

---

This item was submitted to [Loughborough's Research Repository](#) by the author.  
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

## **Gaza H2.0: promoting sustainable water supply and demand and knowledge transfer to enhance water infrastructure resilience in the Gaza Strip**

PLEASE CITE THE PUBLISHED VERSION

PUBLISHER

WEDC, Loughborough University

VERSION

VoR (Version of Record)

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Pedron, Giovanni, Ivo Daniel, David Tilcher, Andrea Cominola, and Anna Crescenti. 2021. "Gaza H2.0: Promoting Sustainable Water Supply and Demand and Knowledge Transfer to Enhance Water Infrastructure Resilience in the Gaza Strip". Loughborough University. <https://hdl.handle.net/2134/16903540.v1>.

**42nd WEDC International Conference**

**ONLINE: 13 – 15 September, 2021**

**EQUITABLE AND SUSTAINABLE WASH SERVICES:  
FUTURE CHALLENGES IN A RAPIDLY CHANGING WORLD**

**Gaza H2.0: Promoting sustainable water supply and  
demand and knowledge transfer to enhance water  
infrastructure resilience in the Gaza Strip**

G. Pedron, I. Daniel, D. Tilcher, A. Cominola & A. Crescenti

*Palestine*

**REFERENCE NO. 3184**

---

Many water distribution systems worldwide experience prolonged intermittent water supply under conditions of water scarcity, both in developed and developing countries. In addition to water scarcity and droughts, infrastructural failures (e.g., leakages) further confront the environmental and economic sustainability of water utility operations. The World Bank highlights extreme events such as droughts and floods and water losses phenomena as one of the main current and future hazards for water management, especially in developing countries<sup>[1]</sup>. These challenges call for the development of effective water resources management and operation strategies, coupled with advanced monitoring technologies, to increase the reliability of water distribution networks (WDNs) to meet consumer demands, mitigate the impact of water scarcity, foster an efficient use of water resources, reduce losses and stress on the infrastructure, and improve the overall resilience of water infrastructures to cascading effects. In this work, we introduce the EU funded project “Gaza H2.0: Innovation and water efficiency”, which aims to promote efficient and sustainable water supply and demand and knowledge transfer to enhance resilience against water scarcity in the Palestinian territory of the Gaza Strip (GS). Palestine is a water-scarce territory whose vulnerability is exacerbated by its unstable geo-political setting. The average domestic water consumption in Gaza amounts to 89 liters per capita per day (lcd), which is below the level of service that according to the World Health Organization would be required to meet the basic water needs, 100 lcd<sup>[2]</sup>. Moreover, sustainable urban water supply and demands in the GS are hampered by persistent environmental, climate, and socio-economic issues, including increasingly frequent droughts, population growth, infrastructural challenges, and deteriorating water quality due to seawater intrusion in the coastal aquifer. A major infrastructural challenge to achieve more sustainable water supply in the GS is represented by water losses. According to the Palestinian Water Authority (PWA), the estimated amount of non-revenue water (NRW) in GS in 2018 amounted to 35.7 million cubic meters, representing a loss of 37.6% of the total supplied water<sup>[3]</sup>. The PWA estimates average levels of NRW in Gaza ranging from 15 to 98 lcd. Water loss reduction is thus a priority area for improvement in the GS. This would require, first, a better knowledge and quantification of NRW components, as they are not accurately quantified. Consequently, water authorities and municipalities are exposed to several pressing targets to improve their water management plans with reduced financial capacity, including: preserving safe supply levels, monitoring the volume conveyed by networks, detecting leaks, cost reduction, reducing NRW, and monitoring and estimating the consumption at both community and household level. These challenges particularly apply to Khan Younis, the second most populated city the GS with a population of 286,391 people. Khan Younis Municipality (KYM) is the main service provider for water and sanitation services in the area, providing water to almost 249,160 people, which constitute 87% of the city’s population. The estimated average daily water amount supplied to the network is 99.5 lcd, while the average daily consumption is only 74.7 lcd. The above numbers provide evidence for the high ratio of NRW in the water distribution network of Khan Younis. The Gaza H2.0 initiative arises from KYM appeal and willingness to reduce water losses in the local supply system and, thus, to improve their

water resources management and efficiency, in line with PWA “National Water and Wastewater Strategy, 2013”. The action was designed in partnership with KYM and PWA and expected goals would be achieved through the application of digital technologies (i.e., sensors and data-driven algorithms); through knowledge transfer and awareness raising, with tailored training on District Metering Areas (DMAs) and Smart Water Networks (SWANs) approaches, and capacity building for citizens; and through advocacy, by the establishment of a SWAN task force, supporting the national policy on water loss reduction and the elaboration of guidelines and accountability mechanisms. From the technical point of view, three major steps will be accomplished in Gaza H2.0 to facilitate NRW reduction in KYM. Firstly, an initial reconnaissance of the current WDN will be conducted as many parts of the system remain unknown. To this end, state-of-the-art in-situ measurement equipment will be applied to detect pipe routing where undocumented. The information gathered will be utilized to complete partial network plans and to understand the current state and topology of the system. In a second step, the updated information will serve the optimal subdivision of the WDN into DMAs <sup>[4]</sup> and, additionally, a hydraulic model will be built and validated through field data from available and newly installed pressure and flow sensors. Lastly, mass-balance measurements will be conducted for each of the DMAs and verified with the hydraulic model, to complete the assessment of the WDN. This will reveal current local imbalances and, thus, uncover present leaks which will effectively be mitigated through in-situ maintenance. The above steps rely on the opportunities that the digital transformation of the urban water sector is opening up for sustainable asset management and effective maintenance programs within the broad realm of SWANs, which enable rapid coordinated actions and control over the decentralized components of a WDN. Once a comprehensive set of sensors is operative, resulting from the above mentioned actions, online data-driven algorithms will be applied for real-time monitoring of the WDN and prompt detection of newly occurring leaks. A state-of-the-art algorithm that relies on data from the pressure sensors installed throughout the WDN will be adapted for application to the local context <sup>[5]</sup>. After calibration on a pre-defined period, the pressure-driven algorithm is capable of analysing incoming data streams without any restriction to the time-related resolution and it raises an alarm when significant deviations from the original state are identified, as likely caused by incipient leaks or pipe bursts. Along the Gaza H2.0 action, knowledge transfer will be ensured through capacity building, which will result in an improvement of technical and managerial capacity of local technicians and authorities, reflecting positively on the level of provided service and reduction of NRW in KYM and the GS. Overall, we expect the Gaza H2.0 project to demonstrate how digital technologies, proactive engagement, and developed knowledge of local utilities and communities can lead to an improved resilience of WDNs in GS, as well as derive recommendations for sustainable technology transfer and scaling up to similar contexts.

## Acknowledgement

The research described in this extended abstract is supported by the European Commission under the programme EuropeAid/163941/DH/ACT/Multi.

## References

- [1] World Bank Group (2018). Securing Water for Development in West Bank and Gaza: Sector Note. World Bank.
- [2] UN Office of the High Commissioner for Human Rights (OHCHR), Fact Sheet No. 35, The Right to Water, August 2010, No.35, available at: <https://www.refworld.org/docid/4ca45fed2.html> [accessed 10 March 2021]
- [3] Palestinian Water Authority (2019). Gaza Water Status Report. Internal Palestinian Water Authority (PWA) Report. Unpublished.
- [4] Di Nardo, A., & Di Natale, M. (2010). A design support methodology for district metering of water supply networks. In *Water Distribution Systems Analysis 2010* (pp. 870-887).
- [5] Daniel, I., Pesantez, J., Letzgus, S., Khaksar Fasaee, M. A., Alghamdi, F., Mahinthakumar, K., Berglund, E., & Cominola, A. (2020). A high-resolution pressure-driven method for leakage identification and localization in water distribution networks. Zenodo. <http://doi.org/10.5281/zenodo.3924632>

## Contact details

**Giovanni Pedron & Anna Crescenti:**

WASH manager & WASH expert, WeWorld-GVC Palestine. Ata Al-Zir Street 15, 90917 Jerusalem.

Email: [giovanni.pedron@gvc.weworld.it](mailto:giovanni.pedron@gvc.weworld.it) Email: [anna.crescenti@gvc.weworld.it](mailto:anna.crescenti@gvc.weworld.it)

Website: <https://www.weworld.it/en>

**Ivo Daniel & Andrea Cominola:**

Chair of Smart Water Networks, Technische Universität Berlin. Einstein Center Digital Future, Straße des 17. Juni 135, 10623 Berlin (DE).

Email: [ivo.daniel@tu-berlin.de](mailto:ivo.daniel@tu-berlin.de) Email: [andrea.cominola@tu-berlin.de](mailto:andrea.cominola@tu-berlin.de)

Website: <https://www.swn.tu-berlin.de/>

**David Tilcher:** Chair of Fluid System Dynamics, Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin (DE). Email: [david.tilcher@tu-berlin.de](mailto:david.tilcher@tu-berlin.de)

Website: <https://www.fsd.tu-berlin.de>