Global Environment Monitoring System for Water (GEMS/Water)

SRI Congress Report

14th June 2021 | 9AM – 10:30AM (CEST)

Virtual Session

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1. General Information

1.1. Background

The Sustainability Research and Innovation (SRI) Congress series is the world's first transdisciplinary gathering for leading researchers and change-makers in sustainability science. A joint initiative of Future Earth - the largest global network of researchers and scholars in sustainability - and the Belmont Forum - the largest international consortium of public research funding agencies exclusively dedicated to transdisciplinary sustainability science - SRI is a global platform for sustainability scholarship, transdisciplinary science, and cross-sectoral research collaboration. The first SRI Congress (SRI2021) was held virtually and onsite in Brisbane, Australia from June 12-15, 2021.

Engaging with Future Earth provides access to the largest global transdisciplinary network of sustainability scientists and researchers. For UNEP, which is represented in the Future Earth Governing Council and the SRI2021 Program Committee, participation at the first SRI Congress offered multiple opportunities and benefits. These benefits included showcasing UNEP-led projects to the global research community, accessing new academic discussions and expertise through direct engagement with global leaders in sustainability science and advocating discussion on issues vital for UNEP's agenda.

Key for UNEP's engagement with Future Earth is to advocate and promote sustainability science and to find solutions for societal transformation. Hence, participation at the SRI2021 offered an opportunity to discuss upgrading and modernizing global environment monitoring, a key function in UNEP's mandate, and to build partnerships to push the renovation of Global Environment Monitoring System/s, GEMS, into a digital age and to mobilize society at large. UNEP was represented at the SRI2021 via the "GEMS Series", a three-part exploration of different GEM-Systems for the Earth's vital shared resources - Water, Air and Ocean. In this context, the different GEMS each held a session exploring the opportunities and challenges of environment monitoring across time, space, and political boundaries.

1.2. GEMS/Water Session Abstract for the SRI2021

Title: ***Moving towards a Holistic and Inclusive Global Water Quality Monitoring – Leveraging Emerging Technologies and Global Partnerships to inform Climate, Nature and Pollution Action***.

Original GEMS/Water session abstract that was displayed on the SRI2021 webpage: The world is facing growing water quality challenges due to serious and increasing water pollution, both in developed and developing countries. This poses a mounting risk to public health, food security, biodiversity and other ecosystem services. Monitoring the world's freshwater resources is a critical step in shaping any coherent water quality policy and is indispensable to responding to current water quality challenges arising from climate and pollution pressures as well as the destruction of natural capital. UNEPs Global Environment Monitoring System for Freshwater (GEMS/Water) Programme has been mandated to keep the state of the world's freshwater resources quality under continuous review. The success of the mandate relies both, on access to and processing of existing data and on fostering innovation and emerging technologies as well as society engagement, as they play an increasingly vital role in monitoring and assessing water quality globally and in building water ownership.

This session aims to think out of the box. Key is to define how to do business differently, to make global environment monitoring fit for future purpose in the 2030 Agenda and beyond and to build effective partnerships. The session will review the GEMS/Water engagement with national custodians of data, and the potential and limitations of those data in supporting decision-making to accelerate sustainable water quality management. It will further present new challenges and opportunities of emerging technologies (such as modelling, Earth Observation, Big Data, AI, citizen science etc.) for global water quality monitoring. The main focus will lie on how and to what extent these new technologies can contribute to fill the massive data gaps and allow GEMS/Water to go beyond providing opportunistic in-situ water quality information. The input of the speakers will catalyze the discussion on how to achieve holistic monitoring of water quality in often data scarce surroundings. The underlying question of this session will therefore be how global water quality monitoring needs to be modernized and improved to provide the greatest possible end to end benefit for users in science-policy processes (i.e., governments, decision-makers, scientists, civil society, businesses) - and – with whom to partner to achieve this goal.

1.3. Introduction

1.3.1. Objectives of the session

UNEP GEMS/Water opened the session with short welcoming remarks and a brief overview of the agenda and objectives of the session. The primary objective of the GEMS/Water session at the SRI2021 was to initiate the redesign process of global water quality monitoring. GEMS/Water, as a key service function of UNEP, needs to map onto the three thematic subprograms of climate action, nature action and chemicals and pollution action, as stipulated in UNEP's recently adopted new Medium-Term Strategy (MTS) 2022-2025. This will assure it remains relevant, meaningful and fit-for-purpose in the Agenda 2030 and beyond. The session therefore aimed at:

- **building effective partnerships** with regard to new technologies that have the potential **to fill data gaps** and allow GEMS/Water to go **beyond receiving and thus providing primarily opportunistic *in-situ* water quality information**.
- **collecting views** and **stimulate input** from participants to engage and recommend partners – start **building the network towards a collective action plan**.

1.3.2. General Information about GEMS and GEMStat

Please click here to view the presentation.

Following the opening remarks, Hartwig Kremer (UNEP) provided an overview on the urgency and importance of monitoring water quality for sustainable development. This included an introduction of the current status of GEMS/Water as well as a short presentation outlining the vision of how GEMS/Water should align and map to UNEP's MTS in the future (see Figure 1). What must be emphasized is that in order to be of maximum utility to Member States as well as to society at large, GEMS/Water needs to go beyond primarily receiving and thus providing opportunistic in-situ data on water quality. It is imperative that GEMS/Water continues its efforts to enhance coverage in spatial, temporal and parameter terms and, therefore, to embrace earth observation (EO) as well as modelling, artificial intelligence (AI) and citizen sciences as additional and complementary means of data collection. This is critical, since UNEP Member States expect monitoring to be about much more than just compiling data. It is really meant to be a service function aiming at informing and transforming action in an end-to-end value chain (see

Figure 2). The critical importance of Global Environment Monitoring Systems for UNEP can be illustrated by its prominent position within the organization's data strategy, where it represents one of seven vital services (see Figure 3).

Phillip Saile (GEMStat) continued with the introduction and gave a short presentation about global water quality and data collection. He provided an overview on the Global Water Quality database and information system (GEMStat), which has mainly been collecting data from governmental sources for almost 50 years. The approach of primarily collecting in-situ water quality data provided by governmental sources comes with its own challenges/limitations, the biggest of which is convincing county authorities to share and update their data with GEMStat in the first place. Furthermore, many organizations and institutions in both developed and developing countries lack adequate data management systems and capabilities, which ultimately leads to low quality data being shared. Apart from spatial and temporal gaps in currently available data and information, another challenge is the lack of an internationally agreed and harmonized format for managing water quality data.

Figure1: MTS Readiness – Implications for Global Environment Monitoring Systems and examples for information flows and uptake

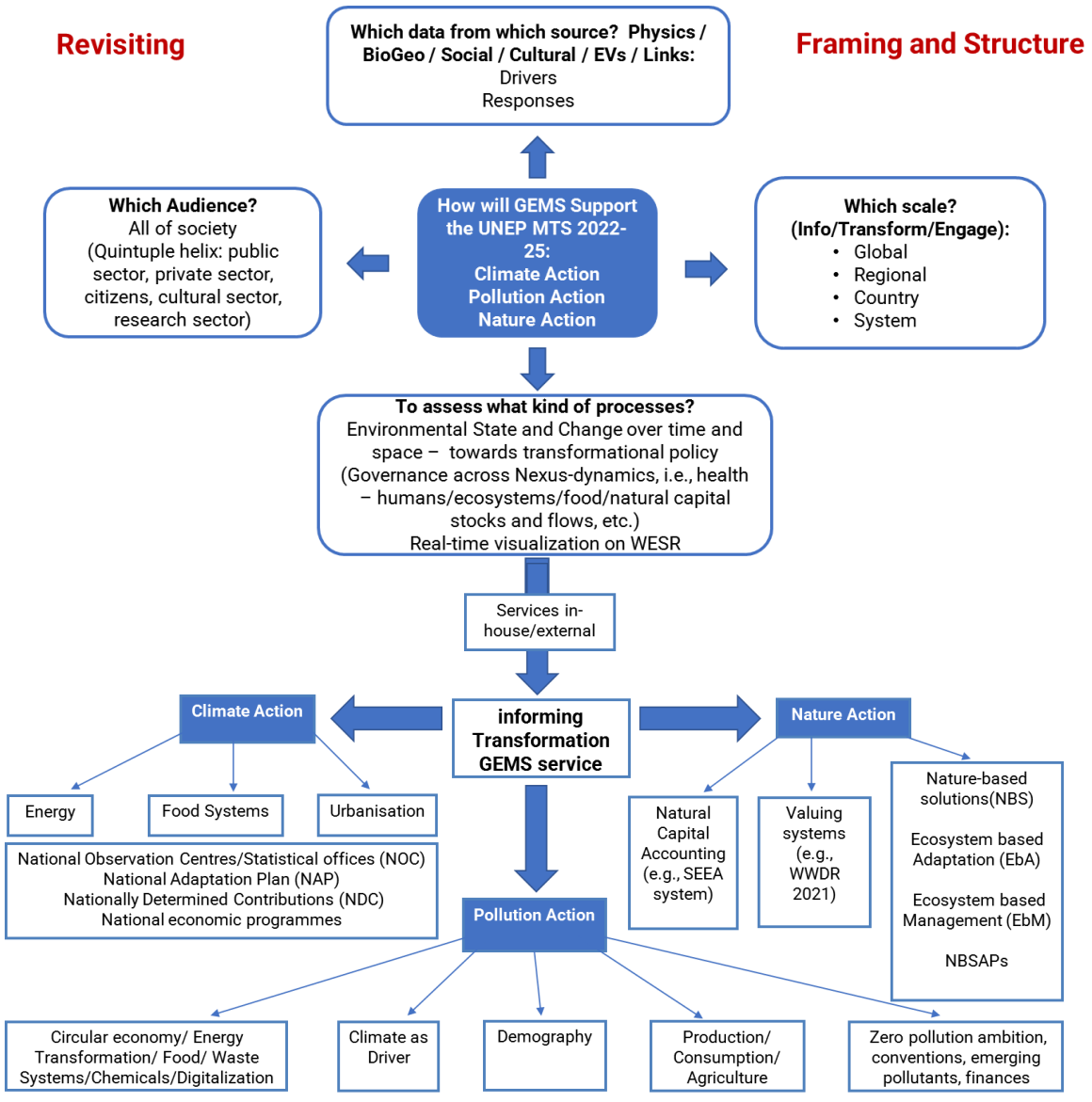


Figure 2: From monitoring to actionable information (monitoring (triangle) as a consortium effort providing end to end value from environment under review to actionable information, innovation, pilot projects and scaling. It combines Observation technology, technology innovation and social process at scale)

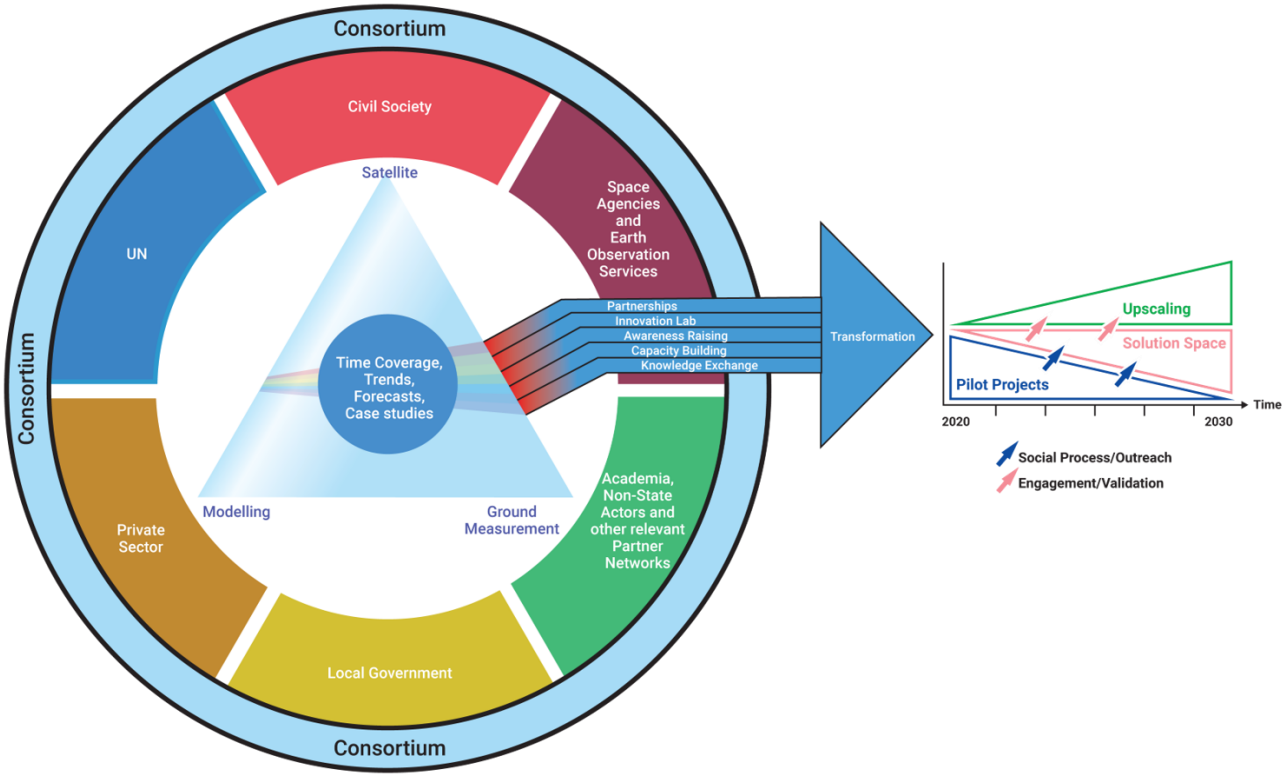


Figure 3: GEMS in UNEP's Data Strategy [1]

[1] UNEP: Conceptual Framework for the Development of a Global Environmental Data Strategy. p. 10. URL: https://wedocs.unep.org/bitstream/handle/20.500.11822/35188/CFDGEDS.pdf?sequence=1&isAllowed=y.

2. Brief Summary of Flash Presentations and Results from the Menti Survey

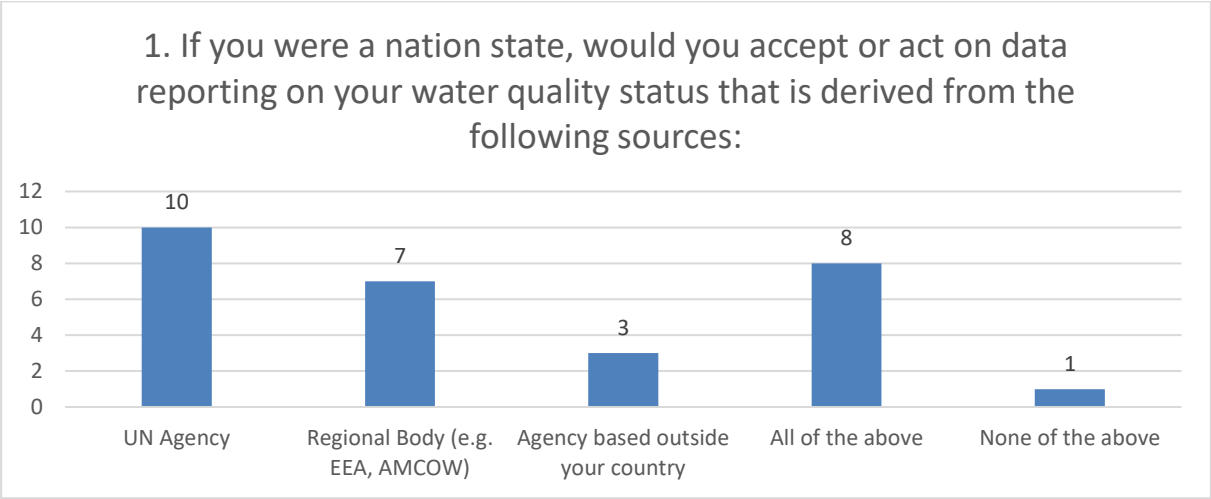
Six brief Flash Presentations were prepared to cover a broad spectrum of ideas, innovations and ongoing activities related to water quality monitoring to provide input to the overall discussion on reviewing and revising the Global Water Quality Monitoring Programme. The presentations are briefly summarized and links to the slides or videos provided for each presentation below.

Parallel to the presentations, participants were asked presentation-related questions through an online polling system (Mentimeter or "Menti"), to which they had the opportunity to respond to during the session. The results of the Mentimeter Survey are displayed under each presentation summary together with a brief analysis[2].

2.1. Presentation 1: The Role of Satellite EO in Holistic and Inclusive Global Water Quality Monitoring (Andrew Tyler, University of Stirling)

Please click here to view the presentation.

The presentation provided an overview on satellite-based earth observation and its utility for monitoring water quality in lakes and surface waters, which was instrumental in developing the first global assessment of inland waters. The question underlying the presentation was **whether data that is derived from sources outside of a given country is acceptable for national policy and management** and whether this data can contribute to global reporting. The concluding statement of the presentation indicated that while we can use EO and technological advances to our advantage when it comes to reporting, **we still need to be inclusive at the national and local level**.



Brief Analysis of the result of the Menti question above: it can be noted that most participants are open to accepting data reported from various reliable sources, even beyond the nation state. However, this is by no means representative for the actual preference of nation states in general terms and public decision-making. It can however be expected and assumed that the trend towards inclusive data acceptance and use in policy will increase in an accelerating digitally

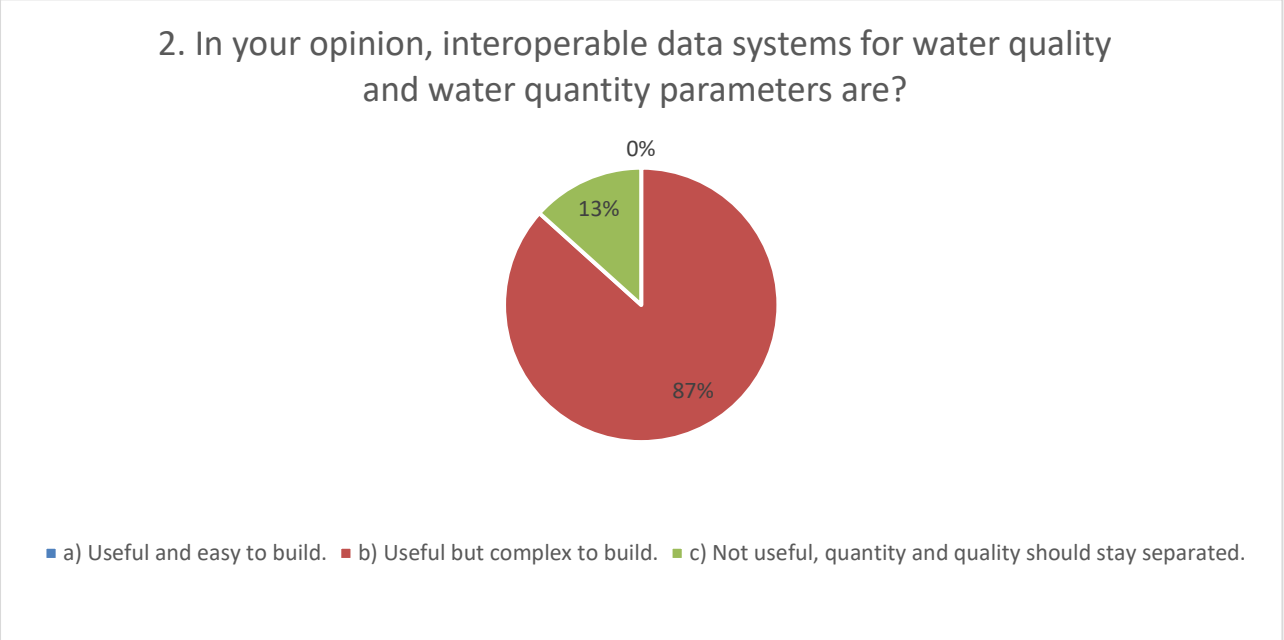
[2] The total number of respondents varied between 10 and 15 session participants for each of the questions. This number only reflects a fraction of the actual session participants and therefore the results of the survey can only be seen as an indication and not as the full response by the session participants.

transforming information society. The results above indicate indirectly that participants would use GEMStat data.

2.2. Presentation 2: A Holistic and Inclusive Global Water Quality Monitoring…and beyond; contribution from WMO Earth System approach (Dominique Bérod, World Meteorological Organization)

Please click here to view the presentation.

The key message of this presentation was that **if we want to understand water quality, we also need information on water quantity**. It was highlighted that WMO can contribute to UNEP and GEMS/Water efforts by building an integrated system for information on the state of water quality and quantity. This will be done by following the WMO Earth System Approach, which looks at the planet as a whole, linking the atmosphere, the ocean and hydrosphere, the terrestrial realm, the cryosphere and the biosphere. The WMO recognizes that collecting water quality data is critical, but also that there is more to it. Ultimately, it is important to ensure that the data collected is actually being used. Thus, **WMO is working on the one hand on a unified data policy for sharing data and on the other hand on technical solutions for data discovery**.



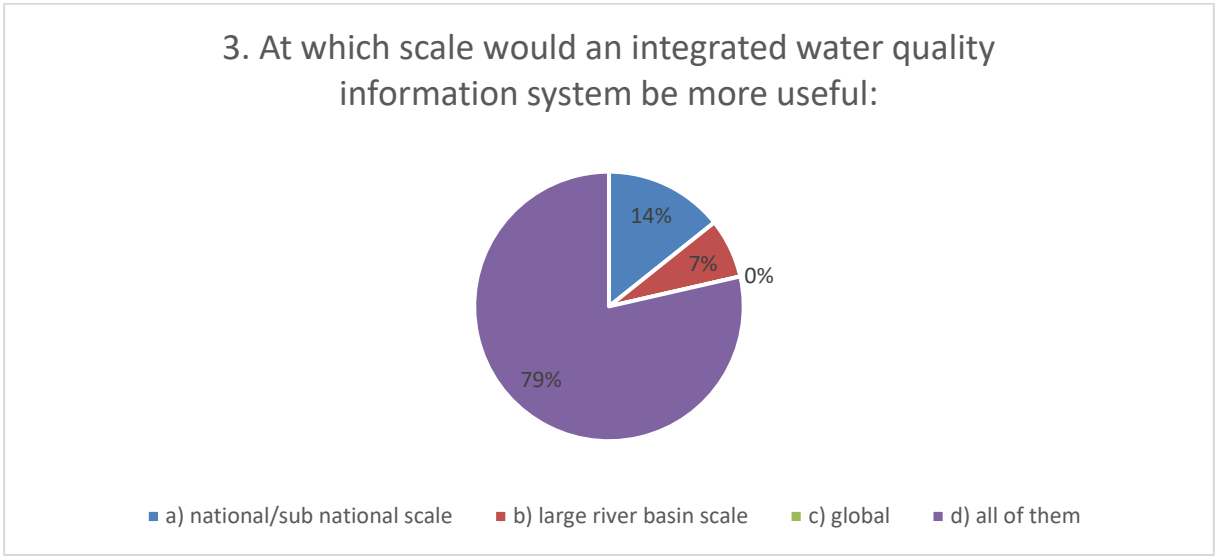
Brief Analysis of the result of the Menti question above: the answers from participants indicate that interoperable data systems for water quality and water quantity parameters are useful but complex to build. However, there are also sentiments that water quality and quantity should stay separated. Relevance for GEMS/Water: Although GEMS/Water is currently focusing primarily on the aspect of water quality, an updated GEMS/Water, together with external collaborating partners as well as with colleagues within UNEP, is aimed to have the ability to provide an interoperable data system for water quantity and quality. The GEMStat host International Centre for Water Resources and Global Change, ICWRGC, at the Federal Institute of Hydrology, Koblenz Germany, is also hosting the Global Run Off data center and data bases are being combined which is pointing into the above direction. Underlying is the growing collaboration of GEMStat in the Global Terrestrial Network for Hydrology, GTN-H.

2.3. Presentation 3: Clean water for a healthy planet – who defines water quality? (Bernd Gawlik, Joint Research Centre of the European Commission)

Please click here to view the presentation.

The underlying question of this presentation was **who defines what good or bad water quality is**. Water quality is defined by the knowledge we have from scientific observations. Whether it is good or bad, however, is based on a value system giving weight to specific aspects. Thus, perception impacts water quality as much as scientific knowledge does. It is essential that in order to manage water and its quality, we need to be able to measure it. With in-situ data collection, EO and modelling we have nowadays a wide array of options for water quality monitoring and assessments for that purpose. The use of these pillars and, where possible, a triangulation of the different sources, has been at the core of water quality assessment and favored such assessments mainly in high resource settings. Yet, water quality presumably matters most where access to clean water is most difficult. To compensate for this situation much attention has in the past been paid to build capacities and somehow export water quality assessment approaches across the globe. An additional pillar that ought not to be overlooked in water quality monitoring is the use of **citizen science**.

Ultimately, water quality is defined by a value system that must be based on objective science, but equally consider subjective perceptions. As a result, this calls for water quality assessment rooted in social engagement. It is **not sufficient to measure water quality for the citizens, but to involve them in the process including to analyze, interpret and derive actionable pathways from the data**. This is because the individual perception will create the political reality of what is good water quality.



Brief Analysis of the result of the Menti question above: the overwhelming majority of participants agreed that it is most useful to have an integrated water quality information system that encompasses the national/sub national scale, larger river basin scale and global scale all together. This shows that while global water quality data are pivotal for the big picture i.e. sketching a global update of achievements or issues of the water quality dimension of SDG 6, it is equally important to provide for integrated monitoring at national/subnational scale and river basin scale. In conclusion, relevance and importance of monitoring data is a matter of matching

scale and deriving actionable information to meet the policy requirements audience where transformation can be enacted. This is the main task of GEMS/Water and to be achieved in partnership.

2.4. Presentation 4: Role of Science to achieve an Inclusive Global Water Quality Monitoring System (Anik Bhaduri, Sustainable Water Future Progamme)

Please click here to view the presentation.

The presentation gave an outline of one of the core projects of Future Earth called Water Future. Water Future, through its partnerships with many researchers and stakeholders, works to harvest and synthesize an authoritative and sound scientific knowledge base to achieve the Sustainable Development priorities associated with water. Water Future is keen to support GEMS/Water's initiative and readiness review process. Science can help to conquer many of the challenges of monitoring via digital water management by utilizing multiple applications for water quality monitoring and management. The concluding statement of the presentation indicated that **digitalization can help many countries to deal with the challenges of minimal time series data as well as lack of data in general to make sound decisions**.

4. In your opinion, what is the purpose of monitoring water quality globally?

Brief Analysis of the result of the Menti question above: the word cloud above shows that all the input to describe the purpose of monitoring water quality globally was quite varied. This shows that there is no visible preference regarding what the priority purpose of monitoring water quality globally should be. It strongly depends on the background and engagement of the respective respondents. What this little experiment shows however, is the multi-faceted character of expectations regarding monitoring, i.e., to provide end-to-end value as observing/"watch dog" function that shall help protect people, nature and resource services as well as to allow for advancement of science and technology and to foster engagement. Therefore,

GEMS/Water through its activities regarding capacity development and upcoming online courses and its operational link to the World Water Quality Alliance and external partners will strengthen its outreach to address a large number of people across whole of society and improve the understanding of the relevance of monitoring water quality globally.

2.5. Presentation 5: World Environment Situation Room (WESR) and global water quality monitoring (Pascal Peduzzi, GRID Geneva)

The presentation spoke about how GEMS/Water can best contribute to the UNEP World Environment Situation Room (WESR) and gave the audience a brief overview of what the platform currently contains and the hopes for the future. Water quality is much more challenging to present than water quantity. **It is possible, however, to achieve water quality data in real time or in relatively close to real time because the technology is there**. A further the key issue of concern is the willingness of countries to share their data. The aim of WESR is displaying available data relevant for UNEP's mandate, transforming it into information and thus supporting decision making for governments and new policies to foster the achievement of sustainable development.

5. In your opinion, which water quality parameters (or variables) are the most important for a global water quality monitoring system (add up to three)?

Brief Analysis of the result of the Menti question above: there is some coherence in the answers in the word cloud in relation to which water quality parameters (or variables) are most important for a global water quality monitoring system. However, two things stand out, first the traditional chemical and physical parameters and composite indicators are seen to remain priority. But second, emerging pollutants and those with direct implications for human and ecosystem health are equally critical. This underlines the focus to be not just on water in isolation but also on the interlinkages with systems such as for instance waste, food, energy, and life cycle considerations of chemicals.

This result is corroborated by GEMS/Water's custodian role for SDG indicator 6.3.2 on ambient water quality. To allow for comparability and ease of reporting, the indicator works with five 'core parameters' (oxygen, salinity, nitrogen, phosphorous, acidification). However, many countries have expressed the wish to include additional parameters which are relevant to certain countries or regions in the context of specific economic activities (e.g. mining) or other sources of pollution.

Again, GEMS/Water can have a major impact through its capacity development activities and the provision of online courses on freshwater quality monitoring and handbooks/manuals (once they are publicly available). It also has a critical role in pursuing and further development of the SDG 6.3.2 monitoring and engagement as well as assisting national capacity in monitoring and reporting.

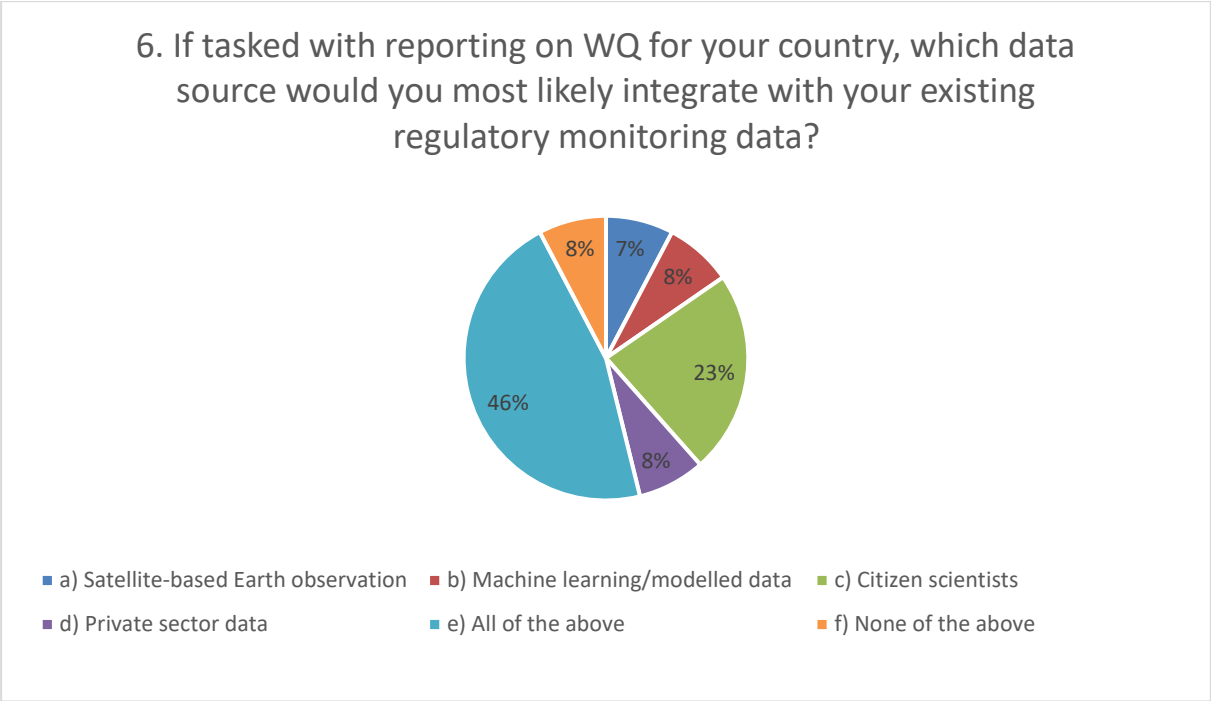
2.6. Presentation 6: Actionable Monitoring for the achievement of Global Water Security (Dietrich Borchardt, Helmholtz Centre for Environmental Research, UFZ)

Please click here to view the presentation.

The presentation addressed the current state of water quality monitoring and the advancement of water quality monitoring through the World Water Quality Assessment initiative. Two complex main questions were addressed in the presentation:

1. How to transform and advance the technology driven part of the development of monitoring systems to also embrace a problem driven focus and how to prioritize the problems and challenges;
2. How to advance current experience in monitoring the state of environment towards a reliable, scientifically and technically rigorous outlook incl. scenarios reflecting actionable estimates of the future and applying a nexus lens;

When talking about water quality and quantity, climate action and adaptation are important in multiple dimensions. **Economic costs of the water crisis create a nexus with food, human health, biodiversity and energy**. Furthermore, water is a key connector across many sectors. It is imperative that current "baseline assessments" are available as well as compelling pictures of the future showing different developments that could be expected under forecasted climate change scenarios. The future in science and technology including digital means towards this objective includes the development of digital twins and integration of the interconnecting role of water. It requires further to synthesize resulting scenarios into pathways and applying an adaptation perspective on relevant scales by taking the global situation into account (global-local connectivity). The monitoring value chain should result in services for action on climate, pollution and ecosystem disturbance.



Brief Analysis of the result of the Menti question above: the result illustrates that a majority of the session participants would integrate all available data from various sources including satellite-based earth observation, machine learning/modelled data, citizen scientists and private sector data for country reporting on water quality. Currently, GEMStat is limited to opportunistic collection of national data which has proven limitations in terms of continuity (affecting availability of time series) and spatial, geographical coverage. As a consequence, and in a readiness update for this monitoring function and service, a fit for purpose GEMS/Water will look at ways of integrating the various data sources into the currently available platform, and foster engagement towards data analytics and related action at scale. From a data perspective, it is expected to allow for increased as well as more current data including data poor areas and building on multiple sources.

3. Guided Discussion - A GEMS/Water concept fit for purpose in the Agenda 2030

3.1. Summary of Guided Discussion

The following section includes a summary of the key questions and discussion items that were addressed during the guided discussion with questions being introduced by the moderator. Overall, the guiding questions stimulated fruitful discussions about the directions that GEMS/Water should take to increase its relevance as a pillar of UNEP's MTS and, first and foremost, to enable societal transformation by observing and informing achievement of the SDG 6 on water quality and its interlinkages.

1. Public water quality monitoring systems often fail to provide reliable data in a timely manner at necessary spatial and temporal scales suited to support policy making.

   Q1 - How do we get water monitoring on the agenda?

   - One point raised concerned reiteration of a compelling "value proposition" i.e., the need to **highlight the benefits and return on investment deriving from water quality monitoring**.

- This also relates strongly to the work of the Economics of Ecosystems and Biodiversity initiative (TEEB), which tries to make the environment visible and somehow measurable in economic discussions. For TEEB water quality is a "low hanging fruit" to get attention from the policy community. There is a direct cost of water pollution as water quality is directly linked to the extent and condition of an ecosystem and therefor the services it provides. To illustrate, if an ecosystem is degraded, damaged or transformed, this has an impact on water quality and comes at a cost. Thus, the advancement of sustainability policy benefits directly from awareness of the extent and conditions of water related ecosystems implications to managing these costs. It is necessary to **demonstrate the cost of worsening water quality**. To achieve this land datasets, water datasets and water use datasets need to be integrated.

Q2 - How can the capacity of governmental authorities in charge of these monitoring systems be improved to deliver data that is fit-for-purpose?

- One point that was discussed was that with the Africa Use Cases[3] of the World Water Quality Alliance (WWQA), there were valid concerns on data sharing, with a need for trust building, funding, data-sharing protocols, internal databases, a common data-management system, capacity building, and data type integration. **Partnership and engagement efforts, such as those of the WWQA, where the concept pursued is to identify and share data, to engage multiple stakeholders in a moderated bottom-up process to define collectively priority hotspots and action/product/s required to respond, can certainly be helpful in addressing these concerns and reducing uncertainties**. This is because the process is shared, transparent and action oriented around a commonly identified and agreed objective. Furthermore, an assessment of data quality from different sources is a key to compare and integrate them and can help building trust in less traditional data sources.

2. Data is currently focused on "State of the Environment" reporting (e.g., for SDG 6.3.2) and not on monitoring the effectiveness of measures or governance.

Q3 - Should this be changed and is there a role for UNEP GEMS/Water?

- The **mere use of monitoring data to check the state of the environment is critical but too narrow if not carried further**. Ultimately, the **data must be used towards an improvement in systems/policy action**. There is a critical role for normative organizations such as UNEP to engage in this downstream dimension and use its agenda setting and convening power.

Q4 (from audience) - Could it be an important role for GEMS/Water to monitor water use alongside water quality and also information on how effectively water resources are managed by the governments?

[3] The aim of the Africa Use Cases is to build the "use case" for a World Water Quality Assessment by means of the piloting and demonstration of current capabilities, future information and services of the World Water Quality Alliance through three case studies, namely: 1. Lake Victoria and its riparian countries (primarily Kenya, Tanzania, Uganda), 2. The Volta system, focusing on Ghana but including other riparian countries and 3. The Cape Town, South Africa urban groundwater.

- Water efficiency and use, namely in the SDG 6 Integrated Monitoring Initiative by UN-Water is very much the focus and agenda of FAO. UNEP and GEMS/Water are connected to the work of FAO in this initiative, however, in future GEMS data could strongly benefit from a topical co-evaluation of the two different data sets.

3. It could be very powerful to direct information from earth observation, modelling, citizen science and regulatory monitoring into a single platform that allowed users to select and understand their local waterbodies.

   Q5 - How can we bring different forms of water quality data and information, such as earth observation and citizen science data, together in an integrated manner?

   - This calls for **capacity to work with Copernicus and other EO data providers; key is integration into the WESR platform** which is possible in principle and WESR is already using/displaying Sentinel EO data. FAO is currently integrating Copernicus data. **This underlines the need to build partnerships in which GEMS will expand on a service role not for UNEP and its member states and decision makers alone but also for partners and their constituency**.

   Q6 - What barriers need to be overcome to integrate multiple data sources, maintain quality and metadata standards, and support the data and information requirements relevant for decision-making?

   - Key is to engage in real world demonstration labs. Water quality in nexus contexts is extremely complex and cannot find one size fits all generic solutions. Compelling showcases building on data integration along commonly agreed standards will serve a convincing proof of concept.

   - *Further discussion points:* Water quality monitoring is much more complex than air quality monitoring due to the variety of water bodies. Most countries that do not have regular water quality monitoring are the developing regions where environmental monitoring is not necessarily a priority in terms of allocation of finances, human resources and technical capacity. Facing such constraints in terms of monitoring in the countries e.g. in-situ water quality testing following agreed protocols for complementary data sources are critical for long-term water quality monitoring. Alternative data i.e. EO and modelling come either from regular satellites and the earth observation services such as Copernicus or NASA and the scientific community at large. Citizen science data may be gained more and more as well in the mid-term future. Key is to work transparently and interactively with country authorities to utilize these data for deriving national pictures and complement where possible with own national sources. Furthermore, namely also in transboundary systems, the sharing of data remains a key requirement across parts of the world. It is to be seen whether the water conventions may serve as a platform to formalize such an approach of multiple data assimilation and use.

4. We know that spatial and temporal scales could be improved simply by having more funds available (more staff for sampling, lab work, maintenance of monitoring stations).

   Q7 - Is there a role for SDGs and Conventions to advocate for national natural resources targets?

- This last main question was not addressed in sufficient detail during this first international and partnership session for GEMS/Water. The setting of target values for national application is a critical bottleneck following current experience in the SDG process. Many countries do not have any such targets and – in fact for ambient water quality they hardly exist and require national action – or they are qualitative in nature and refer to "good" water quality, which may see quite different interpretations in different circumstances. The question of adequate indicators remains an open issue in many places including for example Europe. The SDGs raise awareness but in the current format SDG 6.3.2 cannot solve the problem or results will remain rather coarse in terms of resolution and relevance of individual data drives. Q9 and Q10 were focused on the first part of topic 4.

Q8 - How can monitoring 'pay for itself' (value proposition related to governance, management and ecosystem services)?

- Going back to the beginning of the session participants underlined the need to elaborate on the value added by action taken and feature clearly which implications apply when water quality is not monitored (incl. ultimately the cost of inaction). In conclusion, to mainstream monitoring as a regular means to accelerate sustainability transformation a strong value proposition is required to illustrate the utility of monitoring and actionable water quality information to inform governance and management.

Q9 - How can existing monitoring systems and budgets be used more efficiently?

- UNEP's budget for monitoring is quite limited and it relies, traditionally, on a formal process of engaging with national authorities and/or statistical offices. This needs to be addressed, besides financial resources through a stronger and continued engagement with the national contacts/focal points. Further means are seen to be located in UNCTs and in convening regular NFP user forums. In addition, and equally important are collaborative partnerships, which are vital in providing adequate monitoring services namely with a focus on complementary data and access and in terms of mobilizing social engagement at scale to demonstrate data uptake and solution co-design. Those are means that are seen to assist maximizing the return on resources available.

4. Next Steps

4.1. Outlook

This session was intended to initiate a continuous engagement with a broader network of stakeholders and partners to identify a pathway towards a redefined Global Water Quality Monitoring Programme that is fit for purpose and is responsive to the needs of the organization as well as its global partners. This is meant to be an inclusive user and needs- oriented development process that brings together a broad spectrum of communities from monitoring, data providers, data processing and services and data use by decision-makers. This variety of partners was already well reflected during the SRI2021 session where participants joined from academia, research, earth observation, remote sensing, modelling, citizen sciences, United Nations (UNEP, WMO, FAO), and NGOs bringing to the table the enormous knowledge and experience found in these communities. However, it is recognized, that even this community ultimately only reflects part of the picture and additional partners should be involved. Some of them were already identified and highlighted by the participants during the session, namely: GEO AquaWatch, WHO, River Basin Organizations, Regional Environmental Monitoring

Networks (e.g. EIONET), Community-Based Organizations, Industries, Regulatory Agencies and Governments.

Many of the participants who attended the session expressed their interest to remain actively engaged in the next steps and process of revising the GEMS/Water programme. We are grateful and see a strong rationale in building on this momentum and continue this engagement with all stakeholders who hold an interest in the work of GEMS/Water and who are able to contribute to the revision/updating process.

A few questions had been identified as critical in devising the next steps and while some of them were addressed (by a few participants) during the session. A next step would be to collect additional feedback and thoughts/ideas from the participants and stakeholders of this process and seek further feedback statements and positions incl. potential for concrete engagement where possible.

Therefore, we have developed a brief questionnaire to collect your feedback and input to the next steps and appreciate your time and effort in supporting us in this collective revision process.

You can find the link to the survey here.

Annex I: List of Speakers and Session Agenda

List of Speakers

Name	Organization	Role/Designation
Philipp Saile	ICWRGC	Head, GEMS Water Data Centre
Hartwig Kremer	UNEP	Head, GEM Unit
Dominique Berod	WMO	Head, Earth System Monitoring Division
Anik Bhaduri	SWFP	Director – Future Water
Andrew Tyler	University of Stirling	Scotland Hydro Nation Chair
Bernd Gawlik	JRC	Lead Water Quality
Pascal Peduzzi	GRID Geneva	Head UNEP GRID-Geneva
Dietrich Borchardt	Helmholtz Centre for Environmental Research - UFZ	Head Department Aquatic Ecosystems Analysis and Management (ASAM)

Session Agenda:

Time (AEST)	Agenda Item	Responsible	Comment
3:00 – 3:05	Welcome	UNEP – Melchior Elsler	Welcome and house- keeping/ design/ structure of session and engagement.
3:05 – 3:15	Introduction	UNEP – Hartwig Kremer and Philipp Saile	Introduce GEMS/Water Programme and UNEP MTS 2022-2025 and associated data needs to set the stage for the discussions.
	Flash presentations	Speakers / Moderator	Five-minute presentations with three-minutes for questions from the chat.
3:15 – 3:23	Presentation 1	Andrew Tyler	The Role of Satellite EO in Holistic and Inclusive Global Water Quality Monitoring
3:23 – 3:31	Presentation 2	Dominique Berod	A Holistic and Inclusive Global Water Quality Monitoring…and beyond; contribution from WMO Earth System approach
3:31– 3:36	Presentation 3	Bernd Gawlik	Clean water for a healthy planet – who defines water quality?

3:36 – 3:44	Presentation 4	Anik Bhaduri	Role of Science in an Inclusive Global Water Quality Monitoring
3:44 – 3:52	Presentation 5	Pascal Peduzzi	World Environment Situation Room (WESR) and global water quality monitoring
3:52 – 4:00	Presentation 6	Dietrich Borchardt	Actionable Monitoring for the achievement of Global Water Security
4:00 – 4:25	Guided Discussion	Moderator – Hartwig Kremer	Open discussion with feedback and input from audience on some predefined and open questions