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MDPI

*Commentary*

# Managing the 'Monitoring Imperative' in the Context of SDG Target 6.3 on Water Quality and Wastewater

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**Abstract:** Monitoring the Sustainable Development Goal (SDG) 6 for water and sanitation builds on monitoring frameworks that were developed for the Millennium Development Goals (MDGs), specifically the WHO/UNICEF Joint Monitoring Programme (JMP). Yet, since SDG 6 goes beyond the MDG focus on drinking water and sanitation, it also significantly expands monitoring and reporting responsibilities. The target to improve water quality (Target 6.3) calls for water quality monitoring and data reporting that are likely to pose a significant challenge to countries that lack an established monitoring program. At the same time, redundant burdens may be imposed on countries that already have established programs and report out water quality data to inter- or supranational agencies. In this context, there is a risk that the intention that water quality data should serve as a basis for evidence-based decision making will become subsidiary to the resource-intensive activities of data collection and management. Alternatively, policies could be designed based on historical experience with measures of proven effectiveness, prioritizing policies that could have multiple benefits. Policies could be implemented in parallel with the development of monitoring programs and conventional monitoring data could be complemented by information gained from sources such as remote sensing and unstructured data.

**Keywords:** FAIR principles; GEMI; GEMStat; open data; UN Water

## 1. Introduction

The Sustainable Development Goals (SDGs) pose many challenges to the nations that adopted them in 2015. For all SDGs, a fundamental challenge is how to assess the progress being made with respect to both the current and desired situations. Thus the definition of targets and indicators is an integral part of the development of the SDGs and their implementation will be accompanied by extensive monitoring campaigns. The SDGs and their accompanying targets are seen as "a management tool to help countries develop implementation strategies and allocate resources accordingly, as well as a report card to measure progress towards sustainable development and help ensure the accountability of all stakeholders for achieving the SDGs" [1].

It is, of course, indispensable to have adequate information regarding a current situation before identifying measures to address its deficits. In 2015, UN Deputy Secretary-General Eliasson referred to data as the "lifeblood of decision-making and the raw material for accountability" [2]. Within UN agencies, credible data are also seen as a pre-requisite to advocacy, political commitment and investment.

At the same time, acquiring information (i.e., monitoring) can be an expensive proposition. Major investment needs (estimated to be on the order of a billion USD) for development of statistical capacity to support SDG reporting have been identified [3]. This has led to concerns that "complex

and expensive indicator frameworks [will] divert already scarce resources" [4]. Furthermore, it is not a simple task to determine which data are necessary and sufficient to support "decision making processes for improved implementation of the SDG targets . . . [since] . . . monitoring of SDG indicators is not about data gathering for the sake of data gathering" [5]. SDG monitoring should support countries in addressing national and regional issues [2]. The difficulty in defining a context-specific optimum for data collection as well as the lack of negative feedback (i.e., associated with costs and whether there is sufficient capacity to manage and use collected data) tend to support a "monitoring imperative" in which more data is always seen as better and the intended use of data in supporting decision making recedes into the background.

An additional level of complexity arises from the interest to use the same monitoring data for cross-country comparisons. Such comparisons would require harmonized monitoring approaches [2] that may not best suit the needs of individual countries. Collecting SDG-related data also entails obligations regarding data management and access. These obligations were recognized at the 5th meeting of the Inter-agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDG) in March 2017 [6]. The discussion highlighted the need to reduce countries' reporting burden through data sharing across international agencies as well as the importance of maintaining access (i.e., attribution) to original data sources, which is often lost in data aggregation.

Several UN agencies are cooperating to develop a new global monitoring initiative, Integrated Monitoring of Water and Sanitation Related SDG Targets (GEMI), to compile data on SDG targets 6.3–6.6, which address wastewater treatment and water quality, water use and use efficiency, integrated water resources management (IWRM) and water-related ecosystems [2]. In this commentary, SDG target 6.3 is taken as an example to illustrate issues related to monitoring, both generally and in the context of supporting national objectives. The perspective of a country with well-developed capacity for water quality monitoring (i.e., Switzerland) reveals some of the tensions related to data delivery and harmonization. Experience in industrialized countries with water quality monitoring and with the successful implementation of measures to improve water quality provides some insights that may be valuable to low- and middle income countries (LMICs) that lack a fully-developed capacity for water quality monitoring.

## 2. Monitoring in the Context of Target 6.3

Target 6.3 has the aim to improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and increasing recycling and safe reuse globally by 2030. Progress toward this target will be assessed on the basis of two indicators: 6.3.1, the proportion of wastewater safely treated, and 6.3.2, the proportion of water bodies with good water quality [7].

Target 6.3 is an extension of the Millennium Development Goal (MDG) target 10 (Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation), which was defined under Goal 7, Ensure environmental sustainability [8]. This extension recognizes that access to basic sanitation (i.e., a toilet) is only one step in a chain that includes containment, emptying, transport, treatment and reuse/disposal [9]. Nonetheless, the experience with monitoring for this MDG target and the capacity for data management that has been developed [10] provides a basis for acquiring and handling monitoring data for indicator 6.3.1. Although the SDGs (unlike the MDGs) also apply to industrialized countries, these countries generally have data available on sewer connection rates and treatment levels [11] that can serve as the basis for reporting for indicator 6.3.1.

In contrast, indicator 6.3.2 corresponds to water quality monitoring that is routinely performed in industrialized countries and often reported out to regional entities, such as the Organization for Economic Cooperation and Development, OECD, or the European Environment Agency, EEA. A Global Water Quality Information System (GEMStat) established through UNESCO is hosted in Koblenz, Germany [12], but indicator 6.3.2 is not included in the Global SDG Indicators Database [13] nor in the SDG Index & Dashboards [14]. Although GEMStat includes water quality data from existing

monitoring networks in LMICs as well as industrialized countries (Figure 1), water quality data in LMICs are often scarce and/or of variable quality [15]. Significant efforts have been made to improve data availability in LMICs, for example through cooperation among African nations [16].

### *2.1. Issues Related to Data Ownership, Management and Quality*

Although reporting for target 6.3 focuses on the national level, data ownership does not always reside at this level. In Switzerland, ownership of water resources and the data associated with them mainly resides at the level of the federal states (Cantons) and, in one Canton, even at the community level. Nonetheless, the Swiss Federal Agency for the Environment (FOEN) delivers water quality data to the Swiss Federal Statistical Office and, directly or indirectly, to the EEA and Eurostat. Furthermore, water quality data pertaining to international boundary waters are delivered to responsible international organizations (see Section 2.2). Within Switzerland, the FOEN is responsible for reporting on SDG targets 6.3–6.6.

The proliferation of databases for water quality data is not, per se, a problem. Ideally, the replication of data among multiple databases would be accompanied by a clear attribution to the data originator as well as sufficient and appropriate metadata. This would help to ensure that (monitoring) data would be FAIR, that is, Findable, Accessible, Interoperable, and Re-usable [17]. In the absence of harmonization and cross-referencing among databases, however, there is a tendency for parallel reporting requests to be made and for the associated reporting burdens to expand. Confusion may also arise if there are real, or even apparent, inconsistencies among various databases. It is possible that the trend toward open data may bring much-needed attention to data management issues in the context of improving the consistency of open data and official statistics [18]. In this context, consistent standards for data quality are crucial. This requires careful attention to detail, for example sufficient identification of wells, sampling protocols and laboratory quality control in the case of databases for agrichemicals in groundwater [19]. These considerations pose particular problems when examining long-term, historical data and/or when comparing data collected by different agencies in different locations.

### *2.2. Issues Related to Transboundary Waters and Cross-Comparisons*

The most obvious need for international harmonization of monitoring methods and data management arise in the context of international boundary waters. For Switzerland, this involves especially the large international lakes (Constance on the border with Austria and Germany, Geneva on the border with France, and Maggiore and Lugano on the border with Italy) and rivers (e.g., the Rhine). Switzerland is a member of international commissions (Table 1), which mediate common monitoring efforts and provide access to shared data. Within Switzerland, some issues of harmonization also arise across the cantonal boundaries since the operation of monitoring programs may vary in different Cantons.

In the context of monitoring progress toward the SDGs globally, some basis for international cross-comparison would also be needed. For SDG 6, data on access to improved water sources and sanitation facilities (i.e., targets 6.1 and 6.2) as well as on freshwater withdrawals (target 6.4) have been used to construct an SDG Index and Dashboard [14]. Extending this index to include water quality data (i.e., target 6.3) would involve substantially more effort and raises the question of the value of comparison at the global scale as opposed to the regional scale at which countries are more likely to have overlapping national interests and priorities.

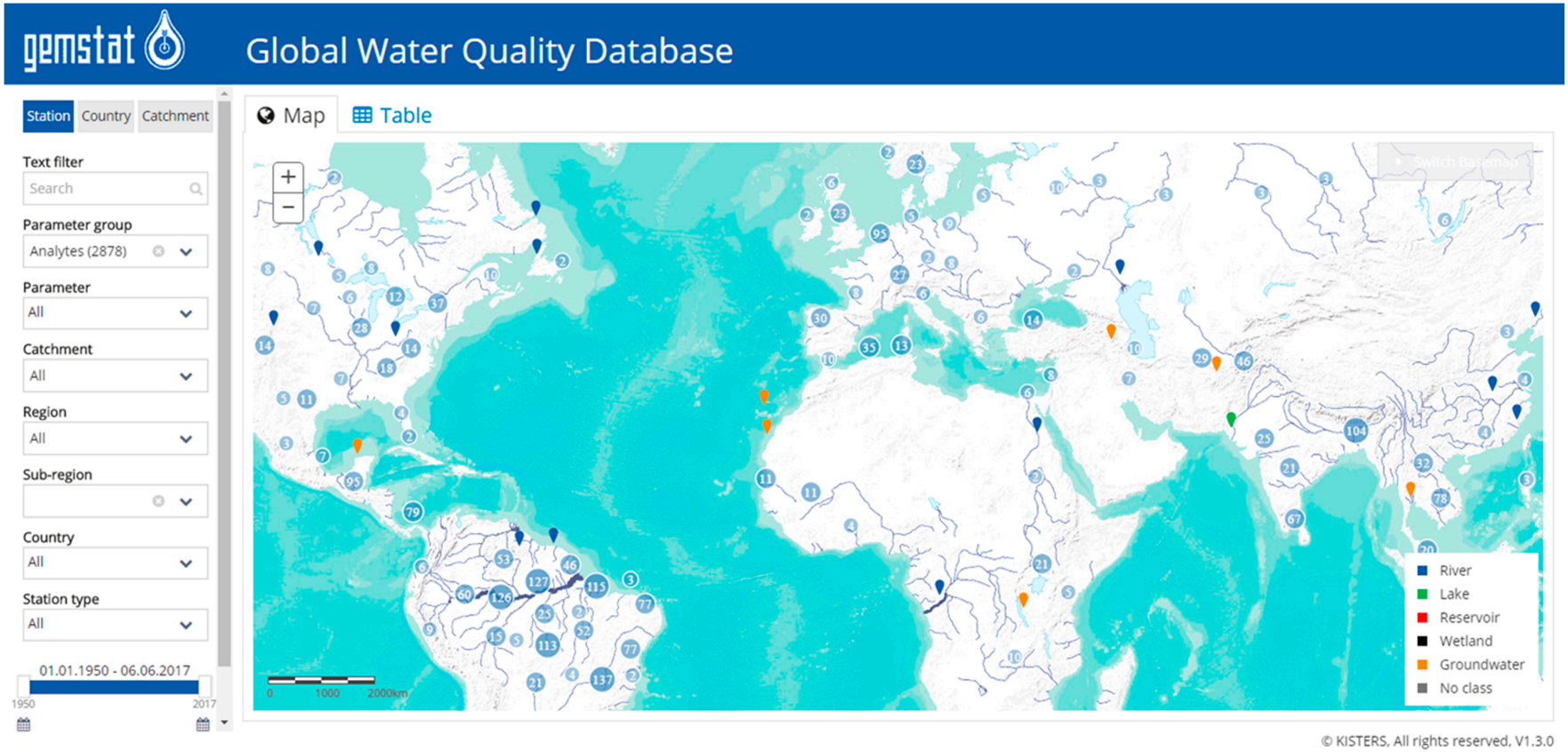


**Figure 1.** Monitoring stations included in Global Water Quality Information System (GEMStat) [12]. Numbered circles indicate clusters of sampling points, which may be of different types (e.g., river, lake). The numbers in the circles correspond to the number of sampling points (darker circles have higher numbers of sampling points). Source: P. Saile (BfG). Used with permission.

**Table 1.** International commissions in which Switzerland participates that provide access to water quality data.

| Name of Commission | Name of Webpage | Link | Comments |
| --- | --- | --- | --- |
| International Commission for the Protection of Italian-Swiss Waters | Lago di Lugano (Lake Lugano) | http://www.cipais.org/html/lago-lugano.asp | Italian only. CIPAIS. Commissione Internazionale per la Protezione della Acque Italo-Svizzere. Links to reports under "Pubblicazioni" |
| | Lago Maggiore | http://www.cipais.org/html/lago-maggiore.asp | |
| International Commission for the Protection of Lake Geneva | Rapport Scientifique (Scientific Report) 2017 | http://www.cipel.org/le-leman/rapport-scientifique/ | Mainly in French. CIPEL. Commission Internationale pour la Protection des Eaux du Léman. No database for water quality data. |
| International Commission for the Protection of the Rhine | Water Quality Data | http://www.iksr.org/en/topics/water-quality/water-quality-data/index.html | |
| International Water Protection Commission for Lake Constance | BOWIS (Bodensee-Wasserinformationssystem) | http://www.igkb.org/aktuelles/bowis-bodensee-wasser-informations-system/ | German only. IKGB. Internationale Gewässerschutzkommission für den Bodensee |

### *2.3. Issues Related to the Alignment of SDG 6 Monitoring Data with National Priorities*

For Switzerland, national priorities for improving water quality focus on reducing the inputs of micropollutants by upgrading wastewater treatments plants (WWTPs) and of plant protection products by managing diffuse sources. With revisions to the Swiss Water Protection Law beginning in 2010 and including a financing plan adopted in 2014, approximately 13% of Swiss WWTPs will be upgraded to remove micropollutants by 2040 [20]. The Federal Office for Agriculture is leading the development of an Action Plan for Plant Protection Products [21] with the goal of reducing the risk of these substances in the aquatic environment by 50%.

Managing point and diffuse sources of pollutants presents quite different needs and challenges with regard to water quality monitoring. For example, the identification of WWTPs for upgrading could be made on the basis of population density, dilution in receiving waters and proximity to drinking water intakes and the success of implemented measures can be assessed by reduction in the toxicity of WWTP effluent [20].

In contrast, the inputs of diffuse sources can (by definition) only be tracked by assessing the quality of receiving waters. Source attribution, however, requires detailed attention to the pathways by which pollutants travel from the source area(s) to the receiving water as well as other variables (e.g., application rates, rainfall) that may be highly variable in space and time [22]. Intensive monitoring campaigns have demonstrated substantial temporal variability (i.e., peak concentrations) especially for streams and small rivers [23,24] that are unlikely to be captured in conventional water quality monitoring programs. In addition, such conventional programs address known target analytes and are insufficient to track novel or emerging contaminants. The precautionary principle provides justification for ancillary, exploratory monitoring [25].

Thus, for Switzerland, the water quality monitoring that would be most relevant to assessing the progress toward national goals is quite distinct from the routine water quality monitoring that is most amenable to international comparison and harmonization. Since Switzerland already delivers routine water quality monitoring data to European agencies, the value of additional efforts to tailor such data for alternate reporting channels such as GEMI is questionable from a national perspective.

## 3. Some Implications of the Swiss Historical Experience with Water Quality Monitoring

Like many industrialized countries, Switzerland experienced significant degradation of surface water quality in the decades following the Second World War. For example, eutrophication associated with excess phosphorus (P) inputs resulted in oxygen depletion in the bottom waters of some lakes and loss of some fish species. Measures taken to control both point sources (i.e., P removal in WWTPs) and diffuse sources (i.e., improved P management in agriculture) have been successful in reversing eutrophication to varying extents in different lakes [26,27]. Historical water quality monitoring data have been essential in tracking the effectiveness of mitigation measures and in evaluating the ecological

impacts of eutrophication [28]. While this example demonstrates the value of long-term monitoring data, it also suggests that such historical experience could be a viable justification for mitigation (especially of point sources) even in the absence of extensive water quality data. Arguably, there would be no need to wait for the establishment of water quality monitoring programs to take measures to reduce the discharge of untreated or inadequately-treated sewage into receiving waters. This is reflected by indicator 6.3.1, which tracks the proportion of wastewater safely treated.

## 4. Monitoring that Is Responsive to National Needs and Resource Constraints

The central tenet of target 6.3 is to improve water quality. Individual countries must decide what types of improvements are most important and feasible both in the national context and in the context of bi- or multilateral agreements regarding international boundary waters. Some water quality data are likely to be needed to define these priorities, but it is also likely that other types of data (or information) could be combined with (or even sometimes replace) water quality data for this purpose. As suggested by the example in Section 3, information on the location and level of treatment at WWTPs could substitute for (or at least help to guide) the collection of water quality data. Data from remote sensing, including aerial photography, citizen science initiatives or unstructured data (e.g., from citizen complaints, purchases or web searches associated with water-borne disease outbreaks) could also be mined (as a complement to conventional water quality monitoring) to target degraded water bodies [29].

On the basis of past world-wide experience with sources of contaminants and their impacts on the water environment, policies and/or interventions could be defined and implemented in parallel to the development of water quality monitoring programs in LMICs. Policies and/or interventions (e.g., leakage reduction in water supply or sewer systems) that would have multiple benefits (especially under a variety of scenarios for future development or climate change) should be emphasized. In the context of climate change adaptation, such policies and/or interventions are often referred to as no- or low-regret strategies [30]. Admittedly, this would compromise the ability to track improvements in water quality relative to pre-intervention conditions. The associated benefits to the environment and human health from the implementation of measures with proven value would, however, be gained sooner than if implementation were delayed due to a lack of baseline data. This is a trade-off that should, at least, be considered explicitly.

For countries, like Switzerland, that have a well-established water quality monitoring program, a two-fold track should be considered. For routine water quality monitoring data, there should be an emphasis on facilitating the reuse of data that are already reported out to national statistical offices and regional agencies such as the EEA. By promoting the interoperability (or at least the cross-referencing) of existing databases, multiple demands on national agencies can be reduced. At the same time, the growing availability of alternatives (e.g., social media) to official monitoring data compiled in structured databases should be recognized and increasingly accommodated. This would include citizen science efforts such as Project Baseline [31]. The combination of open data with national reporting statistics poses considerable challenges [18] but also a considerable expansion of information relevant to improving water quality, particularly with regard to spatial and temporal coverage [29].

Even well-established routine water quality monitoring programs, however, are unlikely to provide the data needed if industrialized countries (like Switzerland) define innovative and challenging national targets to improve water quality. In such cases, a targeted, specialized monitoring program may make more sense than expanding a routine monitoring program to include new analytes.

The current guidance provided by UN agencies related to SDG 6 naturally focuses on monitoring [32,33]. Although UN agencies can obviously not engage in the definition of national goals, this has the tendency that the intended role of monitoring (i.e., to support national policy) recedes into the background. The goal of improving the scientific evidence base for decision making is laudable. In addition, monitoring can serve to maintain awareness of environmental quality issues and to build support for political decisions. It should not, however, be the case that the resource demands

associated with monitoring divert attention, effort and resources from the underlying assessment and definition of national needs.

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