Conference report
7th JSWA/EWA/WEF Specialty Conference “Resilience of Water Service”.

Nora Pankow[1], Andre Niemann[2], Torsten Frehmann[3], Fabio Tatàno[4],
[1]Universität der Bundeswehr München, Professur für Siedlungswasserwirtschaft und Abfalltechnik, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany, [2]Universität Duisburg-Essen, Institut für Wasserbau und Wasserwirtschaft, Universitätsstraße 15, 45141 Essen, Germany, [3]Emschergenossenschaft / Lippeverband (EGLV), Kronprinzenstraße 24, 45128 Essen, Germany, [4]University of Urbino “Carlo Bo”, Department of Pure and Applied Sciences (DiSPeA), Campus Scientifico “E. Mattei”, 61029 Urbino, Italy,

Figure 1: The President of the European Water Association (EWA), Raymond Erpelding, at the opening and welcome address of the 7th JSWA/EWA/WEF Specialty Conference.

Abstract

For the 7th time, the Joint Conference, organized by the Japan Sewage Works Association (*JSWA*), the U.S. Water Environment Federation (*WEF*) and the European Water Association (*EWA*) was held on November 15-17, 2022, in Sendai, Japan. The core of the conference was the resilience of the overall water sector. Tohoku earthquake severely damaged the city of Sendai eleven years ago, and the conference provided an occasion of a commemoration of this disaster. The conference enabled a vital exchange between the three associations again. Practical problems from different countries and diversified perspectives and approaches, with related options for solution, were presented and discussed.

As the representative delegation of the EWA, Raymond Erpelding (ALUSEAU, Luxembourg), Fabio Tatàno (University of Urbino “Carlo Bo”, Italy), Harsha Ratnaweera (Norwegian University of Natural Sciences, Norway) as well as Andre Niemann (University of Duisburg-Essen, Germany), Torsten Frehmann (Emschergenossenschaft / Lippeverband, Germany) and Nora Pankow (University of the Federal Armed Forces Munich, Germany) participated as speakers in presence at the conference. Additionally, Karoly Kovacs (Hungarian Water Association, Hungary) and Bjørn Kaare Jensen (Geological Survey of Denmark and Greenland, Denmark) contributed to the conference with on-video presentations.

Introduction

Typically, the Joint Conference Series of the Japan Sewage Works Association (*JSWA*), the U.S. Water Environment Federation (*WEF*) and the European Water Association (*EWA*) is held every three years, alternating the conference location between Japan, the United States and Europe. Most recently, the previous 2018 edition was held in Munich, Germany, during the environmental trade fair IFAT 2018. Due to the Covid-19 pandemic, the further conference originally scheduled for 2021 could not take place and was finally postponed to 2022 in Sendai, Japan.

The Tohoku earthquake that occurred on the March 11th 2011, with a magnitude of 9.1 $M_{W,}$ is considered one of the strongest earthquakes in the history of Japan (USGS 2016). With the triggered tsunami and the resulting nuclear disaster at the Fukushima Daiichi nuclear power plant, this is known as a triple disaster worldwide. In total, over 20,000 people lost their lives and people are still considered missing to this day (Ritsema et al. 2012; USGS 2016). The economic loss is estimated to be around $300 billion U.S. (Ritsema et al. 2012). Along the coastline, the tsunami that followed the quake, wreaked havoc. The city area of Sendai was also severely damaged due to its proximity to the epicenter. The impact and reconstruction were a major theme during these two days of the conference and highlighted the urgency for increasing resilience in the overall water environment sector for all participants.

The conference, perfectly and logistically organized by the Director of the International Division at the JSWA, Yosuke Matsumiya, and the related staff including Yuka Okabe, was officially opened by the Sendai Mayor, Kazuko Kohri, with a presentation on recovery and rehabilitation after the Tohoku earthquake. Although this disaster now occurred over 10 years ago, the crises of recent years highlighted the timeliness and need to address past disasters.

The complementary opening speeches were given by official representatives of the three associations. As the Scientific Chairperson at the JSWA, Masahiro Takahashi (*Hokkaido University, Japan*) gave an overview on the history of the previous conferences. He emphasized the importance of this format for implementing sustainable and forward-looking water management and improving resilience in water management. As the EWA President, Raymond Erpelding (Figure 1) highlighted the problem areas for the water sector in the future, while also emphasizing that in the areas of energy and resource recovery, for example, water management can provide important solutions. As the WEF Past President, Jamie Eichenberger also emphasized the importance of knowledge exchange, as this is how innovative solutions can be found. In his view, innovations must be stepped up to achieve the goals of the UN Sustainable Development Goals (SDGs) and give everyone access to clean water.

A total of 29 speakers contributed, in-person or on-video, to the interesting two-day conference, including 14 from the USA and Europe. Thematically, the conference was divided into six blocks: Resilience to Climate Change and Other Issues, Innovative Solutions for Clean Water and Sanitation, Transformation and Enhanced Recovery, Smart Water Strategies, Lessons from Real-world Disruptions, and Innovative Analysis and Tools.

Across the thematic blocks, the aspects of digitalization, energy and water reuse, and resilience were found in almost all presentations.

Increasing resilience to various risks

Against the backdrop of the triple disaster in Japan in 2011, special attention was paid to various natural disasters, also with regard to anthropogenic climate change and adaptation and mitigation measures. In the first session, **Resilience to Climate Change and Other Problems,** practical examples of individual cities and measures to deal with natural disasters and extreme weather were presented. These included a 100-year plan for the City of Austin, Texas by Rajendra P. Bhattarai to deal with increasing water demand as well as frequent drought, and the City of Fukuoka's resilience plan to reduce water loss (*Hironori Yashima, Road & Sewerage Bureau Fukuoka, Japan*). Both presentations clearly showed that to increase resilience, it is necessary to think over a longer period and take various measures to achieve the goal. In addition, specific problems such as flooding and possible countermeasures were also presented by Kengo Hashi (*Japan Institute of Wastewater Engineering and Technology, Japan*) and Toshiaki Yoshida (*National Institute for Land and Infrastructure Management, Japan*).

In the session **Lessons learned from real life disruptions**, the topic of resilience was approached from a different point of view. In this session, the presentation by Tetsuya Mizutani (*Sendai City, Japan*) illustrated the consequences of the Tohoku earthquake on wastewater treatment with vivid images and described the reconstruction with flood preparedness adaptations of the destroyed Minami-Gamo wastewater treatment plant. Samendra Sherchan (*Tulane University, U.S.A*) presented another concrete example with the 2015 Nepal earthquake. Typhoon and other natural disaster damage to WWTPs and contingency plans based on them were presented by Manabu Matsuhashi (*National Institute for Land and Infrastructure Management, Japan*). Nora Pankow (*University of the Armed Forces Munich, Germany)* presented a possible approach on risk analysis adapted to wastewater treatment. David Goldbloom-Helzner (*U.S. Environmental Protection Agency, U.S.A*) followed up on this theme in a later presentation by introducing the Vulnerability Assessment Tool for examining risks to the drinking water and wastewater sectors. In both presentations, it was also clear that communication between critical infrastructure and the public is important for a resilient society. A practical approach to communicating with the public was presented by Yuji Koizumi (*Yokohama City, Japan*) for emergency toilets and raising public awareness for use in a crisis.

In addition to the consideration of acute hazards, longer-term hazards were also considered. For this purpose, the view on risk analysis in the overall water related sector included the presentation by Fabio Tatàno (*University of Urbino "Carlo Bo", Italy*) dealing with a procedure for comparative risk assessment of potentially contaminated sites (impacted soil and groundwater). Indeed, the fundamental topic of groundwater protection and restoration was

properly completed with the on-video presentation by Bjørn Kaare Jensen *(Geological Survey of Denmark and Greenland, Denmark)* on possible management tools and technologies against the diffuse contamination. In both presentations, it was pointed out the unavoidable connection of the groundwater environment with the soil and the air environments.

Evidently, to increase the resilience to various risks in the overall water sector, investment needs are expected in the coming years. In this respect, the on-video presentation by Karoly Kovacs *(Hungarian Water Association, Hungary)* gave an interesting view on the possible combination of water economics, cost recovery and solidarity.

Digitalization

The increasing implementation of intelligent solution approaches in the water sector was demonstrated by several presentations dealing with different process engineering, climatic or ecological problems. For example, the second session **Innovative Solutions for Clean Water and Sanitation** was started with a presentation by Harsha Ratnaweera (*Norwegian University of Natural Sciences, Norway*) on hybrid sensors to identify process interruptions. The hybrid sensors can be used as a wastewater quality prediction and early warning system.

The first conference day was concluded with the Session **Intelligent Water Strategies** with contributions given by Akahiro Yamamoto (*JSWA, Japan*) and Andre Niemann (*University of Duisburg-Essen, Germany*). Here, Akihiro Yamamoto presented efficient management and control of wastewater treatment plants using artificial intelligence to compensate for the loss of technical skills when staff shortages occur. Andre Niemann outlined in his presentation current developments in the rapidly changing digital water management. It became clear which potentials can be found in different technologies and how they can be used and combined for environmental monitoring beyond wastewater treatment: for example, different platforms and protocols can be used to share environmental information. Through the exchange, applications can be used for areas such as clustered sensors or smart city and monitoring.

A complementary view was given in the thematic area of flood management in the case of increasing heavy rainfall events by Hayato Mori from the Tokyo Municipal Government (*Japan)*. This involved modeling and visualizing the possible effects of heavy rainfall on Tokyo's sewer network in order to raise awareness for all residents in the individual districts affected by possible flooding.

An approach for an innovative corona warning system was also presented. Tatsuo Omura (*Tohoku University, Japan*) has been working on other infectious diseases in the sewer network prior to the Covid-19 pandemic and showed how norovirus modeling and monitoring could be applied and adapted to a corona virus.

Energy and water reclamation

The session **Transform and built back better** highlighted aspects in the planning and reconstruction of wastewater treatment plants based on practical examples. In the session, which was spread over two days, concrete wastewater treatment plants and their concepts for reconstruction were presented. The focus was on strategic and problem-oriented reorientation of plants that also take into account sustainable development, climate resilience and energy generation. Koichi Teshima (*Osaka City, Japan*) presented an asset management concept to replace aging plant components without loss of performance. Other practical examples from

Japan were provided by Hiroaki Kuroki (*Nagoya City, Japan*) and Chikashi Nakaza (*Yokohama City, Japan*). Here, particular attention is being paid to possible savings in CO_2 emissions, for example through waste heat recovery from wastewater and reuse of water. Torsten Frehmann (*Emschergenossenschaft / Lippeverband, Germany*) used the conversion of the Bottrop wastewater treatment plant as an example to illustrate the focus on energy and the transformation to energy self-sufficient plants, which is currently very much in the spotlight in Germany. The measures implemented at the plant attracted great interest during the conference and were intensively discussed afterwards.

However, Manel Garrido-Baserba (*inCTRL, U.S.A.*) also showed in his presentation that current and future problems can benefit from new ideas and breaking away from conventional technologies. Particularly, he presented a concept for modular wastewater treatment in urban areas.

Technical excursion at the post-conference tour

On November 17, conference attendees had the possibility to visit the restoration of facilities destroyed by the tsunami near Sendai in a technical excursion. The first stop was at the Arahama Elementary School. The damage from the tsunami was preserved there and today the school is used as a memorial and museum. Because of its proximity to the coast, the severity of the natural disaster is still clearly visible not only in building damage but also in changes to the landscape. The school was the highest building in the coastal area of Arahama. As a positive result, more than 300 students and residents found shelter there during the tsunami until evacuation (Visit Miyagi 2022).

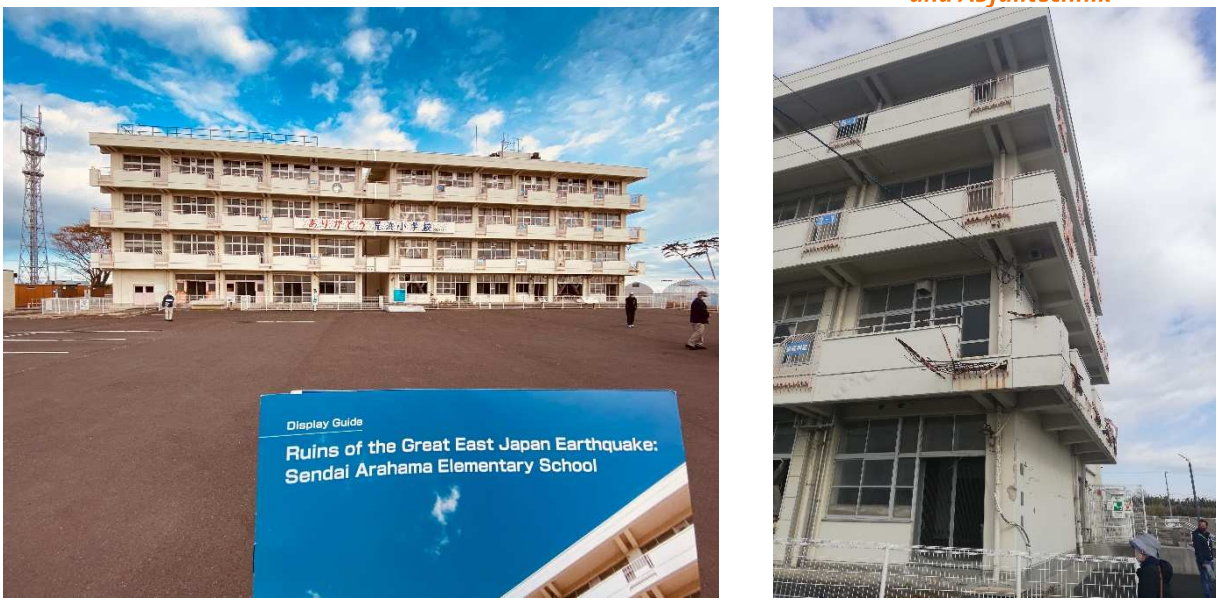

Figure 2: On the left side: Front view of the damaged Arahama Elementary School which saved 320 students and residents. On the right side: A close-up from the damages on the school.

The second site visited was the reconstruction of the Minami-Gamo Wastewater Treatment Plant. More than 1 million inhabitants live in the city of Sendai. The wastewater generated is treated in five wastewater treatment plants. The largest treatment plant is the mentioned Minami-Gamo with a daily wastewater flow of 300,000 m³/d (Mizutani 2022). During the tsunami, this WWTP was flooded and severely damaged. Figure 3 shows the situation when the Tsunami entered the WWTP. This is also contrasted with Figure 4, which shows instead the reconstructed plant in its current state and normal sea water level. In particular, the bridge permits to identify the plant location before and after.

Figure 3: Flooding and evacuation of Minami-Gamo Wastewater Treatment Plant after the tsunami on March 11, 2011 (Sendai City Construction Bureau 2013).

Damage included piping, buildings, wastewater basins and engineering (Figure 5). In addition, there were fuel shortages that made emergency startup difficult. Reconstruction of the Minami-Gamo WWTP took about 5 years and amounted to about $575 million (Mizutani 2022). Protective measures were expanded during the reconstruction for increased resilience. The evacuation tower shown in Figure 6 is designed to provide protection and evacuation for employees during flood events. In addition to personnel protection, coastal protection was increased throughout the area with line armoring. The highway running along the coast has been elevated so that it can act as a kind of dam to hold back the water masses in the event

Figure 5: View on the Minami-Gamo Wastewater Treatment Plant after reconstruction

Figure 4: View of damaged parts of buildings and sections, at the Minami-Gamo Wastewater Treatment Plant, after the tsunami

of a flood.

Figure 6: Conference attendees in front of the evacuation tower of the Minami-Gamo Wastewater Treatment Plant.

Conclusion

All over the world, authorities and water and wastewater treatment plant operators are facing new challenges such as the consequences of anthropogenic climate change, natural disasters, or the shortage of skilled workers. Even, these impacts concern with the water environment also in the interconnection with the soil and the air. The problem areas vary from country to country. With the common goal of increasing the resilience and sustainability of the overall water sector, the Joint Conference Series of the water environment associations JSWA, EWA and WEF contributes to the exchange of knowledge and brings together stakeholders with different approaches and perspectives. In a time of polycrises, this international way of cooperation seems more important to adapt to changing circumstances.

Indeed, increasing resilience and related measures to build and rebuild plants and implement innovative tools and approaches are always in tension with the costs and economics.

As announced by the WEF Past President, Jamie Eichenberger, at the closing of the 2022 conference in Sendai (Figure 7), the next edition of the WEF/JSWA/EWA Joint Conference Series will be expected in the US in the coming 2025.

For the successful 2022 edition of the JSWA/WEF/EWA Joint Conference in Sendai, Japan, Hirofumi Okahisa, Director General of JSWA, and Yoshinari Nakajima, Deputy Director General in charge of engineering of JSWA, are finally and properly mentioned.

Documentation for the conference including proceedings, presentations and videos can be found on the pertaining JSWA (https://www.jswa.jp/en/jswa-en/powerpoint.html), the EWA website https://www.ewa-online.eu/calendar-detail/events/id-7th-jswaewawef-specialty-joint-conference-resilience-of-water-service-copy.html and on the WEF Learning Center (https://learn.wef.org/portal/Resilience-of-Water-Service) websites.

Figure 7: Presenters and organizers of the 7th JSWA/EWA/WEF Specialty Conference at the Closing Ceremony

References

Mizutani, Tetsuya (2022): Improvement of earthquake disaster resilience by asset management in Sendai City Wastewater Utility. 7th JSWA/EWA/WEF Specialty conference. Sendai City. Japan Water Association (JSWA), 16.11.2022. Online verfügbar unter https://www.jswa.jp/en/jswa-en/pdf/powerpoint/221116/501_Improvement_of_earthquake_disaster_resilience_by_asset_management_in_Sendai_city_wastewater_utility.pdf.

Ritsema, J.; Lay, T.; Kanamori, H. (2012): The 2011 Tohoku Earthquake. In: Elements 8 (3), S. 183–188. DOI: 10.2113/gselements.8.3.183.

USGS (2016): M 9.1 - 2011 Great Tohoku Earthquake, Japan. Hg. v. US Geological Service. Online verfügbar unter https://earthquake.usgs.gov/earthquakes/eventpage/official20110311054624120_30/executive, zuletzt aktualisiert am 16.11.2022, zuletzt geprüft am 10.01.2023.

Visit Miyagi (2022): The Tsunami Ruins of Arahama Elementary. Unter Mitarbeit von Roger Smith. Online verfügbar unter https://visitmiyagi.com/articles/the-ruins-of-arahama-elementary-school/, zuletzt aktualisiert am 24.12.2022, zuletzt geprüft am 20.01.2023.