大阪大学
感染症総合教育研究拠点
CiDER
CENTER FOR
INFECTIOUS DISEASE EDUCATION
AND RESEARCH

CiDER-DP

Center for Infectious Disease Education and Research, Discussion Paper

DP018

Revitalizing water environmental engineering: Issues and proposals from the 1st Next-generation Exchange Workshop on WAter enVironmental Engineering (NEW-WAVE)

Michio Murakami, Yoshihiro Ishii, Masaaki Kitajima, Yuki Nakaya, Youhei Nomura, Shizuka Araki, Akihiko Hata, Yuki Hatano, Keita Hattori, Soichiro Hirai, Yuki Hoshiko, Yudai Ikuno, Daisuke Inoue, Yukako Komaki, Koji Kosaka, Takayuki Miura, Kaoruko Mizukawa, Toyohiko Nakakubo, Keishi Noda, Nobuaki Ohsumi, Takashi Onodera, Rin Sato, Takeya Sato, Daiki Shirakawa, Tatsuya Sumida, Yuji Suzuki, Tomohiro Tobino, Shotaro Torii, Midori Yasui, Nobuhito Yasui, Hiroaki Furumai

Revitalizing water environmental engineering: Issues and proposals from the 1st Next-generation Exchange Workshop on WAter enVironmental Engineering (NEW-WAVE)

Michio Murakami [1, *], Yoshihiro Ishii [2, #], Masaaki Kitajima [1, 3, #], Yuki Nakaya [4, #], Youhei Nomura [5, 6, #], Shizuka Araki [7], Akihiko Hata [8], Yuki Hatano [9], Keita Hattori [10], Soichiro Hirai [11], Yuki Hoshiko [12], Yudai Ikuno [13], Daisuke Inoue [14], Yukako Komaki [15], Koji Kosaka [16], Takayuki Miura [16], Kaoruko Mizukawa [17], Toyohiko Nakakubo [14], Keishi Noda [18], Nobuaki Ohsumi [19], Takashi Onodera [20], Rin Sato [12], Takeya Sato [21], Daiki Shirakawa [16], Tatsuya Sumida [22], Yuji Suzuki [23], Tomohiro Tobino [9], Shotaro Torii [9], Midori Yasui [6], Nobuhito Yasui [24], Hiroaki Furumai [25]

August 25, 2026

Affiliation

[1] Division of Scientific Information and Public Policy, Center for Infectious Disease Education and Research, The University of Osaka, Suita, Japan

[2] Wastewater and Sludge Management Division, Water Supply and Sewerage Department, National Institute for Land and Infrastructure Management, Tsukuba, Japan

[3] Research Center for Water Environment Technology, School of Engineering, The University of Tokyo, Tokyo, Japan

[4] Faculty of Engineering, Hokkaido University, Sapporo, Japan

[5] Department of Global Ecology, Graduate School of Global Environmental Studies, Kyoto University, Kyoto, Japan

[6] Department of Environmental Engineering, Graduate School of Engineering, Kyoto University, Kyoto, Japan

[7] Department of Environmental and Civil Engineering, Ritsumeikan University, Kusatsu, Japan

[8] Department of Environmental and Civil Engineering, Faculty of Engineering, Toyama Prefectural University, Imizu, Japan

[9] Department of Urban Engineering, Graduate School of Engineering, The University of Tokyo, Tokyo, Japan

[10] Water Quality Team, Water Environment Research Group, Public Works Research Institute, Tsukuba, Japan

[11] Department of Engineering, University of Yamanashi, Kofu, Japan

[12] Department of Health Science, School of Allied Health Sciences, Kitasato University, Sagamihara, Japan

[13] Health and Environmental Risk Research Division, National Institute for Environmental Studies, Tsukuba, Japan

[14] Division of Sustainable Energy and Environmental Engineering, The University of Osaka, Suita, Japan

[15] Department of Urban Design and Engineering, Graduate School of Engineering, Osaka Metropolitan University, Osaka, Japan

[16] Wako Branch Office, Health and Environmental Risk Division, National Institute for Environmental Studies, Wako, Japan

[17] Department of Agriculture, Tokyo University of Agriculture and Technology, Fuchu, Japan

[18] Shinshu University Innovative Research and Liaison Organization, Matsumoto, Japan

[19] Department of Urban Engineering, Faculty of Engineering, The University of Tokyo, Tokyo, Japan

[20] Regional Environment Conservation Division, National Institute for Environmental Studies, Tsukuba, Japan

[21] Department of Regional Environment Creation, The United Graduate School of Agricultural Sciences, Iwate University, Morioka, Japan

[22] Water Resources Department, Earth System Science Co., Ltd., Tokyo, Japan.

[23] Department of Civil Engineering, Faculty of Engineering, Gifu University, Gifu, Japan

[24] Department of Comprehensive Engineering, Urban Environment Course (Civil Engineering), Kindai University Technical College, Nabari, Japan
[25] Research and Development Initiative, Chuo University, Tokyo, Japan

# These authors contributed equally to this work.
* Corresponding author

Abstract

Securing and nurturing the next generation of researchers and engineers is a critical challenge in water environmental engineering. We report the key issues identified and proposals developed through the 1st Next-generation Exchange Workshop on WAter enVironmental Engineering (NEW-WAVE), in which 31 participants discussed career paths, education, societal implementation, and the future of the field. Four priority areas emerged: interdisciplinary collaboration and advancement, education and talent development, alignment of talent supply and demand, and public collaboration. Four proposals were developed for the next decade, focusing on strengthening the field's role as a hub across disciplines, incorporating emerging approaches to education, including AI, sharing resources and matching needs with expertise across organizational boundaries, and promoting meaningful public collaboration. The workshop highlighted structural challenges facing the field and demonstrated how exchange among early- and mid-career researchers and engineers can generate proposals for revitalization and stimulate broader discussion and continued evaluation.

Keywords

education; interdisciplinary research; next-generation researchers and engineers; social implementation; water environmental engineering

Main text

In water environmental engineering, securing and nurturing the next generation of researchers and engineers is a challenge in Japan. Membership in the Japan Society on Water Environment (JSWE) declined from 2,522 members (including 446 students) in fiscal year 2015 to 2,169 (including 426 students) in 2025 [1]. The number of papers in the Journal of JSWE decreased from 21 in 2015 to 19 in 2025. Similarly, papers by Japanese authors in the Journal of Water and Environment Technology declined from 34 (97% of 35 papers) to 22 (85% of 26 papers). In Water Research, the number of papers changed from 20 (3.0% of 666) to 39 (2.2% of 1,784), indicating a decline in Japan's share. These trends highlight the need to foster the next generation through research and education while revitalizing the field.

To identify key issues and develop proposals for revitalization, we organized the 1st Next-generation Exchange Workshop on WAter enVironmental Engineering (NEW-WAVE) on August 7–8, 2026, at the University of Osaka. The workshop brought together early- and mid-career researchers to build cross-disciplinary networks and discuss revitalization. This letter reports the key issues and proposals identified through the workshop.

Participants were recruited through direct outreach and the member mailing list of Japan National Young Water Professionals (Japan-YWP). Thirty-one participants attended, including 6 students, 17 faculty members, 7 staff members of national research institutes, and 1 corporate employee (27 on the first day and 29 on the second), together with 2 journalists. Four themes were discussed: career paths ("How can we build attractive careers in water environmental engineering?"); education and talent development ("How should we nurture the next generation?"); societal implementation and industry–academia–government collaboration ("How can we connect research and society?"); and the future of the field and joint research ("How can we make water environmental engineering more exciting ten years from now?"). Participants discussed each theme in four groups for 90 minutes, followed by a 210-minute discussion to identify key issues and develop proposals. The program also included a presentation by M. Murakami, short speeches by participants, and a special lecture by H. Furumai.

M. Murakami regarded revitalization of water environmental engineering as maintaining research capacity for contemporary questions and fostering talent and examples that bridge disciplines or create new fields.

Participants' short speeches identified four priorities: (1) integration with other fields and diversity within the discipline; (2) attracting students and young researchers by communicating the field's significance and appeal; (3) societal implementation through industry–academia–government collaboration; and (4) securing funding as a basis for national policy. H. Furumai encouraged early- and mid-career researchers to fearlessly undertake challenging research and build their capabilities by understanding their own strengths and weaknesses; he also urged them to broaden their perspectives through interdisciplinary exchanges and domestic and international networks, while questioning established theories and identifying compelling research topics.

Discussions on career paths emphasized diverse role models, connections with other fields, institutional support for diverse career paths, and providing early-career positions for young researchers through inter-organizational collaboration. For education and talent development, participants highlighted introducing students to the field before higher education, communicating its appeal through university lectures, and developing skills such as Artificial Intelligence (AI) literacy. They also proposed sharing teaching practices, leveraging faculty development opportunities to improve teaching quality, and providing opportunities for continued learning and networking after employment. For societal implementation and industry–academia–government collaboration, participants emphasized aligning needs and research opportunities among researchers, government, and industry, as well as collaboration between researchers and the public and mechanisms linking societal implementation to researcher evaluation. Regarding the future of the field and joint research, participants called for greater convergence with other disciplines and a hub function connecting diverse fields, while maintaining basic research driven by intellectual curiosity. They also highlighted support for ambitious research by young researchers, flexible structures enabling small teams to drive innovation, and networks extending to international collaborators.

Based on these discussions, four priority areas were identified: (1) interdisciplinary collaboration and advancement—strengthening the field by leveraging researchers' strengths and expanding collaboration with other disciplines; (2) education and talent development—highlighting the continued value of water environmental

engineering in the age of AI and ensuring high-quality education in the field; (3) aligning talent supply and demand—building a platform to bridge regional imbalances and connect researchers with academia, government, and industry; and (4) public collaboration—establishing mechanisms for public participation and collaboration (Table 1). Four proposals for the next ten years were also developed: (1) analyzing factors that enable water environmental engineering to serve as a hub for other disciplines and promoting exchange and collaboration centered on water quality to create new domains; (2) making workshops a regular feature of academic conferences to improve education through exchange of teaching practices; (3) sharing educational, research, and societal implementation resources across organizational boundaries, accumulating best practices, and using AI and university research administrators to match needs with expertise; and (4) establishing mechanisms that encourage meaningful public collaboration with researchers and engineers.

The importance of demonstrating the relevance of learning through practical research, field experience, and collaboration with local communities [2, 3], as well as strengthening links between water environmental engineering, public health, and other fields including social sciences, has been previously discussed [4, 5]. The workshop confirmed that these are structural challenges facing water environmental engineering in Japan rather than individual concerns. It also made these challenges visible and shared, including imbalances in talent supply and demand and the need for stronger collaboration with the public, while translating them into concrete proposals. Collaboration with the public and other disciplines can create new strengths and expand the scope of water environmental engineering. These efforts can build networks, better match talent with opportunities, and address challenges in research, education, and societal implementation, creating a virtuous cycle that further clarifies the field's significance and appeal to students and young researchers.

Finally, exchange among early- and mid-career researchers can itself drive revitalization. Sharing the workshop's proposals beyond its self-selected participants can broaden the discussion and facilitate continued evaluation.

Table 1. Identified key issues and corresponding proposals.

	Key Issues	Proposals
Interdisciplinary collaboration and advancement	A balance between engineering and science should be maintained, while establishing a clear identity for water environmental engineering as a field. By taking a broad view of the field and leveraging researchers' strengths to foster collaboration and deepen expertise, the field should serve as a hub connecting other disciplines.	Large-scale research projects will be analyzed to identify the factors contributing to the success of water environmental engineering in serving as a hub connecting other disciplines. Exchange and collaboration with diverse fields through water quality will be promoted to establish new areas within water environmental engineering.
Education and talent development	The appeal of water environmental engineering should be conveyed to students, while the quality of courses should be enhanced to meet evolving needs. The future of education in the AI era should be explored, including measures to secure faculty time and incentives.	Workshops will be established as a permanent feature of academic conferences to exchange and discuss emerging approaches to education, including AI, and enhance teaching quality.
Aligning talent supply and demand	In light of the imbalances in the supply and demand for researchers, students, public-sector organizations, and businesses across Japan, a platform should be built to connect researchers with the field.	Cross-organizational exchanges among researchers will be promoted, and information on education, research, and societal implementation will be shared to accumulate successful examples. AI and university research administrators will be used to facilitate matching between supply and demand in education and research. A contact point within the Japan Society of Water Environment will be established to support social implementation.
Public collaboration	Public collaboration and citizen science should be promoted by establishing mechanisms for meaningful public participation.	Initiatives and mechanisms will be developed to encourage meaningful public participation. Collaborative activities between the public and researchers will be encouraged through academic societies. The dissemination of information to the public will be promoted.

Acknowledgments
We thank Dr. Hideyuki Hara (The University of Osaka) and Dr. Chikako Ono (The University of Osaka) for their assistance during our tour of the laboratory at the Center for Infectious Disease Education and Research. This work was supported by The Nippon Foundation–The University of Osaka Project for Infectious Disease Prevention and Kurita Water and Environment Foundation's grant.

Ethics
Ethical approval was not required because this manuscript reports discussions conducted during a workshop.

Contributors
Conceptualization: Michio Murakami, Yoshihiro Ishii, Masaaki Kitajima, Yuki Nakaya, and Youhei Nomura. Workshop discussion: all authors. Writing – original draft: Michio Murakami. Writing – review & editing: all authors.

Declaration of interests
Michio Murakami received funding directly related to this work from The Nippon Foundation–The University of Osaka and The Kurita Water and Environment Foundation.
Tatsuya Sumida is employed by Earth System Science Co., Ltd.
Hiroaki Furumai received lecture honoraria and travel expenses from The Nippon Foundation–The University of Osaka and The Kurita Water and Environment Foundation.
The other authors declare no conflicts of interest.

AI Statement
DeepL and ChatGPT were used only to assist with language improvement, while Zoom AI was used to support the preparation of minutes of discussions among the authors. The initial manuscript and all substantive content were developed by the authors, who reviewed and verified the AI-assisted output. The authors take full responsibility for the content of this work.

References
[1] Japan Society on Water Environment. Information disclosure documents [translated by the authors]. https://www.jswe.or.jp/aboutus/information/ (accessed on August 10, 2026) (in Japanese)
[2] Phansalkar, R; Hychka, K; Bowser, C; Fell, E; Rahm, B. Preparing the next generation of water professionals in New York State: A review of educational programs and models by the New York State Water Resources Institute. J. Contemp. Water Res. Educ. 2025, 182, 70-88.
[3] Weissbrodt, DG; Winkler, MKH; Wells, GF. Responsible science, engineering and education for water resource recovery and circularity. Environ. Sci.: Water Res. Technol. 2020, 6(8), 1952-1966.
[4] Gelting, RJ; Chapra, SC; Nevin, PE; Harvey, DE; Gute, DM. "Back to the future": Time for a renaissance of public health engineering. Int. J. Environ. Res. Public Health 2019, 16(3).
[5] Hoffmann, S; Feldmann, U; Bach, PM; Binz, C; Farrelly, M; Frantzeskaki, N; Hiessl, H; Inauen, J; Larsen, TA; Lienert, J; Londong, Jr; Lüthi, C; Maurer, M; Mitchell, C; Morgenroth, E; Nelson, KL; Scholten, L; Truffer, B; Udert, KM. A research agenda for the future of urban water management: Exploring the potential of nongrid, small-grid, and hybrid solutions. Environ. Sci. Technol. 2020, 54(9), 5312-5322.