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**ENHANCING WATER SUSTAINABILITY INDEX ASSESSMENT THROUGH RISK MANAGEMENT, IOT, AND ARTIFICIAL INTELLIGENCE IN WATER OPERATION: A REVIEW**

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**Abstract**

Water is an important element for all living things. It is very important to have sustainability in drinking water operations. This is because sustainability in drinking water operations means continuous water supply without interruption. Sustainability is very related to risk management. This can be said that a good water supply sustainability index must be assessed using good risk management. However existing water sustainability index has proved inaccuracy, this can be seen from the sustainability index parameter that has the same weight between each other. An additional method such as Artificial intelligence and IoT was needed to enhance the accuracy of the water supply sustainability index. This method (artificial intelligence and IoT) was used as an enhancement for risk management parameters based on its severity, thus impacting sustainability index accuracy. In this paper, we propose to review detailed risk management research and operations management for sustainable drinking water supplies. Various challenges (issues) that exist in the water sustainability index that are inside drinking water operations are presented together with the future direction of sustainability index based on artificial intelligence and IoT that can enhance the framework. A good drinking water operation combined with enhanced risk management (IoT and artificial intelligence) can boost the sustainability index (assessment) accuracy. © 2023, Zibeline International Publishing Sdn. Bhd. All rights reserved.

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Artificial intelligence; Drinking Water Operation; IoT; Risk Management; Water Sustainability

**Index Keywords**

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**References**

- Abdel-Basset, M., Mohamed, R.  
**A novel plithogenic TOPSIS-CRITIC model for sustainable supply chain risk management**  
(2020) *J. Clean. Prod.*, 247.
- Abdelhafidh, M., Fourati, M., Fourati, L. C., Abidi, A.  
**Remote water pipeline monitoring system IoT-based architecture for new industrial era 4.0**  
(2018) *Proceedings of IEEE/ACS International Conference on Computer Systems and Applications, AICCSA*,
- Abdi-Dehkordi, M., Bozorg-Haddad, O., Chu, X.  
**Development of a Combined Index to Evaluate Sustainability of Water Resources Systems**  
(2021) *Water Resour. Manag.*, 35 (9), pp. 2965-2985.
- Abdullah, N.  
**Towards Smart Agriculture Monitoring Using Fuzzy Systems**  
(2021) *IEEE Access*,

- Adedeji, K. B., Hamam, Y., Abu-Mahfouz, A. M.  
**Impact of pressure-driven demand on background leakage estimation in water supply networks**  
(2019) *Water (Switzerland)*,
- Agrawal, P.  
**Exploring artificial intelligence techniques for groundwater quality assessment**  
(2021) *Water (Switzerland)*,
- Al-Adhaileh, M. H., Alsaade, F. W.  
**Modelling and prediction of water quality by using artificial intelligence**  
(2021) *Sustain*,
- Al-Mulla, Y. A., Al-Badi, T. B.  
**IoT and RS Techniques for Enhancing Water Use Efficiency and Achieving Water Security**  
(2021) *ACM International Conference Proceeding Series*,
- Al-Sulaiman, S. A. A.-W.  
**Chemical Safety of Drinking-Water: Assessing Priorities for Risk Management**  
(2012) *Int. J. Environ. Stud*, 69 (6), pp. 1001-1001.
- Altansukh, O., Davaa, G.  
**Application of Index Analysis to Evaluate the Water Quality of the Tuul River in Mongolia**  
(2011) *J. Water Resour. Prot*,
- Althaus, C. E.  
**A disciplinary perspective on the epistemological status of risk**  
(2005) *Risk Analysis*, 25 (3), pp. 567-588.
- (1998) *Sustainability criteria for water resource systems*,  
Anon
- Antunes, A., Andrade-Campos, A., Sardinha-Lourenço, A., Oliveira, M. S.  
**Short-term water demand forecasting using machine learning techniques**  
(2018) *J. Hydroinformatics*,
- Aven, T.  
**The risk concept-historical and recent development trends**  
(2012) *Reliab. Eng. Syst. Saf*, 99, pp. 33-44.
- Aven, T.  
**Risk assessment and risk management: Review of recent advances on their foundation**  
(2016) *European Journal of Operational Research*,
- Aven, T.  
**Foundational Issues in Risk Assessment and Risk Management**  
(2012) *Risk Anal*,
- Ayad, A., Awad, H., Yassin, A.  
**Integrated approach for the optimal design of pipeline networks**  
(2018) *Alexandria Eng. J*,
- Bali, R., Sharma, S. K., Kumar, D., Ahmed, S. S.  
**Empirical research on sustainable developmental goals and priorities for water sustainability in Saudi Arabia**  
(2021) *Ann. Oper. Res*,
- Barroso Pena, A., Kemper, B., Ketelhut, S., Graß, S., Reiber, J., Schnekenburger, J.  
(2019) *Multimodal optical detection and toxicity testing of microplastics in the*

*environment*, p. 47.

- Bashiri-Atrabi, H., Qaderi, K., Rheinheimer, D. E., Sharifi, E.  
**Application of Harmony Search Algorithm to Reservoir Operation Optimization**  
(2015) *Water Resour. Manag.*
- Bernero, R. M.  
**The Government of Risk: Understanding Risk Regulation Regimes**  
(2002) *J. Radiol. Prot.*, 22 (1), pp. 122-123.
- Brundtland, G.  
(1987) *UN Brundtland Commission Report*,  
Our Common Future
- Cai, J., Zhao, D., Varis, O.  
**Match words with deeds: Curbing water risk with the Sustainable Development Goal 6 index**  
(2021) *J. Clean. Prod.*, 318.
- Carter, R. C.  
(2006) *Investigating Options for Self-help Water Supply: From Field Research to Pilot Interventions in Uganda*,  
RWSN F. Note October
- Chaves, H. M. L., Alipaz, S.  
**An integrated indicator based on basin hydrology, environment, life, and policy: The watershed sustainability index**  
(2007) *Water Resour. Manag.*, 21 (5), pp. 883-895.
- Comas, J., Poch, M.  
(2009) *Decision Support Systems for Integrated Water Resources Management Under Water Scarcity*,
- De Oliveira Fleury, G. R., Do Nascimento, D. V., Galvão Filho, A. R., Lima Ribeiro, F. D. S., De Carvalho, R. V., Coelho, C. J.  
**Image-based river water level estimation for redundancy information using deep neural network**  
(2020) *Energies*,
- Ekins, P., Simon, S., Deutsch, L., Folke, C., De Groot, R.  
**A framework for the practical application of the concepts of critical natural capital and strong sustainability**  
(2003) *Ecol. Econ.*, 44 (2–3), pp. 165-185.
- Elfithri, R.  
**Watershed Sustainability Index for Langat UNESCO HELP River Basin, Malaysia**  
(2018) *Int. J. Eng. Technol.*, 7 (3), pp. 187-190.  
14 Special 14
- El-Gafy, I. K. E. D.  
**The water poverty index as an assistant tool for drawing strategies of the Egyptian water sector**  
(2018) *Ain Shams Eng. J.*, 9 (2), pp. 173-186.
- Elkington, J.  
**Cannibals with forks: the triple bottom line of 21st Century Business**  
(1997), 1 (1986), pp. 1-16.  
Capstone, Oxford., Capestone, London
- Epstein, M. J., Buhovac, A. R., Elkington, J., Leonard, H. B. D.  
(2017) *Making sustainability work: Best practices in managing and measuring corporate*

*social, environmental and economic impacts,*

- Farhaoui, M., Derraz, M.  
**Review on Optimization of Drinking Water Treatment Process**  
(2016) *J. Water Resour. Prot.*, pp. 777-786.  
08 08
- Ferraz, M., Bauer, A. L., Valiati, V. H., Schulz, U. H.  
**Microplastic concentrations in raw and drinking water in the sinos river, southern brazil**  
(2020) *Water (Switzerland)*, 12 (11), pp. 1-10.
- Firdausi, A., Arif, I. R. F., Hakim, G. P. N.  
**Nebulizer Operational Time Control Based on Drug Volume and Droplet Size Using Fuzzy Sugeno Method**  
(2021) *J. Robot. Control*, 2 (2), pp. 94-97.
- Flage, R., Aven, T.  
**Emerging risk-Conceptual definition and a relation to black swan type of events**  
(2015) *Reliab. Eng. Syst. Saf.*
- Gautam, J., Chakrabarti, A., Agarwal, S., Singh, A., Gupta, S., Singh, J.  
**Monitoring and forecasting water consumption and detecting leakage using an IoT system**  
(2020) *Water Sci. Technol. Water Supply*,
- Gerba, C. P., Pepper, I. L.  
(2020) *Chapter 24-Drinking Water Treatment*,
- Gholizadeh, M. H., Melesse, A. M., Reddi, L.  
**A comprehensive review on water quality parameters estimation using remote sensing techniques**  
(2016) *Sensors (Switzerland)*,
- Giné Garriga, R., Pérez Foguet, A.  
**Unravelling the Linkages Between Water, Sanitation, Hygiene and Rural Poverty: The WASH Poverty Index**  
(2013) *Water Resour. Manag.*, 27 (5), pp. 1501-1515.
- (2007) *Canadian Water Sustainability Index (CWSI)*,
- Gwon, Y.-H., Choi, J.-T., Jung, S.-E., Kim, D.-H., Lee, H.-S.  
**A Study on the Design and Implementation of Smart Water Grid Task Support System**  
(2015) *J. Korean Inst. Inf. Technol.*,
- Hakim, G. P. N.  
**Near Ground Pathloss Propagation Model Using Adaptive Neuro Fuzzy Inference System for Wireless Sensor Network Communication in Forest, Jungle, and Open Dirt Road Environments**  
(2022) *Sensors*, 2022, p. 3267.
- Hakim, G. P. N., Firdausi, A., Alaydrus, M., Budiyanto, S.  
**Dynamic Traffic Light Timing Control System using Fuzzy TOPSIS Algorithm**  
(2018) *IOP Conference Series: Materials Science and Engineering*,
- Hakim, G.P.N., Muwardi, R., Yunita, M., Septiyana, D.  
**Fuzzy Mamdani performance water chiller control optimization using fuzzy adaptive neuro fuzzy inference system assisted**  
(2022) *Indonesian Journal of Electrical Engineering and Computer Science*, 28 (3), pp. 1388-1395.

- Hakim, G.P.N., Septiyana, D., Suwarno, I.  
**Survey Paper Artificial and Computational Intelligence in the Internet of Things and Wireless Sensor Network**  
(2022) *Journal of Robotics and Control (JRC)*, 3 (4), pp. 439-454.
- Halkijevic, I., Vukovic, Z., Vouk, D.  
**Indicators and a Neuro-Fuzzy Based Model for the Evaluation of Water Supply Sustainability**  
(2017) *Water Resour. Manag.*,
- Harmancioglu, N. B., Barbaros, F., Cetinkaya, C. P.  
**Sustainability Issues in Water Management**  
(2013) *Water Resour. Manag.*, 27 (6), pp. 1867-1891.
- Hasan, H., Parker, A., Pollard, S. J. T.  
**Whither regulation, risk and water safety plans? Case studies from Malaysia and from England and Wales**  
(2021) *Sci. Total Environ.*, 755.
- Hassanzadeh, E., Elshorbagy, A., Wheeler, H., Gober, P.  
**A risk-based framework for water resource management under changing water availability, policy options, and irrigation expansion**  
(2016) *Adv. Water Resour.*, 94, pp. 291-306.
- Hourneaux, F., da S. Gabriel, M. L., Gallardo-Vázquez, D. A.  
**Triple bottom line and sustainable performance measurement in industrial companies**  
(2018) *Rev. Gest.*, 25 (4), pp. 413-429.
- Hruday, S. E.  
(2001) *Drinking Water Quality: A risk management approach*, 28, pp. 29-32.
- Hruday, S. E., Hruday, E. J., Pollard, S. J. T.  
**Risk management for assuring safe drinking water**  
(2006) *Environ. Int.*, 32 (8), pp. 948-957.
- Ingeduld, P.  
**Real-time forecasting with EPANET**  
(2007) *Restoring Our Natural Habitat-Proceedings of the 2007 World Environmental and Water Resources Congress*,
- Izhar Shah, M., Alaloul, W. S., Alqahtani, A., Aldrees, A., Ali Musarat, M., Javed, M. F.  
**Predictive modeling approach for surface water quality: Development and comparison of machine learning models**  
(2021) *Sustain.*,
- Jayaratne, A.  
**Application of a risk management system to improve drinking water safety**  
(2008) *Journal of Water and Health*, 6 (4), pp. 547-557.
- Jiang, Y. Z., Ye, Y. T., Wang, H.  
**Smart basin and its prospects for application**  
(2011) *Xitong Gongcheng Lilun yu Shijian/System Eng. Theory Pract.*,
- Jones, C. H., Meyer, J., Cornejo, P. K., Hogrewe, W., Seidel, C. J., Cook, S. M.  
**A new framework for small drinking water plant sustainability support and decision-making**  
(2019) *Sci. Total Environ.*, 695.
- Juwana, I., Perera, B. J. C., Muttill, N.  
**A water sustainability index for West Java. Part 1: Developing the conceptual**

## **framework**

(2010) *Water Sci. Technol*, 62 (7), pp. 1629-1640.

- Juwana, I., Perera, B. J. C., Muttill, N.  
**A water sustainability index for West Java-Part 2: Refining the conceptual framework using Delphi technique**  
(2010) *Water Sci. Technol*, 62 (7), pp. 1641-1652.
- Juwana, I., Muttill, N., Perera, B. J. C.  
**Indicator-based water sustainability assessment-A review**  
(2012) *Science of the Total Environment*, 438, pp. 357-371.
- Karamoutsou, L., Psilovikos, A.  
**Deep learning in water resources management: The case study of Kastoria lake in Greece**  
(2021) *Water (Switzerland)*,
- King, A., Bartels, W.  
**Currents of Change-The KPMG Survey of Corporate Responsibility Reporting 2015**  
(2015) *KPMG Corp. Responsib. Report*, pp. 1-48.
- Klinke, A., Renn, O.  
**The Coming of Age of Risk Governance**  
(2021) *Risk Anal*, 41 (3), pp. 544-557.
- Koo, K. M., Han, K. H., Jun, K. S., Lee, G., Yum, K. T.  
**Smart water grid research group project: An introduction to the smart water grid living-lab demonstrative operation in yeongjong island, korea**  
(2021) *Sustain*,
- Kouzminov, A., Ruck, J., Wood, S. A.  
**New Zealand risk management approach for toxic cyanobacteria in drinking water**  
(2007) *Aust. N. Z. J. Public Health*, 31 (3), pp. 275-281.
- Laucelli, D., Berardi, L., Giustolisi, O.  
**Assessing climate change and asset deterioration impacts on water distribution networks: Demand-driven or pressure-driven network modeling?**  
(2012) *Environ. Model. Softw*,
- Liang, G., Niu, D., Liang, Y.  
**Sustainability evaluation of renewable energy incubators using interval type-II fuzzy AHP-TOPSIS with MEA-MLSSVM**  
(2021) *Sustain*,
- Linnerooth-Bayer, J., Löfstedt, R. E., Sjöstedt, G.  
(2010) *Transboundary risk management*,
- Maiolo, M., Pantusa, D.  
**Sustainable water management index, swam\_index**  
(2019) *Cogent Eng*, 6.
- Manjakkal, L.  
**Connected Sensors, Innovative Sensor Deployment, and Intelligent Data Analysis for Online Water Quality Monitoring**  
(2021) *IEEE Internet of Things Journal*,
- Marques, R. C., da Cruz, N. F., Pires, J.  
**Measuring the sustainability of urban water services**  
(2015) *Environ. Sci. Policy*, 54, pp. 142-151.
- Mihelcic, J. R.  
**Sustainability Science and Engineering: The Emergence of a New Metadiscipline**

(2003) *Environ. Sci. Technol*, 37 (23), pp. 5314-5324.

- Mocek-Plóćiniak, A., Skowronska, M.  
**Water-An important element not only of the soil environment**  
(2021) *Soil Science Annual*,
- Mohapatra, S. P., Sahu, A. K.  
**Issues in Trends in Sustainability Reporting by Indian Companies as per Global Standards**  
(2015) *Asian J. Res. Bus. Econ. Manag*, 5 (7), p. 57.
- Mohapatra, S. S., Wu, W., Tiwari, M. K., Arora, M.  
**An IUWM incorporated model to improve water supply reliability in intermittent and no service areas**  
(2022) *Resour. Conserv. Recycl*,
- Momeni, M., Behzadian, K., Yousefi, H., Zahedi, S.  
**A Scenario-Based Management of Water Resources and Supply Systems Using a Combined System Dynamics and Compromise Programming Approach**  
(2021) *Water Resour. Manag*, 35 (12), pp. 4233-4250.
- Monis, P., Lau, M., Harris, M., Cook, D., Drikas, M.  
**Risk-based management of drinking water safety in Australia: Implementation of health based targets to determine water treatment requirements and identification of pathogen surrogates for validation of conventional filtration**  
(2017) *Food Waterborne Parasitol*, 8 (9), pp. 64-74.
- Mosleh, L., Negahban-Azar, M.  
**Role of models in the decision-making process in integrated urban water management: A review**  
(2021) *Water (Switzerland)*,
- Nimbargi, S., Mhaisne, S., Nangare, S., Sinha, M.  
**Review on AMI technology for Smart Meter**  
(2017) *2016 IEEE International Conference on Advances in Electronics, Communication and Computer Technology, ICAECCT 2016*,
- Odjegba, E., Oluwasanya, G., Idowu, O., Shittu, O., Brion, G.  
**Sustainability indices and risk analysis of drinking water systems in Southwest Nigeria**  
(2020) *J. Water Supply Res. Technol.-AQUA*, 69 (6), pp. 591-603.
- Oliveira, P. J. A., Boccelli, D. L.  
**K-Nearest Neighbor for Short Term Water Demand Forecasting**  
(2017) *World Environmental and Water Resources Congress 2017: Hydraulics and Waterways and Water Distribution Systems Analysis-Selected Papers from the World Environmental and Water Resources Congress 2017*,
- Otazo-Sánchez, E. M., Navarro-Frómata, A. E., Singh, V. P.  
(2020) *Correction to: Water Availability and Management in Mexico*, pp. C1-C1.
- Pérez-Blanco, C. D., Gómez, C. M.  
**Drought management plans and water availability in agriculture: A risk assessment model for a Southern European basin**  
(2014) *Weather Clim. Extrem*, 4, pp. 11-18.
- Plummer, R., Velaniškis, J., de Grosbois, D., Kreutzwiser, R. D., de Loë, R.  
**The development of new environmental policies and processes in response to a crisis: the case of the multiple barrier approach for safe drinking water**  
(2010) *Environ. Sci. Policy*, 13 (6), pp. 535-548.

- Pollard, S. J. T., Strutt, J. E., Macgillivray, B. H., Hamilton, P. D., Hrudehy, S. E.  
**Risk Analysis and Management in the Water Utility Sector**  
(2004) *Process Saf. Environ. Prot*, 82 (6), pp. 453-462.
- Ponte, B., de la Fuente, D., Parreño, J., Pino, R.  
**Intelligent Decision Support System for Real-Time Water Demand Management**  
(2016) *Int. J. Comput. Intell. Syst*,
- Pryor, T.  
**Six Capitals, or Can Accountants Save the Planet?**  
(2016) *J. Corp. Account. Financ*, 27 (3), pp. 87-90.
- Qi, C., Huang, S., Wang, X.  
**Monitoring water quality parameters of Taihu lake based on remote sensing images and LsTM-RnN**  
(2020) *IEEE Access*,
- Rathnayaka, K., Malano, H., Arora, M.  
**Assessment of sustainability of urban water supply and demand management options: A comprehensive approach**  
(2016) *Water (Switzerland)*, 8 (12).
- Rosén, L.  
**SCORE: A novel multi-criteria decision analysis approach to assessing the sustainability of contaminated land remediation**  
(2015) *Sci. Total Environ*, 511, pp. 621-638.
- Safwani, E., Firdausi, A., Hakim, G.  
**Tower Planning And Arrangements Mobile Telecommunication District Central Aceh With Methode Fuzzy Clustering**  
(2020) *J. Robot. Control*, 2 (1), pp. 7-11.
- Saluja, M.  
**Intelligent Water Management System: Smart Approach Towards Sustainability (Smart Water)**  
(2020) *Lecture Notes in Electrical Engineering*,
- Sampathirao, A. K., Grosso, J. M., Sopasakis, P., Ocampo-Martinez, C., Bemporad, A., Puig, V.  
**Water demand forecasting for the optimal operation of large-scale Drinking Water Networks: The barcelona case study**  
(2014) *IFAC Proceedings Volumes (IFAC-PapersOnline)*,
- Schulte, J., Knuts, S.  
**Sustainability impact and effects analysis-A risk management tool for sustainable product development**  
(2022) *Sustain. Prod. Consum*,
- Sharma, R. K., Kumar, D., Kumar, P.  
**Systematic failure mode effect analysis (FMEA) using fuzzy linguistic modelling**  
(2005) *Int. J. Qual. Reliab. Manag*, 22 (9), pp. 986-1004.
- Shi, J.  
**Groundwater antibiotics and microplastics in a drinking-water source area, northern China: Occurrence, spatial distribution, risk assessment, and correlation**  
(2022) *Environ. Res*, 210.
- Simonovic, S. P.  
**Risk in sustainable water resources management**  
(1997) *IAHS-AISH Publ*, 240, pp. 3-17.



- Singh, C., Bazaz, A., Ley, D., Ford, J., Revi, A.  
**Assessing the feasibility of climate change adaptation options in the water sector: Examples from rural and urban landscapes**  
(2020) *Water Secur*, 11.
- Singh, R. K., Murty, H. R., Gupta, S. K., Dikshit, A. K.  
**An overview of sustainability assessment methodologies**  
(2009) *Ecological Indicators*, 9 (2), pp. 189-212.
- Singh, R. K., Murty, H. R., Gupta, S. K., Dikshit, A. K.  
**An overview of sustainability assessment methodologies**  
(2012) *Ecological Indicators*, 15 (1), pp. 281-299.
- Song, J., Han, M., il Kim, T., eun Song, J.  
**Rainwater harvesting as a sustainable water supply option in Banda Aceh**  
(2009) *Desalination*,
- Sorlini, S., Biasibetti, M., Abbà, A., Collivignarelli, M. C., Damiani, S.  
**Water Safety Plan for drinking water risk management: the case study of Mortara (Pavia, Italy)**  
(2017) *Ambient. e Agua-An Interdiscip. J. Appl. Sci*, 12 (4), p. 513.
- Srivastava, A. K., Dixit, S., Srivastava, A. A.  
**Criticism of Triple Bottom Line: TBL (With Special Reference to Sustainability)**  
(2022) *Corp. Reput. Rev*, 25 (1), pp. 50-61.
- Sullivan, C. A.  
**The water poverty index: Development and application at the community scale**  
(2003) *Nat. Resour. Forum*, 27 (3), pp. 189-199.
- Sullivan, C.  
**Calculating a Water Poverty Index**  
(2002) *World Dev*, 30 (7), pp. 1195-1210.
- Sullivan, C., Meigh, J., Fediw, T.  
**Derivation and Testing of the Water Poverty Index Phase 1**  
(2002) *Cent. Ecol. Hydrol. CEH. Nat. ...*, 1, p. 53.  
May
- Sun, K. H., Huh, H., Tama, B. A., Lee, S. Y., Jung, J. H., Lee, S.  
**Vision-Based Fault Diagnostics Using Explainable Deep Learning with Class Activation Maps**  
(2020) *IEEE Access*,
- Tay, K. M., Lim, C. P.  
**Application of fuzzy inference techniques to FMEA**  
(2006) *Adv. Soft Comput*, 34, pp. 161-171.
- Tscheikner-Gratl, F., Egger, P., Rauch, W., Kleidorfer, M.  
**Comparison of multi-criteria decision support methods for integrated rehabilitation prioritization**  
(2017) *Water (Switzerland)*,
- Tsitsifli, S., Tsoukalas, D. S.  
**Water Safety Plans and HACCP implementation in water utilities around the world: benefits, drawbacks and critical success factors**  
(2021) *Environmental Science and Pollution Research*, 28 (15), pp. 18837-18849.
- Tzanakakis, V. A., Angelakis, A. N., Paranychanakis, N. V., Dialynas, Y. G., Tchobanoglous, G.  
**Challenges and opportunities for sustainable management of water resources in the**

**Island of Crete, Greece**

(2020) *Water (Switzerland)*, 12 (6).

- Utomo, S. B., Irawan, J. F., Alinra, R. R.  
**Early warning flood detector adopting camera by Sobel Canny edge detection algorithm method**  
(2021) *Indones. J. Electr. Eng. Comput. Sci.*
- Van Asselt, M. B. A., Renn, O.  
**Risk governance**  
(2011) *J. Risk Res.*, 14 (4), pp. 431-449.
- Van Engelenburg, J., Van Slobbe, E., Teuling, A. J., Uijlenhoet, R., Hellegers, P.  
**Sustainability characteristics of drinking water supply in the Netherlands**  
(2021) *Drink. Water Eng. Sci.*, 14 (1), pp. 1-43.
- Vieira, J. M. P.  
**Water safety plans: Methodologies for risk assessment and risk management in drinking water systems**  
(2007) *IAHS-AISH Publ.*, (310), pp. 57-67.
- Wang, Y., Ho, I. W. H., Chen, Y., Wang, Y., Lin, Y.  
**Real-time Water Quality Monitoring and Estimation in AIoT for Freshwater Biodiversity Conservation**  
(2021) *IEEE Internet Things J.*
- Wang, Z. S., Wei, Z. K., Yin, Q.  
**The design of water supply network based on GIS**  
(2008) *2008 IEEE International Conference on Cybernetics and Intelligent Systems, CIS 2008*,
- Wee, S. Y., Aris, A. Z.  
**Endocrine disrupting compounds in drinking water supply system and human health risk implication**  
(2017) *Environment International*, 106, pp. 207-233.
- Weintraub, L. H. Z., Tao, H., Redder, T. M.  
**Water Prism: A Tool to Assess Water Availability Risk and Investigate Water Management Strategies**  
(2017) *J. Am. Water Resour. Assoc.*, 53 (3), pp. 605-625.
- Wong, A.  
**Corporate sustainability through non-financial risk management**  
(2014) *Corp. Gov.*
- (2019) *Microplastics in drinking-water*, p. 124.  
Who
- Xu, J.  
**Low-cost, tiny-sized MEMS hydrophone sensor for water pipeline leak detection**  
(2019) *IEEE Trans. Ind. Electron.*
- Yang, L., Sui, J., Hua, Z.  
**Harmony search algorithm for optimal design of water supply networks**  
(2012) *J. Theor. Appl. Inf. Technol.*
- Yastrebova, A. Y., Gulyaeva, E. E.  
**Right to Health in the International Legal System of Human Rights at the Universal and Regional Levels**  
(2021) *Moscow J. Int. Law*, (2), pp. 99-121.

- Zeng, H., Dhiman, G., Sharma, A., Sharma, A., Tselykh, A.  
**An IoT and Blockchain-based approach for the smart water management system in agriculture**  
(2021) *Expert Syst*,

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