use of treated wastewater and provides tariff plans for the use of treated wastewater and mixed treated wastewater. It was accompanied by another policy on decentralized wastewater management to serve small communities, an important step given that wastewater accounts for nearly 15% of available water resources in Jordan (UNESCWA, 2015). For Bahrain, wastewater management schemes are included in both the national water plan and the national environment strategy. In the case of Morocco, national priorities for wastewater are set by The National Plan for Water -based strategy with a 2030 perspective. According to this plan, Morocco aspires to the reuse of 325 million m³ of wastewater by 2030 which will contribute to the relief of the water deficit which will reach 5 billion m³ / year in 2030. Also, besides The National Plan for Water, Morocco has other plans and programs related to wastewater, the most important of which are: The National Water Sanitation and Cleansing Plan, currently under revision, providing, among other, for actions aiming at reaching 300 Wastewater Treatment Plants (STEP) by 2025; The National Household Waste Plan (PNDM), embarking on a 15-year horizon (but as yet not accounting for the STEP-generated sludge); The "Green Morocco" Project, embarking on objectives spanning through to the year 2020 and comprising a significant component for irrigation and water conservation; The Water Resources Integrated Development Master Plans (PDAIRE), prepared by each ABH for its respective basin, harboring a long-term vision, subject to reviews on a five-year basis; Communal Development Plans, resulting from the obligation of each municipality to develop such plans every three years, in particular as regards investments for the ASP and Sanitation.

Costa Rica has recently adopted a national strategy based on three pillars: the National Wastewater Treatment Policy 2016-2045, the National Program for the Management of Wastewater, and the Framework Cooperation Agreement between Ministry of Environment, Ministry of Health and the AyA, which regulates matters to allow compliance with wastewater regulations. For some countries of Europe (e.g. Bulgaria, Czech Republic, Estonia, Lithuania, Slovakia), the measures taken are based on the Program for the implementation of Directive 91/271/ EEC on urban wastewater treatment. The Philippines has launched a national policy based on "The Local Initiatives for Affordable Wastewater Treatment" (LINA) project promoted installation of decentralized wastewater systems

that apply innovative, low-cost technologies tailored to a community's resources and needs. Based on results of the mini-survey, detailed examples, about countries experiences, are provided in the Appendix n°2.

Box n°4: Successful Wastewater Management Policy

To successfully align wastewater management policy in support of sustainable development and the SDGs, the following strategies and practices are recommended:

- Passage and/or establishment of legislation, norms, standards (effluents, Standard Operating Procedures; SOP, Quality Management Plant; QMP) and subsidiary regulations (including a legislation in compliance with relevant obligations under international law), along with implementation, compliance, and enforcement actions to ensure their effectiveness;
- Clear delineation of roles, responsibilities and mandates among supporting actors (e.g. national and local authorities, operators, producers, importers) and adequate allocation of resources, authority, and power to fulfill these responsibilities (including sub-national or regional cooperation mechanisms);
- Monitoring of progress and gathering and publication of data and information;
- Providing appropriate support for all cooperating institutions and ensuring effective coordination among them all;
- Establishing protocols for the equitable sharing of technologies and best practices, and where appropriate, facilitating regional cooperation;
- Coordination with other relevant sustainable development policy areas, e.g. trade policy;
- Link to supporting frameworks for wastewater reduction, and for materials recovery and recycling operations (e.g. extended producer responsibility agreements or regulations);
- Creating systems of tariffs, fees, taxes and financial incentives that support the sector, such as providing necessary investments, or avoiding perverse subsidies;
- Creating pilot programmes and technical support/exchange initiatives to assist local implementation;
- Passage of appropriate regulation and control of private sector and household behavior;
- Building of inclusive community participation mechanisms;
- Education and publicity programs to change public attitudes and behavior;
- Maintaining programs to develop and maintain a body of skilled and committed waste management workers, not only in the waste management industry itself but also in government (at all levels) and in those organizations that are major generators of waste;
- Ensuring institutional mechanisms for review and reform of any of the above actions.

Source: UNEP and UNITAR, 2013

4.2. Financial mechanisms and instruments

Governments can mobilize mechanisms that are part of the so-called market-based environmental policy instruments (MBIs). This approach offers to government the choice between several alternative tools based on market power and competition to achieve environmental objectives. In other words, MBIs allow the government to orient producers and consumers with incentives to change their behaviors and look for more effective ways of making environmental progress, while giving them flexibility in how they do so. According to WGEA study on “Market Based Instruments for Environmental Protection and Management” (2016), the most commonly used MBIs are: environmental taxes and charges, tradable permits, deposit refund systems, environmental subsidies and incentives and other market-based instruments, such as liability schemes, green public procurement and labelling schemes.²

However, for the UN-WATER (2017) traditional financing sources still commonly categorized as the 3Ts, namely: taxes, tariffs and transfers. For taxes, it is a question of applying special taxes on the polluter (in accordance with the polluter-pays principle). Regarding mini-survey results, France,

² For more details about MBIs, see the WGEA study in the link below: https://www.environmental-auditing.org/media/5370/wgea-instrument-protection-and-management_isbn-ok.pdf

Kuwait and Russia are among the countries that have implemented such taxes, in particular, for discharges of pollutants into water bodies, as well as adjustment of the amount of the fee (deducting the cost of implementing measures to reduce the negative impact on the environment). With regard to financing via tariffs, they consist in charging the wastewater treatment charges and invoices to the user himself. This is the case of New Zealand, Jordan and Thailand where local authorities fund such systems by user charges (rates).

As for the mode of transfer, it refers to the transfer of responsibility for funding wastewater programs and projects to others entities: local government/ entities, private sector and NGOs. In the United States of America, the federal government provides about 25 percent of funding for infrastructure projects, while cities or utilities pay the rest of their wastewater infrastructure. Eight federal agencies provide funding for water and wastewater in the U.S., the largest being the U.S. Environmental Protection Agency's (EPA). The Clean Water Act provides for funding to states called the Clean Water State Revolving Fund program. Under the act and this program, EPA provides federal funds to states who then loan the funds to municipalities and wastewater treatment plants for infrastructure investment. The Philippines adopted the Republic Act No. 9275, which established a water quality management fund, to be administered by the Department, in coordination with other concerned agencies, as a special account in the National Treasury. The fines imposed and damages awarded to the government by the Pollution Adjudication Board (PAB), proceeds of permits issued by the Department under this Act, donations, endowments and grants in the form of contributions to the national government under this Act shall form part of the fund. In addition to this fund, the Philippines has also selected other innovative financing mechanisms in the form of tax incentives and non-tax incentives for operators who intend to invest in projects related to wastewater management. [Others examples, about countries experiences, are illustrated in the Appendix n°3 based on mini-survey results.](#)

4.3. Support to R&D

R&D plays a key role in promoting access to appropriate technologies and reducing the costs of treatment and reuse of wastewater, whose benefits are shared broadly by society. The role of direct government support can be large in the early stages of innovation and become smaller as technologies mature. In R&D, the general role of the public sector is in supporting high-risk, fundamental research with a long-term perspective, while the private sector tends to focus on near-competitive technologies and shorter-term demonstration projects. The public sector can support research institutes and academic institutions, fund research programs targeted at specific technologies and supply grants to private-sector R&D efforts. In developing countries, the focus should be on creating capacity to facilitate technology transfer, adapt technologies to local market conditions and support private-sector players that install, manufacture, operate and maintain the technologies.

Based on the mini-survey conducted among the WGEA community, it appears that government policies on R&D focus in particular on issues of funding and implementation of research facility and coordination of the research. In Philippines, under Section 24 of Republic Act No. 9275, the DENR, in coordination with the DOST, shall establish a national research and development program for the prevention and control of water pollution. As part of said program, the DOST shall conduct and promote the coordination and acceleration of research, investigation, experiments, training, mini-survey and studies relating to the causes, extent, prevention and control of pollution among concerned government agencies and research institutions.

In United states of America, several U.S. agencies fund water research. For example, the U.S. Bureau of Reclamation and U.S. Geological Mini-survey study ground water and surface water quantity and quality, the U.S. EPA studies water quality and contaminants, and multiple agencies including EPA and the U.S. National Oceanic and Atmospheric Administration study harmful algal blooms.

Chapter III: Role of International Cooperation in the development of wastewater technologies

The new UN SDGs 2030 agenda, in particular target 6.3 on water quality, will help to promote policy development and the implementation of the necessary measures, regarding wastewater management processes, which should benefit from international cooperation and technology transfer mechanisms, capacity building, and other means of implementation.

Thus, wastewater issues are gaining increasing importance at international level. Because of transboundary issues between countries when they flow into transboundary rivers, lakes or aquifers. International and regional conventions and treaties can provide an appropriate framework to help countries manage these transboundary effects.

1. International conventions related to wastewater

Wastewater management is a major international concern, as pollution problems are borderless. Concerning legal aspects of international cooperation, there are two main international conventions on transboundary wastewater (WWDR, 2017):

- The United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (entered into force in 2014) requires States to take all appropriate measures not to cause "significant harm" to other States in the international watercourse (Article 7) and that States cooperate to protect international watercourses (Article 8);
- The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the Water Convention) has been prepared as a regional instrument by the United Nations Economic Commission for Europe (UNECE) -UN, 1992). It entered into force in 1996 and has been open to United Nations Member States worldwide since 2013. The Water Convention addresses transboundary impact; sustainability, precautionary principles and the polluter pays (Article 2), and includes the obligation to control pollutant emissions and prior authorization of wastewater discharges.

These conventions have framed the development of many types of international cooperation such as bilateral and multilateral arrangements, partnerships, city networks and several others.

2. Funds to support wastewater projects

International cooperation has played a crucial role in financing projects aimed at developing advanced technological solutions to manage wastewater in an optimal way. International coordination can help ensure that limited financial resources are spent in the most efficient way possible. According to the UN (2017), many multilateral environmental agreements provide for innovative economic incentives to prevent and reduce the generation of wastewater, which can include the precautionary principle, polluter pays principle, public-private partnerships and innovative pricing policies. [Box n°5 below illustrates the success of using innovative financial mechanisms in the Caribbean context.](#)

In Ecuador, a significant portion of the financial resources is derived from several financial agreements with international partners such as the World Bank (WB), the Inter-American Bank of Development (IBD) and the Spanish Agency for International Development Cooperation (AECID). Similarly, Macedonia has received financial support from Japan through JICA, which refer to the preparation of a study on improvement, reconstruction and upgrading of the existing wastewater collection system in Ohrid and Struga.

Thailand has gone into a more than financial partnership with The Asian Development Bank and the World Bank to benefit from the expertise, technical assistance and training provided by both

Box n°5: The Caribbean Regional Fund for Wastewater Management (CReW)

Within the Wider Caribbean Region, it is often a tremendous challenge to secure funding for sectors such as education, health, drinking water supply and wastewater management, with the latter consistently receiving the least investment. However, without adequate levels of investment, the consequence will be a continuing discharge of untreated wastewater, which threatens the Region's economic development and the quality of life of its people. The CReW, funded by the GEF and implemented by the Inter-American Development Bank (IDB) and UNEP, offers one way of addressing the issue of insufficient funding for wastewater infrastructure in the region.

CReW has tested two types of funding mechanisms: revolving funds (in Belize, Trinidad and Tobago, and Guyana) and a credit enhancement facility (CEF) in Jamaica. The CEF was established with a reserve guarantee of US\$3 million provided by CReW, as leverage financing for a further US\$9 million to fund wastewater projects. The K-factor wastewater utility surcharge, established in 2008, is used to repay funds to the CEF. This innovative model creates an incentive for allocating the resources garnered from the monthly collection of the K-factor funds (a portion of the water tariff) for debt servicing for larger commercial bank loans, rather than using the funds directly for capital investments in the sector. Belize, Guyana and Trinidad and Tobago use CReW resources (US\$5 million, US\$3 million, and US\$2 million respectively) to create revolving funds which provide loans to the respective water utilities to finance selected wastewater projects. Replenishment of these revolving funds depends on income generated primarily by the interest from the loans and through the tariff regime. The case of Guyana is special, as the allocation targets primarily the private sector.

Among the lessons learned are the notion that the sustainability of financing for the wastewater sector depends predominantly on the commitment of governments; the adequacy of national policies, laws and regulations; the level of enforcement of existing laws and regulations; and the presence of sufficient, ongoing funding for upgrading, operating and maintenance. The project helped increase awareness of: i) the issue of poor wastewater management amongst decision-makers; ii) the importance of integrated water and wastewater management; iii) innovative ways of approaching financing for wastewater management; and iv) a better understanding of the requirements for sustainable funding in the sector.

organizations.

3. Transfer of knowledge

Technology transfer is one good example of international cooperation in the development of wastewater solutions and technologies. It is the flow of knowledge, policies, experiences and equipment from one area to another, from an industrialized country to a developing country, but it can be between developing countries or even from urban areas to rural areas. Like other new technologies, wastewater faces barriers that related to technology transfer. Before a technology can be transferred successfully, enabling conditions need to be fulfilled, such as institutional and adaptive capacity, access to finance, and knowledge of the technology.

Several countries have joined this cooperative initiative. In Pakistan, many international agencies have extended their cooperation related to areas in water management. These include (but not limited to) IWMI, IUCN and Water Aid. At this level, it is also important to remember that the UN institutions, particularly UNESCO, FAO and WHO, provide several advisory services, support services, studies and guidelines aimed at strengthening the mastery of the different aspects of wastewater management.

Chapter IV. Auditing Wastewater

Around the world, wastewater constitute a strategic concern for public decision-makers, whether at the national level or at the level of local authorities. These entities continue to take action and allocate significant budgetary resources to address the different constraints and challenges imposed by wastewater. In order to ensure the relevance and effectiveness of the efforts mobilized in relation to the objectives set, many SAIs have considered regularly orienting their evaluation and audit activities towards issues relating to wastewater.

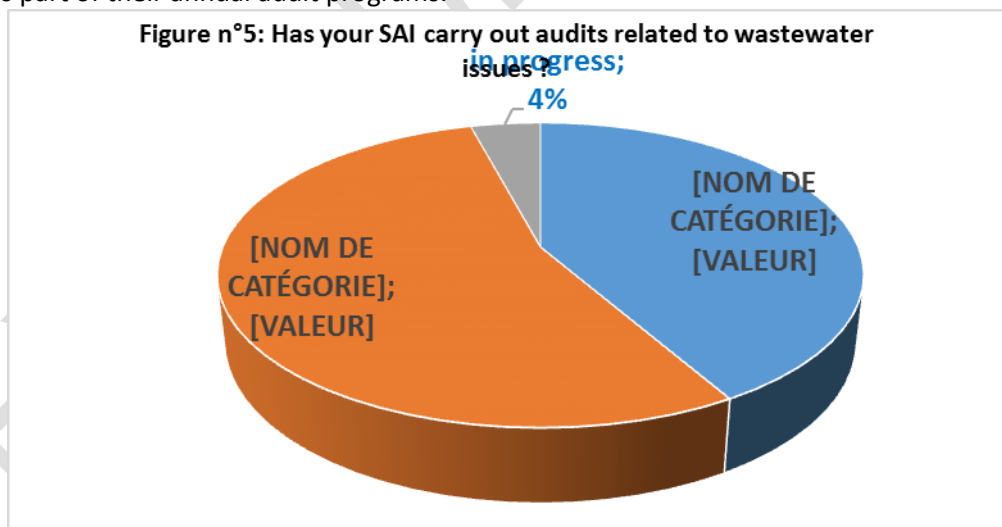
In other words, the issue of wastewater has become currently a very interesting field for SAIs activities. The increasing number of audit operations conducted on wastewater during the last decade confirms this trend. Indeed, the audit reports database available at the WGEA website and in the websites of SAIs contains more than 45 audit cases related to the wastewater aspects. In addition, the responses to the questionnaire submitted to the INTOSAI community shows that almost 42% SAIs had conducted audits on this field. This chapter emphasis, firstly, a brief review on wastewater auditing practices. Secondly, it identifies recurring topics related to wastewater auditing.

1. Overview about wastewater auditing practices

A total, of 50 SAIs have responded to the wastewater mini-survey. The analysis of the responses received reveals the existence of positive and encouraging attitudes within the WGEA community regarding the issue of wastewater auditing.

1.1 Wastewater is a progressive priority for SAIs

In relation to the question “has your SAI carry out audits related to wastewater issues”, 21 SAIs among the 50 responded to the mini-survey (almost 42%) indicated that they had conducted audits on this field, and 4% of respondents mentioned that they have ongoing audit work on this topic. On another side, several SAIs have indicated that they intend to schedule wastewater audits in the future as part of their annual audit programs.



The results of the mini-survey also show that 21 SAIs, which have proceeded to the auditing of wastewater, have published 31 reports during the past ten years 2008-2018. In addition, the temporal analysis of publication dates of audits shows that more than 64% of reports have been published in the last five years (2014-2018). This trend confirms the SAIs awareness on the importance of wastewater issues and that wastewater auditing become progressively an emerging audit topic for SAIs.

1.2 Type of audit: The relevance of performance auditing

In terms of the type of audit to deal with wastewater issues, it appears from SAIs audit cases that the majority of SAIs (25 among 31 audit cases), has adopted performance audit, and only three SAIs have made the choice of the compliance audit. It should be noted that there are also other types of wastewater audit that are rarely practiced by the asked SAI, for example: combined between performance and compliance audit (the cases of Jordanian SAI and Moroccan SAI), and a special examination of Environmental Control to the Wastewater Treatment Systems of the Municipal Autonomous Decentralized Government (SAI of Ecuador). The following table n°4 illustrates the distribution of audit reports on Wastewater Published.

Table n°3: Audit Reports on Wastewater Published by SAIs from WGEA Community

		Types of Audit				Total audit per year
		Performance audit	Compliance audit	Combined	others	
Year of publication	Before 2010	USA				2
	2011	France				1
	2012	Mexico, USA				2
	2013	Colombia, Costa-Rica, Estonia, Kuwait, Thailand, USA				6
	2014	Fiji, India Macedonia	Czech Republic	Morocco		4
	2015	Colombia, France, Peru, Philippines	Costa Rica	Jordan	Ecuador (special examination)	7
	2016	Brazil, Canada, India	Peru			4
	2017	Costa Rica, India, USA				3
	2018	Bahrain, Slovak Republic				2
	Total		25	3	2	1

2. Wastewater audit topics

As mentioned above, the wastewater audit has become in the last five years a theme that is attracting more and more attention among SAIs around the world. The analysis of audit cases, based on mini-survey responses and the summary of the reports extracted from the WGEA and SAIs websites made it possible to highlight that the aspects audited touch a wide variety of topics related to wastewater. These topics can be broadly classified into five majors audit topics as follows:

- Auditing wastewater management and treatment;
- Auditing specific wastewater programs and projects;
- Linking wastewater to water resources management and drinking water safety
- Wastewater as component of the sanitation services;
- Wastewater environmental impact.

2.1. Auditing wastewater management and treatment

According to the mini-survey results, many SAIs provided a significant interest to audit the wastewater management and treatment. The aim of this topic is to examine the fact that the mechanisms (policies, framework, infrastructures, systems, treatment technologies...) put in place by the governmental entities, particularly those responsible for the management of water resources,

make it possible to ensure optimum and safe management of wastewater throughout the cycle, from generation of flows and discharge until reuse for productive purposes. A number of eight audit cases related to this issue are provided by SAIs:

SAI of Brazil: Performance Audit in Wastewater (2016)

The objective of the audit was to assess to what extent federal policies and governmental actions related to the sewage service in Brazil contribute to the efficient management of water resources. The scope of the audit was sewage services in municipalities with more than 50 thousand inhabitants. These municipalities, because of their population size, are those that generate more organic load, which, when not properly treated, compromises the quality of water resources. We developed our audit lines of enquiry based on national legislation and regulations, technical documents, interviews with experts and government managers, field visits to 33 municipalities with a low percentage of sewage treatment in different geographic regions of Brazil. In the visits, we interviewed local public managers, managers of treatment sewage agencies, as well as managers of regulatory agencies. For further detail of the report, it is available at:

<https://contas.tcu.gov.br/pesquisaJurisprudencia/#/detalhamento/11/%252a/NUMACORDAO%253A3180%2520ANOACORDAO%253A2016/DTRELEVANCIA%2520desc%252C%2520NUMACORDAOINT%2520desc/false/1/false>

SAI of COSTA RICA (1): Audit on the control implemented by the Ministry of Health for the collection, transport, disposal and treatment of sludge from special wastewater treatment systems (2015).

The objective was to establishing the reasonableness of the control exert by the Ministry of Health for the collection, transport, treatment and disposal of sludge. For the scoop, the audit was focused on actions and controls implemented by Ministry of Health, through its regional offices located all around the country, using a sample of registered wastewater treatment systems. The audit revealed alarming results: (1) Insufficient control of the treatment and disposal of sludge; (2) Lack of opportunity in the verification of performance reports from treatment plants and in the attention of corrective actions (the maximum deadline for submitting operational reports is not defined; untimely intervention of the Ministry of Health when there is non-compliance with the parameters of discharges; inconsistencies in the physical-chemical and microbiological characteristics of the discharges contained in the performance reports). Further details of the report, are available at:

https://cgrfiles.cgr.go.cr/publico/docs_cgr/2015/SIGYD_D_2015009195.pdf

SAI of COSTA RICA (2): Performance auditing on Alajuela's Local Government sewage service (2017)

The SAI has conducted this audit to assess the effectiveness and efficiency of Alajuela's Local Government sewage service. The audit considered the public funding invested in Alajuela's Local Government sewage service, specifically related to the following matters: a) Coverage of Alajuela's Local Government sewage service; b) Quality of wastewater discharged in waterways (rivers and streams, etc.); c) Management of Local Government sewage infrastructure; d); Management of Alajuela's septic system. Further, the audit analysis period was ranged between January 1st, 2016, and December 31th, 2016. As for the methodology applied, the auditing work team established performance indicators in order to assess the effective and efficiency of Alajuela's Local Government sewage service. In addition, AyA engineers for identifying the state of the infrastructure carried out inspections. Finally, 71 files related with approved building permits (included the septic system permits) were chosen based on a representative statistical sample. The main findings were: Audit findings: a) 66% of Alajuela's Local Government sewage service's users (houses and commerce) are not receiving treatment of the wastewater produced in their houses and commerce buildings. b) Four of the nine wastewater treatment plants in charge of Alajuela's Local Government, are not complying with national quality standards for discharging waste water in waterways (DBO, DQO, etc.).c) The Local Government sewage network in Alajuela downtown doesn't has the enough capacity to transport the quantity of wastewater generated during the raining season. d) The

Alajuela's Local Government doesn't carry out physical inspection to determine that Alajuela's septic systems are in line with approved building permits. more details about this case are available at: https://cgrfiles.cgr.go.cr/publico/jaguar/Documentos/informes_rec/DFOE-DL-IF-05-2017.pdf

SAI of Fiji: Management of Wastewater (2014)

This audit was conducted in 2014 but not tabled in Parliament. It had a dual objective: (1) to assess the adequacy of wastewater regulatory and planning framework in governing, guiding and providing resources to enable the efficient management of waste water systems in Fiji, and (2) to determine the effectiveness of WAF in managing its infrastructures to meet demands, and monitoring of its daily wastewater processes that ensures discharge quality to the environment is of the required standard. The audit focused on the activities of the Water Authority of Fiji in administering the waste water systems for the period 2010 until the date of the audit in October 2014. The audit covered 10 out of the 11 wastewater treatment plants around the country, i.e. 91% coverage of the WAF wastewater service in Fiji. The audit was conducted using the following audit gathering techniques: Documentary reviews; Interviews and physical inspections of the water treatment plants located at 3 divisions.

SAI of Jordan: Evaluate the performance of treated wastewater management in the Water Authority (2015)

The overall objectives of the audit were: (1) Determine the degree of compliance with the environmental standards of the audited activity; (2) identify and describe the impact of treated wastewater use on the following environmental elements: water / soil / vegetation; (3). Examination of the use and degree of compliance with environmental indicators. The results of the audit can be enumerated as follows : (a) There is no national standard or guidelines in the Water Authority to measure the impact of treated wastewater on soil and plant; (b) Decrease in the number of laboratory tests to measure the effect of treated wastewater on soil and plants by the Authority in recent years; (c) No measuring of concentrations of phenol by the Authority in wastewater samples (especially industrial) that are collected from sewage stations; (d) Dependence on intraday sampling rather than aggregation when examining the wastewater of some of the factories connected to the network, which had some violations in the wastewater measurements of the technical specification; (e) Not to take the nature of the plant's activity as a criterion for sampling, where it is currently dependent on the volume of water discharged from the plant. Further details about this case are available at:

<http://www.audit-bureau.gov.jo/Annual%20Reports/Annual%20Report%202016/Full.pdf>

SAI of Peru: Management and Treatment of Municipal Waste Water – Empresa Municipal de Agua Potable y Alcantarillado Cañete S.A (2016)

The audit was conducted to determine if Empresa Municipal de Agua Potable y Alcantarillado Cañete S.A. complied with the environmental normative framework that regulates the management and treatment of the municipal wastewater that is directly poured into the course of the Mala River. The issue to be examined was the management and treatment of the municipal waste waters in the jurisdiction of the San Antonio district, by EMAPA Cañete S.A., its pouring into the natural course of the Mala River and the negative impact that this might cause in the quality of the environment and public health. Also, the actions undertaken with regard to the Project "Improvement and Expansion of the Drinking Water and Sewerage System of San Antonio – Cañete" being only partially operational. It encompassed the review and analysis of documentation relative to the treatment process y disposal of municipal wastewater in the district of San Antonio, during the period between January 1st, 2014 and December 31st, 2015. Among the main results of the audit, it should be noted that EMAPA Cañete S.A. pours wastewater from the San Antonio district into the course of the Mala River without previously treating them, affecting the body of water. It also failed to comply with its

duties of follow-up and monitoring established in the agreement for the execution of the sanitation project. It didn't have the authorization for pouring waste waters that the National Water Authority (ANA) issues, even though it was granted a special period to meet the requirements through the Compliance with Pouring and Reuse Program that ended in March of 2015. Consequently, wastewater continues to be poured into the Mala River without any sort of previous treatment, affecting that body of water where the levels are over what is allowed by law. On the other hand, EMAPA Cañete S.A. failed to comply with the follow-up and monitoring to the construction side of the sanitation project, which contemplated the building of a wastewater treatment plant for the San Antonio district. Further details about this case are available at:

<https://apps1.contraloria.gob.pe/portal/BuscadorInformes/BuscadorInformes.htm>

SAI of Thailand: The Management of the Wastewater Management Authority (2013)

The main objective of the audit was to determine whether WMA was meeting its purpose of providing central wastewater treatment systems both within and outside the wastewater management areas with fee collection, as well as to provide services in wastewater related affairs. The audit covered activities implemented from the WMA was founded by the Royal Decree Establishing the Wastewater Management Authority, B.E. 2538 (1995) on August 15th, 1995, through fiscal year 2013. This performance audit conducted in accordance with the Royal Decree Establishing the Wastewater Management Authority, B.E. 2538 (1995) and the amendments in 1997 and 2005. The audit found that The WMA could not achieved the objectives under the Royal Decree Establishing the Wastewater Management Authority, B.E. 2538 (1995), i.e. (a) From the WMA was founded in 1995 until 2013, The WMA could not establish central wastewater treatment systems to treat wastewater both within and outside its assigned areas; (b) The wastewater treatment fee has not been applied in local municipalities.

SAI of USA: Water Pollution: EPA has Improved Its Review of Effluent Guidelines but Could Benefit from More Information on Treatment Technologies (2012)

By this audit, the GAO aimed to examine : (1) the process EPA follows to screen and review industrial categories potentially in need of new or revised effluent limitation guidelines and the results of that process from 2003 through 2010; (2) limitations to this screening and review process, if any, that could hinder the effectiveness of the effluent guidelines program in advancing the goals of the Clean Water Act; and (3) what actions EPA has taken or could take to address limitations, if any, that exist. In terms of findings, the audit showed that the Environmental Protection Agency (EPA) uses a two-phase process to identify industrial categories potentially needing new or revised effluent guidelines to help reduce their pollutant discharges. EPA's 2002 draft Strategy for National Clean Water Industrial Regulations was the foundation for EPA's process.

In the first, or "screening," phase, EPA uses data from two EPA databases to rank industrial categories according to the total toxicity of their wastewater. Using this ranking, public comment, and other considerations, EPA has identified relatively few industrial categories posing the highest hazard for the next, or "further review," phase. In this further review phase, EPA evaluates the categories to identify those that are appropriate for new or revised guidelines because treatment technologies are available to reduce pollutant discharges. Since 2003, EPA has regularly screened the 58 categories for which it has issued effluent guidelines, as well as some potential new industrial categories, and it has identified 12 categories for its further review phase. Of these 12 categories, EPA selected 3 for updated or new effluent guidelines. EPA chose not to set new guidelines for the others. Limitations in EPA's screening phase may have led it to overlook some industrial categories that warrant further review for new or revised effluent guidelines. Specifically, EPA has relied on limited hazard data that may have affected its ranking of industrial categories. Further, during its screening phase, EPA has not considered the availability of advanced treatment technologies for most industrial categories.

Although its 2002 draft strategy recognized the importance of technology data, EPA has stated that such data were too difficult to obtain during the screening phase and, instead, considers them for the few categories that reach further review. Officials responsible for state water quality programs and experts on industrial discharges, however, identified categories they believe EPA should examine for new or updated guidelines to reflect changes in their industrial processes and treatment technology capabilities. According to some experts, consideration of treatment technologies is especially important for older effluent guidelines because changes are more likely to have occurred in either the industrial categories or the treatment technologies, making it possible that new, more advanced treatment technologies are available. Recognizing the limitations of its hazard data and overall screening approach, EPA has begun revising its process but has not assessed other possible sources of information it could use to improve the screening phase. In 2012, EPA supplemented the hazard data used in screening with four new data sources. EPA is also developing a regulation that, through electronic reporting, will increase the completeness and accuracy of its hazard data. In 2011, EPA also began to obtain recent treatment technology literature. According to EPA, the agency will expand on this work in 2013.

Nonetheless, EPA has not thoroughly examined other usable sources of information on treatment technology, nor has it reassessed the role such information should take in its screening process. Without a more thorough and integrated screening approach that both uses improved hazard data and considers information on treatment technology, EPA cannot be certain that the effluent guidelines program reflects advances in the treatment technologies used to reduce pollutants in wastewater. Further details about this case are available at: <https://www.gao.gov/products/GAO-12-845>

2.2 Auditing specific wastewater programs and projects

Some SAIs have conducted wastewater audit by focusing on programs and projects implemented by national and local governments in this area. The choice of this topic is justified by the fact that wastewater projects are characterized by their transverse aspect that involve multiple levels of public actors and by the fact that they require significant budgetary resources. Therefore, the objective of auditing this topic is to evaluate whether the audited programs and projects were implemented and provided results as planned, and whether they reached their targets. Six cases of audits focused on programs and projects implemented in this field were identified:

SAI of Bahrain: Audit of Wastewater Projects (2018)

The Audit objectives are to ensure that: 1) Efficiency and effectiveness of the ministry in the planning, implementation and management of sewage projects; 2) The existence of internal control systems on sewage projects work efficiently and effectively; 3) The Ministry's commitment to laws, regulations and regulations related to government projects. The report of this audit is being discussed for later publication during this year.

SAI of Canada: Federal Support for Sustainable Municipal Infrastructure (2016)

The Office of the Auditor General's responsibility was to conduct an independent examination of federal support for municipal infrastructure intended to improve environmental performance, in order to provide objective information, advice, and assurance to assist Parliament in its scrutiny of the government's management of resources and programs. All of the audit work in this report was conducted in accordance with the standards for assurance engagements set out by the Chartered Professional Accountants of Canada (CPA) in the CPA Canada Handbook—Assurance. While the Office adopts these standards as the minimum requirement for our audits, we also draw upon the standards and practices of other disciplines. As part of our regular audit process, we obtained management's confirmation that the findings in this report are factually based. The overall objective was to determine whether Infrastructure Canada and the Federation of Canadian Municipalities

managed two key programs designed to support sustainable communities to achieve their objectives, and whether Infrastructure Canada adequately coordinated the set of programs.

Our audit work focused on Infrastructure Canada's management of the Gas Tax Fund and its coordination of some key federal programs that provide funding for municipal infrastructure. We also assessed the Federation of Canadian Municipalities' management of the Green Municipal Fund. We also spoke to officials in Environment and Climate Change Canada and Natural Resources Canada, in view of their roles in overseeing the Green Municipal Fund. We relied on interviews with officials from audited organizations and with stakeholders, such as the recipients of federal funds. We examined selected project files and databases used for tracking performance information. Entity officials provided details on key management processes. We spoke to municipal and provincial officials in several jurisdictions and conducted interviews and site visits in Calgary, Toronto, and St. John's. For our work on the Gas Tax Fund, we also used an online mini-survey distributed to all signatories of funding agreements to obtain their views on aspects of the management of the Fund.

To assess the procedures used by Infrastructure Canada to review the reports received from the signatories of the Gas Tax Fund agreements, we chose 35 of the second of the two annual payments made to the signatories from October 2012 to November 2015 and looked at the procedures leading up to the payments. Given that there were 15 signatories and that our testing covered four fiscal years, we expected that there would be 57 possible payments, considering that our testing occurred in November 2015, when three annual reports were not yet due. The payments were selected to focus on higher-risk items (for example, because of larger dollar amounts) and to include examples of payments to all jurisdictions. The main emphasis of the audit was on the period between April 2010 and October 2015. Some questions required consideration of events and information related to the design and early implementation of the programs. For example, the agreements for the Green Municipal Fund and for the first round of the Gas Tax Fund were signed in 2005. To provide the most up-to-date information possible, we also included some information from after October 2015. Further details about this case are available at:

http://www.oag-bvg.gc.ca/internet/English/parl_cesd_201605_01_e_41380.html#hd2d

SAI of the Czech Republic: Funds of the Operational Program Environment earmarked for wastewater treatment (2014).

This audit was a control of legality of the activities carried out by the Funds of the Operational Program Environment earmarked for wastewater treatment. The objective was to verify whether the funds of the Operational Program Environment for Waste Water Treatment were provided and used in accordance with the legal regulations and the conditions laid down; verify the implementation of the measures taken based on previous controls. The Supreme Audit Office scrutinized subsidies from the Operational Programme Environment, which were approved by the Ministry of Environment and the State Environmental Fund of the Czech Republic in period 2008–2013 for purification of waste waters. Auditors aimed at selection, supervising, evaluation, and monitoring processes related to projects, which had been granted subsidies. The auditing operation scrutinized 15 individual projects. The auditing operation scrutinized 15 individual projects. Handling of the applications took rather long. On average, 28 months passed from receiving the application to ruling about the subsidies. In 23 cases, auditors revealed that the Ministry of Environment approved applications after the construction works had been finished. Delays were caused by complexity of applications and frequent mistakes in forms, and the fact that projects managers were overburden with many tasks and big projects needed European Commission's approval. Moreover, the Ministry and the State Environmental Fund failed to keep all necessary documents related to calls and selection processes. As a result, it was not possible to assess whether these phases had been transparent. The SAO's concluded that it is hard to assess whether the objectives of the Operational Programme Environment were met. Priority Axis 1.1, which was the main focus of the auditing operation, aims at reducing of the pollution of ground water. But the Ministry failed to define the measures of the targeted pollution's reduction. Errors were found in the monitoring system as well. For example, terms and dates for public administration controls at beneficiaries were not properly set. So, the

State Environmental Fund carried out an audit scheduled for June 2012 as late as September, the audit notes were elaborated in February 2013 and the audit protocol was presented to the beneficiary in March 2013. The Operational Program Environment is among the programs, which were temporarily suspended by the European Commission because of serious errors. The Czech Republic was ordered to cut by 5 % all reimbursements claimed by the end of August 2012. In 2012, the Government prepared Action Plan to deal with the reimbursement problems, but there were CZK 23,500 million left in the Program by the end of 2013, which made roughly one half of the allocations. By the end of 2013, only 44 % of the funds allocated in the Operational Program Environment were paid to beneficiaries. More details about this case are available at: <https://www.nku.cz/scripts/detail.php?id=5072>

SAI of Slovak Republic: Audit the benefits of investment in sewerage from the Operational Program Environment (2018)

The audit was conducted to Review and analyze the efficiency of the resources spent on drainage within the Operational Program Environment (value for money) from the point of view of meeting objectives and measurable indicators (connectivity). Analyze the unit prices of selected budget items as well as the cost of 1 km of newly built sewerage. Report on the fulfillment of the Slovak Republic's commitment to the EU in the area of drainage under the Treaty of Accession to the EU. The purpose was also to verify the obligations of municipalities in the area of wastewater treatment in agglomerations, as well as to identify the reasons for non-connection of citizens to newly built sewerage networks. The audit examined the economy, efficiency and effectiveness of the spent financial resources. When assessing economy, the criteria were the assessment of the cost of 1 km of built-in sewerage and the comparison of unit prices of selected construction items. Efficiency was assessed in terms of the degree of connection of citizens to the sewer network. Criteria for assessing effectiveness were to assess the fulfillment of the Slovak Republic's commitment to the EU as a result of the Accession Treaty and the fulfillment of the set objectives. Audit was focused on 26 final beneficiaries (municipalities and water companies) and MoE SR. The questionnaire was addressed to all district authorities. Audit was in 23 cases ended with prepared records and in four ones with protocols.

SAI of USA (1): Drinking Water and Wastewater Infrastructure: Information on Identified Needs, Planning for Future Conditions, and Coordination of Project Funding (2017)

There are three objectives of this audit: (1) how federal agencies and selected states identify drinking water and wastewater infrastructure needs; (2) how federal agencies have supported selected states in planning for future conditions that may affect such needs; and (3) the extent to which federal and state agencies have coordinated in funding drinking water and wastewater infrastructure projects, and any challenges they face in funding these projects. As audit criteria, the GAO is used mainly two elements. The first is the GAO, Managing for Results: Key Considerations for Implementing Interagency Collaborative Mechanisms, GAO-12-1022 (Washington, D.C.: Sept. 27, 2012) and the second is the GAO, Results-Oriented Government: Practices That Can Help Enhance and Sustain Collaboration among Federal Agencies, GAO-06-15 (Washington, D.C.: Oct. 21, 2005). The results of the audit touched on several aspects. The Environmental Protection Agency (EPA) and other federal and selected state agencies collect information to identify drinking water and wastewater infrastructure needs through mini-surveys, the administration of agency programs, and studies. EPA's most recent mini-surveys estimated approximately \$655 billion of drinking water and wastewater infrastructure needs nationwide over the next 20 years. The seven other agencies GAO reviewed—the departments of Agriculture (USDA) and Housing and Urban Development (HUD) and the Economic Development Administration, Indian Health Service, Bureau of Reclamation, U.S. Army Corps of Engineers, and Federal Emergency Management Agency (FEMA)—collect information on these needs by administering their programs. For example, the Corps collects information on congressionally authorized water projects. Of the six states GAO selected for review, all but Alaska and California had collected data on their needs such as through mini-surveys of communities. For

example, North Dakota biennially collects information on drinking water projects from its communities. The Corps, Reclamation, and FEMA provide technical assistance and funding to support efforts in the six selected states to plan for future conditions that may affect drinking water and wastewater infrastructure needs. For example, the Corps helped Minnewaukan, North Dakota, identify alternatives for reducing flood risks to the city's drinking water and wastewater infrastructure, and Reclamation worked with Santa Fe, New Mexico, to study its projected water supply and demand. The remaining five agencies have at times been involved in long-term planning but do not have established programs for such purposes. Federal and state agencies in the six selected states have taken actions to coordinate funding for projects while facing several challenges. For example, agencies in most of the selected states had established interagency coordinating groups that reached out to communities needing funding for projects. In some cases, agencies developed written agreements for their coordinating groups, with such goals as simplifying the application process and encouraging agencies to fund projects together. However, agencies in the selected states faced challenges, such as difficulty in developing a set of specific projects that were ready for funding, despite having infrastructure needs. For example, in the six selected states, USDA did not have enough applicants with projects that were developed to the extent needed to receive funding; therefore, USDA did not loan a total of about \$193 million in available loan funds for fiscal years 2012 through 2016 to communities in those states. GAO found that federal and state agencies within selected states had taken some actions to help address challenges they faced in funding projects; these actions included conducting joint outreach to develop a set of projects ready for funding. EPA and USDA also have taken actions. For example, in February 2017 in response to a GAO recommendation in a prior report, EPA and USDA issued a joint memorandum outlining five practices to help improve interagency collaboration at the state level on drinking water and wastewater infrastructure projects; these practices include using common application materials and conducting joint marketing or outreach. Further details about this case are available at: <https://www.gao.gov/products/GAO-17-559>

SAI of USA (2): Clean Water: Further Implementation and Better Cost Data Needed to Determine Impact of EPA's Stormwater Program on Communities (2007)

Four main objectives have been set for this audit: (1) EPA's and states' responsibilities in the Total Maximum Daily Load (TMDL) program; (2) what is known about the status of long-established TMDLs; (3) the extent to which long-established TMDLs contain key features that enable attainment of water quality standards; and (4) the extent to which such TMDLs exhibit factors that facilitate effective implementation. The work is based on the Clean Water Act: The Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92-500, § 2, 86 Stat. 816, codified as amended at 33 U.S.C. §§ 1251-1387 (2013) (commonly referred to as the Clean Water Act). It's also focused on National Research Council, *Assessing the TMDL Approach to Water Quality Management* (Washington, D.C.: National Academies Press, 2001). In terms of findings, the audit shows that the Environmental Protection Agency (EPA) and the states each have responsibilities for developing and implementing pollution targets, known as total maximum daily loads (TMDL). EPA oversees states' TMDL efforts by establishing in regulations minimum requirements TMDLs need for approval, providing funding, and furnishing technical assistance. States develop TMDLs and generally take the lead in implementing them by identifying pollutants that impair water quality and taking actions to reduce them. Of about 50,000 TMDLs developed and approved, nearly 35,000 were approved more than 5 years ago, long enough for GAO to consider them long established. State officials GAO mini-surveyed in its representative sample of 191 TMDLs reported that pollutants had been reduced in many waters, but few impaired water bodies have fully attained water quality standards. The sample of 25 TMDLs reviewed by water resource experts GAO contacted seldom contained all features key to attaining water quality standards. According to the National Research Council and EPA, these features—some that are beyond the scope of EPA's existing regulations—include identifying pollution-causing stressors and showing how addressing them would help attain such standards;

specifying how and by whom TMDLs will be implemented; and ensuring periodic revisions as needed. The experts found, however, that 17 of 25 long-established TMDLs they reviewed did not show that addressing identified stressors would help attain water quality standards; 12 contained vague or no information on actions that need to be taken, or by whom, for implementation; and 15 did not contain features to help ensure that TMDLs are revised if need be. GAO's review showed that EPA's existing regulations do not explicitly require TMDLs to include these key features, and without such features in TMDLs—or in addition to TMDLs—impaired water bodies are unlikely to attain standards. In response to GAO's mini-survey, state officials reported that long-established TMDLs generally do not exhibit factors most helpful for attaining water quality standards, particularly for nonpoint source pollution (e.g., farms and storm water runoff). The officials reported that landowner participation and adequate funding—factors they viewed as among the most helpful in implementing TMDLs—were not present in the implementation activities of at least two-thirds of long-established TMDLs, particularly those of nonpoint source TMDLs. Because the Clean Water Act addresses nonpoint source pollution largely through voluntary means, EPA does not have direct authority to compel landowners to take prescribed actions to reduce such pollution. In GAO's mini-survey, state officials knowledgeable about TMDLs reported that 83 percent of TMDLs have achieved their targets for point source pollution (e.g., factories) through permits but that 20 percent achieved their targets for nonpoint source pollution. In 1987, when the act was amended to cover such pollution, some Members of Congress indicated that this provision was a starting point, to be changed if reliance on voluntary approaches did not significantly improve water quality. More than 40 years after Congress passed the Clean Water Act, however, EPA reported that many of the nation's waters are still impaired, and the goals of the act are not being met. Without changes to the act's approach to nonpoint source pollution, the act's goals are likely to remain unfulfilled. Further details about this case are available at:

<https://www.gao.gov/products/GAO-07-479>

2.3 Linking wastewater to water resources management and safety drinking

Currently, it is widely accepted that water authorities should perceive wastewater as a vital component not only of the prevention of water resources from contamination and pollution risks, but also by terms of water quality and safety drinking. Several policies and programs have been implemented in this perspective. For this reason, some SAIs have decided to focus their audit efforts on measures that have a direct link between wastewater, on the one hand, and water management and safety drinking, on the other hand. Five examples of audit related to this issue are identified:

SAI of Colombia: Audit of the Bogotá river vigencias 2012-2015 (2015)

The conduct of this audit was considered in order to determine the improvement of the quality of water and the reduction of the contamination of the water resource, in the period 2012-2015, and verify if the Autonomous Regional Corporation of Cundinamarca when granting the discharge permits that affect the Bogotá River has evaluated the impact of the pollutant loads and their behavior and determine the fulfillment of the plans of sanitation and handling of wastewater subscribed by the municipalities in the same period. The audit based on the evaluation and verification of the management of the Autonomous Regional Corporation of Cundinamarca and the FIAB Fund during the 2012-2015 term of the resources executed for the decontamination of the Bogotá River.

SAI of Costa Rica: Effectiveness of the State to guarantee the water quality in its different uses (2013)

The objective of conducting this audit was to determine the effectiveness of the State in the protection of water bodies from the pressure exerted by different sources of pollution, as well as in safeguarding the quality of water resources to meet the requirements of their different uses, ensuring the constitutional rights to human health and the environment. The audit was carried out in

the Ministry of Health, the Ministry of Environment and the Costa Rican Institute of Aqueducts and Sewers. The audit included the analysis of the pressure exerted to the bodies of water and their status in terms of quality, as well as the exposure of people in contact with waters that do not meet quality parameters, and the effect of water quality on human health and the environment. In addition, good practices implemented by the audited entities in terms of regulation, risk-based planning, control and monitoring of water quality were analyzed; roles and institutional and sectoral coordination; the generation of information and reports for decision making and accountability to public authorities and citizens. Further, the audit analysis period was ranged between January 1st, 2009, and December 31th, 2011. The results of the audit indicate several weaknesses: (a) Only 5% of the ordinary wastewater discharged into water bodies of the country receive some type of prior treatment. There are different sources of pollution of water resources, but the main one is the discharge of domestic wastewater; (b) 19.8% of the population disposes the wastewater in the sanitary sewer; and of this population, only 15.19% has treatment. The problem of contamination by this origin occurs mainly in the Metropolitan Area; (c) None of the 4 large collectors administered by the Costa Rican Institute of Aqueducts and Sewers in the Metropolitan Area has treatment systems, so wastewater is discharged directly into the rivers of the Grande de Tárcoles basin; (d) 16 of the 20 wastewater treatment systems operated by public entities exceeded the maximum permissible limits during the 2009-2011 period of: methylene blue active substances, biological oxygen demand, chemical oxygen demand, fats and oils. Further details about this example are available at: https://cgrfiles.cgr.go.cr/publico/jaguar/sad_docs/2013/DFOE-AE-IF-01-2013.pdf

SAI of Macedonia: Effectiveness and efficiency of the legislation on water in the Republic of Macedonia, the safety of drinking water and wastewater (2014)

The basic audit objective in the performance audit: The effectiveness and efficiency of the legislation on water in the Republic of Macedonia, the safety of drinking water and wastewater, is set out in the following question: “Does the current level of implementation of the water legislation provide quality drinking water and wastewater disposal”? According to the results of the audit the MEPP of the Republic of Macedonia has not done a complete and detailed analysis for the implementation of the Law on Waters, ie it does not have enough data on the level of implementation of the legal provisions for the waters in the Republic of Macedonia, necessary for obtaining indicators as a basis for determining priorities in the further creation of policies. The MEPP has not established a complete and up-to-date registry of permits for water use, discharge of waters, extraction of sand and gravel, protection zones, old rights and obligations, water management consents, requests for issuing permits and other data. Keeping the register would mean collecting and recording data, updating them, archiving them in order to obtain a single database that would could be the basis for proper administration of water-related decisions. In addition, there is an insufficient number of adopted bylaws is the reason for the difficult implementation of the legislation on water, although they are with a determined deadline. In another side, the National Council is an advisory body, its functioning should result in consideration of water management issues, proposing various measures for preservation, protection and continuous improvement of the water regime on the territory of the Republic of Macedonia. However, according to the current way of working, its efficiency is weak. In the same way, and related to the wastewater, the audit has identified a small number of applications for obtaining a permit for discharging wastewater, although the licenses are a legal obligation, for both (legal entities and natural persons), including the state administration bodies, the municipalities, the municipalities in the City of Skopje and the City of Skopje. They may discharge wastewater or discharge or dispose of substances and substances in the recipients only after obtaining water right or a license for discharge into the waters. The audit found that the responsible persons in the MEPP and MOH did not establish a list of water bodies as protective zones for discharging urban wastewater. In addition, the requirements regarding the load and method of purification of urban wastewater discharged into water bodies as protection zones have not been determined. These conditions lead to the risk that environmental protection is not provided for the

harmful effects of the discharge. The audit established that legal entities and natural persons who discharge wastewater do not transfer data in accordance with the Rulebook on the manner and transmission of information from monitoring of the discharged wastewater, they have not set measuring instruments for the quantity and quality of wastewater due to which they have no records or data to submit to the MEPP of the Republic of Macedonia. The audit established that legal entities and natural persons who discharge wastewater do not transfer data in accordance with the Rulebook on the manner and transmission of information from monitoring of the discharged wastewater, they have not set measuring instruments for the quantity and quality of wastewater due to which they have no records or data to submit to the MEPP of the Republic of Macedonia. Further details about this example are available at:

http://www.dzr.mk/Uploads/1_61_RU_REZIME_Efektivnost_efikasnost_na_zakonska_regulativa_na_vodi_RM.pdf

SAI of Mexico: Integrated Water Resources Management (2012)

This audit was conducted in accordance with the 2017 annual program, it aimed to control the integral management of water, in order to verify the fulfillment of its objectives and goals. The results of the audit focused on 15 aspects related to water management : (1) Annual programming of CONAGUA activities; (2) Participation of basin councils in national water planning; (3) Information system for processing and registration of concession titles; (4) Water availability: Groundwater and Surface water; (5) Concessions of volumes of groundwater; (6) Concessions of surface water volumes; (7) Publication and update of water availability; (8) Mechanisms for Coordination with Watershed Councils to establish the extraction volumes; (9) Inspection of national water users; (10) Sewage sanitation coverage; (11) Water quality; (12) Operational efficiency of water quality monitoring; (13) Compliance with official Mexican regulations on wastewater discharges; (14) Water Cost; (15) Budget of the Basin Council. Further details about this example are available at:

https://www.asf.gob.mx/Trans/Informes/IR2014i/Documentos/Auditorias/2014_0103_a.pdf

SAI of USA: Clean Water Act: Changes Needed If Key EPA Program Is to Help Fulfill the Nation's Water Quality Goals (2013)

In conducting this audit, the GAO has aspired to achieve four major objectives: (1) EPA's and states' responsibilities in the Total Maximum Daily Load (TMDL) program; (2) what is known about the status of long-established TMDLs; (3) the extent to which long-established TMDLs contain key features that enable attainment of water quality standards; and (4) the extent to which such TMDLs exhibit factors that facilitate effective implementation. Among the main results of the audit is that the Environmental Protection Agency (EPA) and the states each have responsibilities for developing and implementing pollution targets, known as total maximum daily loads (TMDL). EPA oversees states' TMDL efforts by establishing in regulations minimum requirements TMDLs need for approval, providing funding, and furnishing technical assistance. States develop TMDLs and generally take the lead in implementing them by identifying pollutants that impair water quality and taking actions to reduce them. Of about 50,000 TMDLs developed and approved, nearly 35,000 were approved more than 5 years ago, long enough for GAO to consider them long established. State officials GAO mini-survey ed in its representative sample of 191 TMDLs reported that pollutants had been reduced in many waters, but few impaired water bodies have fully attained water quality standards. The sample of 25 TMDLs reviewed by water resource experts GAO contacted seldom contained all features key to attaining water quality standards. According to the National Research Council and EPA, these features—some that are beyond the scope of EPA's existing regulations—include identifying pollution-causing stressors and showing how addressing them would help attain such standards; specifying how and by whom TMDLs will be implemented; and ensuring periodic revisions as needed. The experts found, however, that 17 of 25 long-established TMDLs they reviewed did not show that addressing identified stressors would help attain water quality standards; 12 contained vague or no

information on actions that need to be taken, or by whom, for implementation; and 15 did not contain features to help ensure that TMDLs are revised if need be. GAO's review showed that EPA's existing regulations do not explicitly require TMDLs to include these key features, and without such features in TMDLs—or in addition to TMDLs—impaired water bodies are unlikely to attain standards. In response to GAO's mini-survey, state officials reported that long-established TMDLs generally do not exhibit factors most helpful for attaining water quality standards, particularly for nonpoint source pollution (e.g., farms and storm water runoff). The officials reported that landowner participation and adequate funding—factors they viewed as among the most helpful in implementing TMDLs—were not present in the implementation activities of at least two-thirds of long-established TMDLs, particularly those of nonpoint source TMDLs. Because the Clean Water Act addresses nonpoint source pollution largely through voluntary means, EPA does not have direct authority to compel landowners to take prescribed actions to reduce such pollution. In GAO's mini-survey, state officials knowledgeable about TMDLs reported that 83 percent of TMDLs have achieved their targets for point source pollution (e.g., factories) through permits but that 20 percent achieved their targets for nonpoint source pollution. In 1987, when the act was amended to cover such pollution, some Members of Congress indicated that this provision was a starting point, to be changed if reliance on voluntary approaches did not significantly improve water quality. More than 40 years after Congress passed the Clean Water Act, however, EPA reported that many of the nation's waters are still impaired, and the goals of the act are not being met. Without changes to the act's approach to nonpoint source pollution, the act's goals are likely to remain unfulfilled. Further details about this example are available at: <https://www.gao.gov/products/GAO-14-80>

2.4 Wastewater as component of the sanitation services

Wastewater cannot be dissociated from sanitation services. Much of the wastewater generated around the world comes from flows into urban sanitation systems, and reciprocally, sanitation is the hygienic means of preventing human contact from the hazards of wastes to promote health. Therefore, it is highly conceivable that SAIs may be of particular interest in auditing sanitation services to examine how the urban wastewater supply is managed and treated during the pipeline process. A number of four examples of audit cases related to this issue are identified:

SAI of France: Publics services of water and sanitation (2011)

In its thematic report of 2003 dedicated to the management of public water and sanitation, the Cour des comptes had recommended an inter-communal management, in order to strengthen the economies of scale, financial transparency and the management of these services. Seven years later, despite the noted progress, important streamlining efforts remain to be accomplished. Implementation of the recommendations of the Cour des comptes: the advances initiated by Central Government and Parliament. Among these advances, the Decree of 14 March 2005 has standardised the presentation and the content of the annual operating income account (compte annuel de résultat de l'exploitation or CARE). The law of 30 December 2006 on water and the aquatic environment for its part has made budget planning and management easier. The obligations of the assignee were also strengthened, notably in relation to the renewal of facilities. Finally, the law created a system of information about the public water and sanitation services (système d'information sur les services publics d'eau et d'assainissement or SISPEA). The efforts engaged to improve the management of water and sanitation services can be seen in the development of expert capacities. They make possible a greater transparency in the choice of the management method, a decrease in the length of delegation contracts, faster return to competition as well as inclusion of contractual clauses allowing real control over the performance conditions. Thus, deficiency remains, notably in terms of costs, due to the excessively high number of water and sanitation services. According to ONEMA (1); France totals 35,000 of these services, a number unmatched in Europe. The laws adopted since 2003 to favor their combination did not modify the territorial grid pattern. This excess creates difficulties for funding SISPEA, its reliability and completeness criteria being rather

incompatible with the current fragmentation of structures. A necessary rebalancing of the relationships between local authorities and the assignees. Due to the poor knowledge of the networks, the local authorities do not have true control over the renegotiation of contracts, which explain the low rate of operator changes. Likewise, the financial reports of the assignee, often short and incomplete, do not allow for a comparison between actual and estimated results. The water and sanitation syndicates and smaller authorities were traditionally supported by the Central Government services in terms of public engineering, but these services are slated for complete discontinuation by 2011. In conclusion, only a drastic reduction in the number of structures and the pooling of resources and skills will make it possible to improve management and rebalance the relationship between the local authorities and the public service assignees. The audit report eventually offered the following recommendations : (a) Make the opening of their own cash accounts mandatory for all public service contract holders (delegation de service public or DSP) ; (b) Authorize the investment of surpluses by applying the provisions of Article L.2224-11-1 of the CGCT; (c) Implement efficiently the new accounting standards from instruction M49 applicable to water and sanitation services ; (d) Determine by regulatory means the content and presentation of the CARE contractor, to render it comparable to the estimated operating account appended to the contract ; (e) Postpone until 30 September the presentation of the annual report on the price and quality of the service, in order to enable the organizing authority to prepare an expert opinion based on the information provided by the contract holder ; (f) In order to have a database on water pertinent for the entire territory of France, improve the operations of the information system for the public services of water and sanitation by establishing a requirement to submit all the performance indicators for the public services with the greatest weight nationally. Further details about this example are available at:

<https://www.ccomptes.fr/fr/documents/22077>

SAI of Kuwait: Report of the evaluation of the efficiency of sanitation activity (2013)

Effectiveness and efficiency of the sanitation process, programs, treatment and internal control of the wastewater management. The scope of the audit covered all the projects and government programs that were carried out during the 2007-2012 period. The main conclusion of the audit is that there is a low level of coordination among the different stakeholders involved in the implementation of projects and programs related to wastewater. This weakness is the main reason why these projects have not been forthcoming so far. Therefore, the coordination process needs to be speeded up to complete the projects in a timely manner.

SAI of Morocco: Delegated management of local public services (2014)

The Moroccan Court of accounts has examined the measures taken by public entities (both at national and local level) to promote and invest in the field of wastewater, under a theme entitled "Delegated management of local public services ". The main objectives of this theme were: 1) To draw up a diagnosis of this management method in terms of strengths and weaknesses: socio-economic efficiency for the citizen, quality of service for the user, efficiency of public choices for the taxpayer; 2) Draw lessons from delegated management through the review of the execution of a sample of significant contracts; 3) Suggest ways of reform and / or improvement. For the realization of the theme, the Court relied on the exploitation of a questionnaire relating to the management of local public services which was sent to all urban and rural communes, on the previous audit reports carried out by the Regional Courts of Accounts dealing with the same subject and on benchmarks and good practices. The work team also organized workshops and working sessions with key stakeholders in delegated management, in particular the chairpersons of communal councils, the heads of the Ministry of the Interior, the Ministry of Finance and the Ministry of Environment, ONEE and managers in different delegated companies. The mission also engaged experts in the areas of delegated management, including aspects related to the preparation of institutional frameworks, the negotiation of contracts and the management of local public services. In relation to the subject of wastewater, the results of the theme showed both positive progress and negative aspects. The

positive points are that because of the use of delegated management and the "National Program for Liquid Sanitation and Wastewater Treatment" Morocco has been able to catch up with investments, especially in liquid sanitation, to create wastewater treatment plants in large cities (Casablanca, Rabat, Tangier, Tetouan). Several indicators confirm this trend: the connection rate to the wastewater network rose to 72% compared with 70% in 2005; the wastewater treatment rate in relation to the total volume increased to 28% compared to 8% in 2005, representing 210 Mm³ per year; 16% of volumes are processed at the tertiary level; 75 polluted water treatment plants (WWTP) have been completed, including 30 with the tertiary level; 50 other WWTPs are under construction including 15 with tertiary treatment. But, despite the efforts made, the wastewater still escapes the treatment process and that reuse remains minimal compared to the potential offered. Indeed, it was noted that the legal texts governing delegated management have become inappropriate and do not allow to meet all the constraints and contractual challenges posed by the problem of wastewater. Similarly, significant differences were recorded in structuring projects, especially in the sanitation sector, such as emissaries, pre-treatment stations, interceptors and collectors. Finally, the theme ends with recommendations that aims to improve the current situation of wastewater management. Further details about this example are available at: www.courdescomptes.ma/upload/MoDUle_20/File_20_126.pdf

SAI of Peru: Performance Audit to the Sanitation Services of Rural Homes (2015)

The overall objective of the audit was Explain how the sector normative framework, the oversight and vigilance of the quality of the water for human consumption, contribute to the quality of the sanitation services for rural homes. The problem identified by the audit is that a significant percentage of the rural population has access to sanitation services, but their quality is not adequate, creating a health hazard. The main critical elements related to the problem are: the norms on quality of services and regulation, the oversight on the services provision, and the system monitoring the quality of the drinking water. The general question of the audit is: How do the normative framework on quality and economic regulation, the oversight, and the monitoring of the drinking water quality, contribute to the quality of the sanitation services on rural homes? In order to answer this question, qualitative and quantitative methodologies were applied. In relation to the former, the following tools were used: Documentary archive review, semi-structured interviews and workshops. In relation to the later, mini-surveys were conducted on regional and local governments. The audit found that: (a) the normative criteria on the quality of the sanitation services for rural homes are not articulated, nor are they made explicit in the various technical and normative instruments. This is due to the following: i) the governing body prioritized regulation on the pre-investment and investment phases of the sanitation projects in the rural areas, rather than post-investment. ii) limited information about the sanitation services in rural homes prevents proper decision-making. (b) The family quotas that the rural homes pay do not cover the minimal costs necessary for operating, maintaining, managing, and replenishing the system; (c) The governing body didn't implement mechanism to oversee the compliance with national and sector policies and norms on rural sanitation. It also failed to supervise the provision of the sanitation services; (d) Weak effectiveness on the supervision actions to the communal organization that provide sanitation services to rural homes. Further details about this example are available at:

<https://apps1.contraloria.gob.pe/portal/BuscadorInformes/BuscadorInformes.htm>

2.5 Wastewater Environmental impact

Currently, the environmental impact of wastewater is well established. A large part of wastewater effluent is released into natural environments (lakes, ponds, streams, rivers, estuaries, oceans ...) without any treatment. In addition, despite the case where the wastewater passes through sophisticated treatment systems, the effluents discharged by the treatment systems contain sometimes a hazardous pollutant, because even sophisticated treatment systems are still not able to

remove all pollutants and chemicals from water. The infiltration of polluting elements causes almost irreparable damage to the quality of the environment, as they also affect the ecological biodiversity of aquatic and terrestrial areas. For SAIs, this major risk should not go unnoticed. Several audit reports have been produced to highlight the effectiveness of the measures taken to limit the contamination of the environment by pollutants from wastewater. A number of five audit case studies related to this issue are identified:

SAI of Colombia: Special audit to the management on the Bogotá river (2013)

The overall objective of this special audit is to verify the effectiveness of public spending, in compliance with the collective rights established in our social state of law, in this case the healthy environment, identifying the efficiency, effectiveness and economy of the resources from the national budget that have been invested in the sanitation, adaptation and conservation of the Bogotá river basin. The audit focused on the execution of resources that the entities audited to conceptualize about compliance with the fiscal management principles indicated and issue a concept on the management carried out by each entity in the Bogotá river basin. This auditor process had the General Coordination of the Delegate Comptroller for the Environment, with the participation of the Sectoral Delegated Comptrollers and the Provincial Comptroller Bogotá - Cundinamarca. The audit carried out covered 63 national and territorial entities that have competence in the conservation and preservation of the Bogotá River, as well as in the municipalities of jurisdiction of the basin, through the collection of homogeneous information about the current management. The audit report show two majors findings : (a) 3570 of 2011: Objectives and structure of the Ministry of Environment and Sustainable Development and the Administrative Sector of Environment and Sustainable Development is integrated, chapter I is assigned in addition to those determined in the Political Constitution and in art 489 of 1998, its objectives and functions, as rector of the management of the environment and renewable natural resources, responsible for guiding and regulating the environmental order of the territory and defining the policies and regulations to which the recovery, conservation, protection, ordering, management will be subject , use and sustainable use of renewable natural resources and the environment of the Nation, in order to ensure sustainable development. In addition, the MADS, together with the Presidency of the Republic is responsible for formulating the national environmental policy and renewable natural resources, guaranteeing the right of all people to enjoy a healthy environment and protect the natural heritage and sovereignty of the Nation. As well as direct the National Environmental System (SINA), which guarantees the fulfillment of the duties and rights of the State and of individuals in relation to the environment and the natural patrimony of the Nation. (b) Document Conpes 3320 of 2004, called "strategy for the environmental management of the Bogotá River", recommends to the -MAVDT to carry out activities in the sense of issuing a regulation, with special emphasis on use, reuse and water quality, to support management to obtain economic resources for programs and projects to decontaminate the Bogotá River; provide support to municipalities that need to adjust their -POT-, in the formulation and presentation of new housing projects in the call of the Agrarian Bank for projects linked to rural sector policy programs, lead the confirmation of regional schemes.

SAI of Ecuador: Special examination of environmental control to the wastewater treatment systems of the Municipal Autonomous Decentralized Government (2015)

The choice to conduct this examination aims to achieve three main objectives: (1) To examine the processes of environmental licensing of wastewater treatment systems; (2) To evaluate compliance with the legal, technical and environmental requirements of wastewater treatment systems; and (3) To verify the application of the resolutions issued in the administrative process. This special examination analysed the process of environmental regularization and obtaining the permits for operation and discharge of wastewater, the legal, technical and environmental aspects of the wastewater treatment system; and the compliance, in relation to wastewater, of the contract for the preparation of the Environmental audit, the update of the environmental management plan including the operation of the subsystem of the pumping stations as an integral part of the

wastewater treatment plant and the environmental monitoring of compliance of the projects "Operation and Maintenance of the Wastewater Treatment Plant and the New Potable Water System" of the city. Among the major results of the examination, the following observations should be made: (a) The environmental compliance audit was not submitted, after one year of issuing the environmental license; (b) The corresponding authorizations were not available for the operation of the submarine outfalls and the discharges of the wastewater system, which caused that control by the environmental authority was not carried out; (c) There were no plans or maintenance programs for the wastewater treatment plant and the pumping stations, allowing the wastewater treatment plant and the pumping stations to stop operating for 450 hours and to be discharged into the sea through the by pass, 12 960 cubic meters of wastewater without treatment; (d) There was no interim wastewater monitoring kit, nor the equipment of the WWTP laboratory, provided in subparagraph a) of measure 3 of paragraph 7.3 "Waste management plan", of the Environmental Management Plan, of the ex post esIA "Operation and maintenance of the city wastewater plant"; (e) Quarterly monitoring was not carried out in accordance with the provisions of subparagraph d) of measure 5 "Monitoring environmental and safety factors" of the aforementioned study; (f) The dosage, preparation and placement of the bacteria and chemicals used in the WWTP, did not have technical support, so it is not demonstrated that the concentrations of the solution of bacteria and prepared chemicals used in the WWTP are those required for the removal of the contaminants; (g) The discharges do not comply with the maximum permissible limits established in table 11 "Limits of discharge to a body of seawater. (B) The discharges through submarine emissaries" of the Ministerial Agreement No. 028 that substitutes the Book VI of the Unified Text of Secondary Legislation. Further details about this example are available at:

<http://www.contraloria.gob.ec/Consultas/InformesAprobados/DAPyA-0001-2017>

SAI of Estonia: Sustainability of the state developed drinking water and wastewater infrastructure and its impact on achieving environmental goals (2013)

The National Audit Office audited whether the investments made in water management have helped to achieve the required quality of wastewater treatment and drinking water in the public water supply and sewerage systems, whether the water management infrastructure is sustainable and whether the investments have helped to improve the condition of the water bodies. The audited agencies were the Ministry of the Environment, the Environmental Board, the Environmental Inspectorate, the Environmental Investment Centre, the Competition Board and the Health Board. According to the National Audit Office, despite adequate funds, the state has not managed to keep its promise and make all larger drinking water and waste water systems comply with the requirements. The Ministry of the Environment therefore considers it necessary to invest another 165 million euros of EU money in water infrastructure from 2014-2020. The state has also failed to give sufficient attention to guaranteeing the future sustainability of the drinking water and wastewater treatment systems, the establishment or renovation of which cost a lot of money. There is also more specific findings related to waste water management: (a) The state and local authorities have invested more money in water infrastructure than initially planned; (c) Irrespective of the large investments, waste water is still not collected in the required quantities and many waste water treatment plants have not treated the waste water of urban areas according to requirements and agreed deadlines; (d) The pollution load in many waste water collection areas (agglomerations) may be overestimated, which means that it is not certain that the money allocated for the reconstruction and establishment of waste water treatment systems goes where it is needed the most. Further details about this example are available at:

<http://www.riigikontroll.ee/tabid/206/Audit/2309/Area/15/language/en-US/Default.aspx>

SAI of India: Performance Audit of Rejuvenation of River Ganga (Namami Gange) (2017).

Performance Audit on Rejuvenation of River Ganga seeks to examine: (1) Whether various schemes/projects were planned as per prescribed framework; (2) Whether projects on sewerage, Ghats and crematoria, river front development, canals and rural sanitation were implemented in

accordance with milestones prescribed under Namami Gange in an economic, efficient and effective manner; (3) Whether execution of projects for conservation of flora, fauna and maintenance of river flows were implemented in effective and efficient manner; (4) Whether human resources were adequate. The scope of audit included examination of records at the following entities involved in implementation of projects relating to Rejuvenation of River Ganga. In terms of results, this audit revealed two findings related to the issue of wastewater: the first the non-achievement of targets for Sewage treatment under Namami Gange and the second is that the capacity of the installations put in place remains largely low in order to be able to properly treat the generated wastewater flows. Further details about this example are available at:

https://cag.gov.in/sites/default/files/audit_report_files/Report_No.39_of_2017_-_Performance_Audit_on_Ministry_of_Water_Resources%2C_River_Development_%26_Ganga_Rejuvenation_Union_Government.pdf

SAI of Philippines: Adopt-an-Estero/Water Body Program (is this for biodiversity?) (2015)

By this audit, the SAI of Philippines aimed to determine whether the Adopt-an-Estero program reduced the water pollution and improved the water quality of esteros. The audit focused on the implementation of the program in six regions (NCR, CAR, 3, 6, 9 and 11). The results indicate that the goal to achieve cleaner, safer and healthier environment by reducing the water pollution through the Adopt-an-Estero/Water Body Program has not yet been attained for the past five years in the NCR, Regions 3, 6 and 11 due to: (a) non-abatement of the dumping of domestic wastes and that only 10 percent of the total water body in Metro Manila was adopted as of December 31, 2015; (b) the terms and conditions of the MOA are not fully observed; (c) non-involvement of the residents in the management of the estero; and (d) low enforcement of ordinance on solid waste management in the barangay level. Further details about this example are available at: www.coa.gov.ph –annual audit report

Appendices

Appendix n°1: Institutional aspects (role of national bodies, local government, private sector ...), based on the mini-survey results

Countries	Institutional aspect (role of national bodies, local government, private sector, ...) Based on mini-survey results
Bulgaria	At national level, the water management policy is implemented by the Ministry of Environment and Water, assisted by the Water Management Directorate, and at the basin level - from 4 Basin Directorates, with 16 Regional Inspectorates of Environment and Water conducting monitoring and control of wastewater in the boundaries of their respective territorial range.
Colombia	<ul style="list-style-type: none"> -Ministry of Environment and Sustainable Development: Rector of the Environmental Policy in Colombia. -Superintendence of Residential Public Services: Entity that monitors and controls the adequate provision of public services in Colombia. -Regional Autonomous Corporations at the national level, management as environmental authorities and at the same time cofinance, plans, programs and projects related to wastewater Territorial Entities, which develop and implement plans, programs and projects related to wastewater
Czech Republic	<ul style="list-style-type: none"> -Ministry of the Environment (MoE) -State Environmental Fund (SEF) mediates investment in environmental protection and improvement in the Czech Republic -The Czech Environmental Inspectorate (CEI) is the expert body responsible for monitoring compliance with environmental legislation. It has national jurisdiction. It is established by the MoE.
Ecuador	<p>The Single Water Authority (SENAGUA) is the legal entity under public law that directs the national strategic water system. Its head is appointed by the President of the Republic and has the rank of Minister of the State. It establishes the coordination and the complementarity mechanisms with the Decentralized Autonomous Governments regarding the provision of public irrigation and drainage services, potable water, sewerage, sanitation, wastewater treatment and others established by law.</p> <p>The Agency of Water Control and Regulation (ARCA) coordinates with the Ministry of Environment and the National Health Authority the formulation of policies on water quality and control of water pollution; establishes the coordination and the complementarity mechanisms with the Decentralized Autonomous Governments in relation to the provision of public irrigation and drainage services, potable water, sewage, sanitation, wastewater treatment and others established by law; and, issues a feasibility technical report for the execution of potable water, sanitation, irrigation and drainage projects.</p>
Jordan	<p>National Committee:</p> <p>The committee was formed by instruction from the Cabinet, letter number 57/11/1/6826 of the Prime Minister dated 21/5/2003. The committee was formed under the supervision of the Secretary General of the Water Authority of Jordan and representatives of The Royal Court, Ministry of Environment, Ministry of Health, Ministry of Agriculture, Jordan Valley Authority, National Center for Agricultural Research and Technology Transfer (NCARTT), Royal Scientific Society, Farmers Union, Universities and the Private Sector. The committee will cooperate with the Environment and Water Reuse Unit in all water reuse issues to eliminate overlapping between ministries and to achieve the objective and goals of the unit.</p> <p>The NWRCC will work in close association with the sewerage and wastewater treatment plants committee and with the Jordan Institution for Standards and Metrology (JISM).</p>

<p>Paraguay</p>	<p>National Service of Environmental Sanitation (SENASA): technical body of the Ministry of Public Health and Social Welfare whose function was to promote and build drinking water supply systems in rural populations with less than 10,000 individuals and in indigenous communities.</p> <p>ESSAP is an autonomous agency, provider of drinking water services, sanitary sewer and storm sewer to urban populations, in localities of more than 10,000 inhabitants. There is also the figure of Private Drinking Water Operators, who provide drinking water services in rural and urban areas.</p> <p>Sanitary Services Regulator Entity (ERSSAN): regulates the functioning of the agencies responsible for the preparation, standardization, coordination, execution and control of the national environmental policy and management.</p> <p>The General Secretariat for the Protection and Conservation of Water Resources (DGPCRH) was created in the Secretariat of the Environment (SEAM), which must formulate, coordinate and evaluate policies for the maintenance and conservation of water resources and their watersheds.</p> <p>The General Direction of Conservation and Protection of the Water Resources of the SEAM, fulfills the functions of:</p> <ul style="list-style-type: none"> • Formulate policies for rational and sustainable management of water resources and their basins and raise them for consideration by the Executive Secretariat. • Promote, review, approve and submit to the Executive Secretariat preliminary drafts of creation, regulation, modification and / or updating of laws related to water resources and their watersheds. • Define technical norms related to the management of water resources and propose them to the Executive Secretariat for approval. • Provide technical support to the DFAI in the control and supervision of activities aimed at the exploitation of water resources. • Control compliance with the plans and programs developed. • Develop plans to control the rational and sustainable use of water resources. • Prepare monitoring plans for the renovation processes, maintenance of the basic flows of the water currents, the recharge capacity of the aquifers, the care of the different uses and the use of the water resources, preserving the ecological balance. • Coordinate and actively support current and future policies and regulations related to the conservation of water resources and wetlands. • Evaluate and approve the proposals for technical regulations and preliminary drafts of laws, resolutions and regulations presented by the Hydrology and Watersheds Directorates. • Promote the management of water resources considering their multiple uses. • Execute national and international projects and agreements related to the conservation and preservation of water resources and their watersheds. • Supervise the authorization of the sustainable use of water resources and the improvement of environmental quality. • Promote, jointly with the General Directorate of Conservation and Preservation of Biodiversity, the research and exchange of data and publications related to wetlands and their flora and fauna. • Promote technical training on issues related to water resources and their watersheds. • Conduct international and cross-border technical management with international organizations on issues related to Water Resources, jointly with the Planning Department and with the intervention of the Ministry of Foreign Affairs when appropriate. • Prepare joint work programs in transboundary basins, with the intervention of the Ministry of Foreign Affairs.
<p>Peru</p>	<ul style="list-style-type: none"> • The Ministry of Housing, Construction and Sanitation is the governing body of the sanitation sector. • National Superintendence of Sanitation Services. • The National Water Authority of the Ministry of Agriculture y Irrigation, is the governing body and the normative technical authority of the National System of Water Resources Management.

	<ul style="list-style-type: none"> • The Ministry of the Environment, has among its functions designing, approving, and supervising the application of all the tools for prevention, control and environmental rehabilitation relating to sanitation, with the goal of guaranteeing optimal environmental quality. • The Ministry of Development and Social Inclusion, governing body of the national policies promoting development and social inclusion, is responsible for intervening in the rural aspect of sanitation investment and for maintaining and rehabilitating said systems. • The Ministry of Economy and Finance, is the governing body in economic and financial policy, on a national level and by sectors, applied to all level of government. This ministry is the center of all decisions on public financing, through the assignation of the state budget, and promoting private participation in the sanitation sector. • Regional Governments, that provide technical support for investments, as well as for the planning and financing. • Local Governments, responsible for providing sanitation services, and as shareholders and public utility companies, help plan and finance investments.
<p>Philippines</p>	<p>The Environmental Management Bureau, an attached agency to the Department of Environment and Natural Resources (DENR) implements the Clean Water Act Republic Act No. 9275 dated March 22, 2004” AN ACT PROVIDING FOR A COMPREHENSIVE WATER QUALITY MANAGEMENT AND FOR OTHER PURPOSES”, the following are the roles of different stakeholders on Wastewater:</p> <p>A. Local Government Units (LGUs)</p> <ol style="list-style-type: none"> 1. LGUs - appropriate the necessary land for the construction of the sewage and/or septage treatment facilities in accordance with the Local Government Code; may raise funds to subsidize necessary expenses for the operation and maintenance of sewerage treatment or septage facility servicing their area of jurisdiction; and shall submit to DPWH a priority listing of their projects. 2. The League of Municipalities/Cities/Provinces - shall contribute specific inputs reflecting the interests of Local Government Units (LGUs). <p>B. National Government and Corporate Agencies</p> <ol style="list-style-type: none"> 1. Department of Environment and Natural Resources (DENR) – provide specific environmental criteria & data for the prioritization of sanitation, sewerage, septage management and combination of different systems and projects. 2. Metro Manila Water Supply and Sewerage (MWSS) and Local Water Utilities Authority (LWUA) - provide the responsibilities of concessionaires and water districts in sewerage, septage and sanitation management. 3. Department of Health (DOH) - formulate guidelines and standards for the collection, treatment and disposal of sewage including guidelines for the establishment and operation of centralized sewage treatment system. 4. Department of Public Works and Highways (DPWH) - prepare a national program on sewerage and septage management. 5. Department of Agriculture (DA) - shall coordinate with the Department, in the formulation of guidelines for the re-use of wastewater for irrigation and other agricultural uses and for the prevention, control and abatement of pollution from agricultural and aquaculture activities. 6. Department of Science and Technology (DOST), in coordination with the DENR and other concerned agencies, shall prepare a program for the evaluation, verification, development and public dissemination of pollution prevention and cleaner production technologies. 7. Department of Education (DepEd), Commission Higher Education (CHED), Department of the Interior and Local Government (DILG) and Philippine Information Agency (PIA) shall assist and coordinate with the DENR in the preparation and implementation of a comprehensive program. <p>C. Others</p> <ol style="list-style-type: none"> 1. Water supply utility provider - shall be responsible for the sewerage facilities and the main lines. 2. In areas where there are no existing facilities, the LGUs, water districts or water

	<p>utilities may adopt septage management program or other sanitation alternatives.</p> <p>3. The DENR and the LGUs, in coordination with the appropriate government agencies, and in consultation with the business and industrial sectors including commerce, shall formulate appropriate incentives for the adoption procedures that will preserve and protect our water bodies through the introduction of innovative equipment and processes that reduce if totally eliminate discharge of pollutants into our water bodies.</p> <p>4. Loan from a private bank and equity of a water district to finance its Septage Management Project. Full cost recovery of the project was taken from septage fees collected through the water bills.</p> <p>5. Entering into a joint venture agreement between a LGU and a water district – There will be an equal sharing of capital and operating costs and any future income between the two; the water district will collect and transport septage to the treatment plant; and the LGU will operate and maintain the septage treatment plant.</p>
Portugal	<p>The treatment of urban wastewater is a competence of the municipalities.</p> <p>The situation in Portugal is complex and the situations are very diverse, and the collection and treatment can be done directly by the municipalities or municipal companies or be granted to mixed or private companies. In general, the sewage treatment is done by municipal or mixed companies, but in many situations the treatment plants cover several municipalities.</p> <p>Licensing of the activity and inspection of compliance with the standards is the responsibility of the Portuguese Environment Agency, of the Ministry of the Environment.</p> <p>The regulation of the Sector is made by The Water and Waste Services Regulation Authority (ERSAR).</p>
Thailand	<p>There are 4 ministries involved in the wastewater management in Thailand; i.e.</p> <p>1. Ministry of Industry is responsible for industrial wastewater management by Factory Act, 1992. Industrial wastewater collection, conveyance, treatment and quality effluent standard are controlled by this act. The monitoring and inspection of factory are also included.</p> <p>2. Local authority, such as municipality, district administration, and provincial administration which belong to Ministry of Interior, is responsible for community wastewater management by Building Controlled Act, 1979. Local authority takes charge of the construction of sewerage system and community wastewater treatment plant. The quality effluent standard of all accommodation and building is controlled by this act.</p> <p>3. Wastewater Management Authority and Department of pollutant Control belong to Ministry of Natural Resources and Environment. Wastewater Management Authority takes charge of national community wastewater management policymaker and gives technical advice to local authority. Department of pollutant Control is responsible for water quality control of natural water resources. Both agencies have implemented to follow the Enhancement and Conservation of National Environmental Quality Act, 1992.</p> <p>4. Ministry of Public Health is responsible for human excreta collection, transportation, and treatment. The wastewater from septic tank of toilet or contaminated by human excreta is controlled by Public Health Act, 1992.</p>

Appendix n°2: Key policies, programs or measures adopted, based on the mini-survey results

Countries	Key policies, programs or measures adopted by country, Based on mini-survey results
Colombia	National Plan for the Management of Municipal Residual Waters, National environmental policy for the sustainable development of the Oceanic Spaces and the Coastal and Insular Areas of Colombia, the National Development Plans include topics for integral water management and water decontamination, there is a comprehensive policy of water resource, laws on wastewater management and treatment, water use, dumping management, etc.
Czech Republic	<ul style="list-style-type: none"> CEI – controls of major waste water treatment plants, industrial plants, and sites with

	<p>old ecological burdens, controls of agricultural holdings, fisheries and biogas stations</p> <ul style="list-style-type: none"> • National programs • Operational program of the environment (e.g. Improving water management infrastructure and reducing the risk of floods) • Rainwater subsidy program • Flood protection measures
Fiji	<ul style="list-style-type: none"> • Divisional Master Plans • Fiji National Liquid Waste Management Strategy and Action Plan (2006) • Capital works include improvement & upgrade of wastewater distribution system, relocation of existing wastewater, and automation of WAF Wastewater control system • 5 year and 20 year National Development Plan
India	<ol style="list-style-type: none"> 1. National Water Policy, 2012 2. National Urban Sanitation Policy 2014 3. National Environment Policy 2006 4. National Water Quality Monitoring Programme (NWMP) 5. Nation Mission for Clean Ganga 6. National River Conservation Plan 7. National Lake Conservation Plan 8. Atal Mission for Rejuvenation and Urban Transformation (AMRUT) 9. Smart Cities Mission 9. Nirmal Bharat Abhiyan
Pakistan	<p>There is a hybrid system in Pakistan, in most of the cases the local government and its concerned agencies are responsible for waste management but in few cases, waste management has been outsourced to private companies like Lahore Waste Management Company.</p>
Peru	<ul style="list-style-type: none"> • National Sanitation Policy, approved by the Supreme Decree N° 007-2017-VIVIENDA, the National Sanitation Policy is the set of guidelines aimed at improving the management and performance of the sanitation sector. This policy arose as a way to address the following points: <ol style="list-style-type: none"> 1. Increasing the coverage, quality and sustainability of sanitation services, with the aim of achieving universal access. 2. Reducing the infrastructure gap in the sector and insuring priority access to sanitation services for rural and poor populations. 3. Attaining business autonomy and integration for the sanitation service providers. 4. Increasing the efficiency of the sanitation service providers with high indicators of quality, continuity and coverage. 5. Achieving sustainable management of the environment and water resources in the provision of sanitation services. <p>The National Sanitation Policy sets as a goal for 2021 a 100% coverage of sanitation services for Peruvians in urban areas, and 84% of Peruvians in rural areas. To date, the Ministry of Housing, Construction and Sanitation reports that over 100,000 Peruvians have been added to the sanitation services by the conclusion of 174 projects. By the end of 2017, over 720,000 Peruvians will have been added.</p> <ul style="list-style-type: none"> • National Sanitation Plan 2017-2021, approved by the Supreme Decree N° 018-2017-VIVIENDA, • Agreement on the delegation of functions and powers with provincial municipalities, signed by the Ministry of Housing, Construction and Sanitation, which states that it will assume responsibility for the improvement of the drinking water and sewage treatment services, in order to benefit thousands of people.
Portugal	<p>The Strategic Plan for Water Supply and Sanitation (PENSAAR 2020), was approved in 2014 and is in progress. The plan reflects the maturity reached by the sector (population served by wastewater treatment over 80%) and includes, in relation to wastewater, the following objectives:</p> <ul style="list-style-type: none"> • Reduction of the urban pollution of the water bodies; • Improvement of the quality of the wastewater sanitation service; • Sustainable cost recovery and optimization of operating costs; • Improvement of the operational framework, the management and the provision of

	<p>services;</p> <ul style="list-style-type: none"> • Increase the availability of information; • Innovation; • Climate change, natural disasters, risks – mitigation, adaptation.
Thailand	<p>The Policy and Prospective Plan for Enhancement and Conservation of National Environmental Quality (1997–2016) recognized the role of local governments and civil society in improving and protecting water quality with the following objectives:</p> <ul style="list-style-type: none"> o Accelerate the rehabilitation of water quality in important water bodies o Reduce water pollution originating from communities, agriculture, and industry o Apply the “polluter-pays” principle o Promote private sector involvement in water pollution management
United states of America	<p>Under the Clean Water Act, the U.S. Environmental Protection Agency has adopted several policies to ensure that waters of the United States meet the intent of the Clean Water Act, which is to provide fishable, swimmable, and drinkable water.</p> <p>Point sources are regulated by EPA under the National Pollutant Discharge Elimination System, as described in previous sections.</p> <p>Nonpoint sources of pollution are managed by a voluntary program called the Total Maximum Daily Load program. The states identify waters that are impaired and identify the sources of impairment. They add limits to permits and develop a TMDL for nonpoint sources of pollution.</p> <p>Stormwater has been gradually added to the point-source permit program</p> <p>Green infrastructure is a relatively new policy to manage stormwater.</p> <p>EPA has numerous settlements and agreements with cities that have combined sewer overflows. Many occur in older cities in the northeastern U.S.</p> <p>EPA has an affordability policy that allows for integrated planning for wastewater infrastructure. This policy allows cities who are facing large infrastructure investments to prioritize their investments based on an affordability calculation.</p>

Appendix n°3: Financial mechanisms and instruments, based on the mini-survey results

Countries	Financial mechanisms and instruments, Based on mini-survey results
Bulgaria	<p>Operational Programme Environment, Priority Axis 1: Improvement and development of infrastructure for drinking and wastewater as well as improvement of ambient air quality. The main activities financed under the priority axis are the construction of sewage treatment plants and sewerage networks for agglomerations of settlements with a population of more than 10000 eq., Construction of wastewater treatment plants and sewerage networks for agglomerations of populated areas 2000 - 10000 eq. and those below 2000 eq. falling within urban agglomeration areas, as well as development and updating of river basin management plans, activities related to the delivery of leakage detection and measurement equipment, as well as provision of treatment facilities of sludge from urban waste water treatment plants as well as preparation of investment projects for subsequent financing under priority axis 1.</p> <p>-Rural Development Programme, Sub-measure 7.2. Investments in creating, improving or expanding all types of small-scale infrastructure</p>
Peru	<p>One of the axes of the Policy refers to the following:</p> <p>Policy Axis 2: Financial sustainability</p> <p>Specific Goal: Guarantee the generation of economic resources and their efficient use by the providers</p> <p>Policy Outlines:</p> <ol style="list-style-type: none"> 1. Plan long term investment on a national, regional and local level, for the drinking water, sewage, and sewage treatment services according to the type of provider.

	<ol style="list-style-type: none"> 2. Assign economic resources according to the Multiyear Investment Plan and national goals. 3. Leverage the assignment of the national government's budget resources with the resources available to the regional and local governments. 4. Assign public resources by linking them to specific oriented to closing the gaps. 5. Promote the sustainability of infrastructure investments. 6. Make it so that the fees guarantee the investment goals and the financing structure. 7. Establish that the internal generation of progressive cash flow be the main source of financing for the country's sanitation infrastructure, as well as for its adequate and efficient management, operation and maintenance. 8. Progressively implement a system of crossed subsidies 9. Assign funds according to quality and efficiency indicators, in order to guarantee the sustainability goal.
Portugal	<p>Financing by Operational Programme for Sustainability and Efficiency in Resource Use and Regional Operational Programmes and also by own resources. The cost of the investment to be undertaken as proposed in the PENZAAR 2020 (water supply and wastewater treatment) is estimated as follows:</p> <ul style="list-style-type: none"> • Environmental protection, improvement of the quality of the water bodies – 918 M€ • Improvement of the quality of the services provided – 739 M€ • Optimization and efficient management of resources – 1,828 M€ • Economic, financial and social sustainability – 12 M€ • Basic and cross-cutting conditions – 208 M€

Bibliography

- Corcoran, E. Nellemann, C., Baker, E., Bos, R., Osborn, D. and Savelli, H. (eds). 2010. Sick Water? The Central Role of Wastewater Management in Sustainable Development. A Rapid Response Assessment. United Nations Environment Programme/United Nations Human Settlements Programme/GRID-Arendal (UNEP/UN-Habitat).
- Culp, G. L. and Culp, R. L. 1971. Advanced Wastewater Treatment. New York, Van Nostrand Reinhold Environmental Engineering Series.
- Heymann, E., Lizio, D. and Siehlow, M. 2010. World Water Markets: High Investment Requirements Mixed with Institutional Risks. Frankfurt am Main, Germany, Deutsche Bank Research. [www.dbresearch.de/ PROD/DBR_INTERNET_EN-PROD/PRODO000000000258353.PDF](http://www.dbresearch.de/PROD/DBR_INTERNET_EN-PROD/PRODO000000000258353.PDF)
- Massoud, M. A., Tarhini, A. and Nasr, J. A. 2009. Decentralized approaches to wastewater treatment and management: Applicability in developing countries. *Journal of Environmental Management*, Vol. 90, No. 1, pp. 652–659. doi: 10.1016/j.jenvman.2008.07.001
- Miller, K. 1990. « US Water Reuse: current status and future trends », *Wat. Env. Technology*.
- Spiller M, McIntosh BS, Seaton RAF, Jeffrey PJ (2012) An organizational innovation perspective on change in water and wastewater systems – the implementation of the Water Framework Directive in England and Wales. *Urban Water Journal* 9, 113-128.
- Sterner T. 2003. Policy Instruments for Environmental and Natural Resource Management. Washington, DC, Resource for the Future.
- Tchobanoglous (1995), *Wastewater Engineering: Treatment, Disposal and Reuse*. Tata McGraw-Hill Publishing Co. Ltd, New Delhi.
- UNEP (United Nations Environment Programme). 2015. Economic Valuation of Wastewater - The Cost of Action and the Cost of No Action. Nairobi, UNEP. unep.org/gpa/Documents/GWI/Wastewater%20Evaluation%20Report%20Mail.pdf
- UNEP and UNITAR. (2013). *Guidelines for National Waste Management Strategies: Moving from*
- UNICEF/WHO (United Nations Children's Fund/World Health Organization). 2014. *Progress on Drinking Water and Sanitation, 2014 Update*. New York/Geneva, UNICEF/ WHO Joint Monitoring Programme for Water Supply and Sanitation.
- UNESCWA (United Nations Economic and Social Commission for Western Asia). 2015. *ESCWA Water Development Report 6: The Water, Energy, Food Security Nexus in the Arab Region*. Beirut, United Nations. www.unescwa.org/publications/escwa-water-development-report-6-water-energy-and-food-security-nexus-arab-region

- UN-Water. 2015. Wastewater Management: A UN-Water Analytical Brief. UN-Water. www.unwater.org/fileadmin/user_upload/unwater_new/docs/UNWater_Analytical_Brief_Wastewater_Management.pdf
- UN-WATER. 2017. World Water Development Report. <http://unesdoc.unesco.org/images/0024/002471/247153e.pdf>.
- US EPA (United States Environmental Protection Agency). 2012. 2012 Guidelines for Water Reuse. Washington, DC, US EPA. nepis.epa.gov/Adobe/PDF/P100FS7K.pdf
- Winpenny, J., Heinz, I., Koo-Oshima, S., Salgot, M., Collado, J., Hernandez, F. and Torricelli, R. 2010. The Wealth of Waste: The Economics of Wastewater Use in Agriculture. FAO Water Report No. 35. Rome, Food and Agriculture Organization of the United Nations (FAO). www.fao.org/docrep/012/i1629e/i1629e00.htm
- WHO (World Health Organization). 2006. Guidelines of the Safe Use of Wastewater, Excreta and Grey Water – Vol. 2: Wastewater Use in Agriculture. Geneva, Switzerland, WHO. www.who.int/water_sanitation_health/wastewater/wwuvol2intro.pdf
- World Water. 2013. Fresh Thinking to Improve Business and Sustainability. msdssearch.dow.com/PublishedLiteratureDOWCOM/dh_08d9/0901b803808d92c4.pdf?filepath=liquidseps/pdfs/noreg/609-50111.pdf&fromPage=GetDoc

EXPOSURE DRAFT