



World Federation of Engineering Organizations
Fédération Mondiale des Organisations d'Ingénieurs

Water, Women and Engineering

Engineering contribution to the United Nations World
Water Development Report 2026 on behalf of the World
Federation of Engineering Organizations

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Executive Summary

Engineering innovations have transformed public health and daily life through the provision of safe drinking water, sanitation and wastewater systems, and these systems are central to Sustainable Development Goal 6 (SDG 6), which aims to ensure the availability and sustainable management of water and sanitation for all. While these benefits extend across entire communities, women and girls often experience disproportionately positive impacts because they are frequently responsible for water collection, cooking and caregiving. Nevertheless, despite much progress, women continue to bear the brunt of unpaid labour when it comes to water related and care giving activities, and the lack of water at household level and adequate sanitation facilities keeps girls from achieving the education they need, and prevents women from fulfilling their roles in public life and in achieving full employment.

This report examines how contemporary infrastructure choices, technologies and water governance methods can accelerate progress on water and sanitation in countries which face increasing climate vulnerabilities. It argues that gender-responsive engineering design, delivery and governance are essential to achieving equitable outcomes, and that technical solutions alone are insufficient without inclusive participation and accountability.

The report highlights persistent gender gaps within the water and engineering workforce, the consequences of underinvestment and inadequate service provision, and the importance of sex-disaggregated data to inform design, monitor outcomes and guide decision-making. It concludes that progress on SDG 6 cannot be separated from progress on SDG 5 (gender equality), and that engineers have a critical role to play in addressing both.

Context

This report was prepared on behalf of the World Federation of Engineering Organisations as the engineering contribution to the United Nations World Water Development Report 2026 entitled '**Water for all people: Equal rights and opportunities**' [1] to highlight the role and importance of engineering in addressing water related equality issues.

1. Introduction

The work of engineers is vital to discussions about the relationship between women and water, as engineers are responsible for saving millions of lives through the provision of clean water, sanitation and sewerage treatment systems, which is the focus of Sustainable Development Goal 6 [2]. The lack of clean water is a much greater burden for women than for men, as women worldwide are generally responsible for cooking, and caring for children, elderly and sick family members, so where clean water is available at the property level this has huge benefits for women and girls [3]. Where it is not available, women and girls are predominantly the ones who are responsible for collecting water, which creates chronic time poverty and exposes them to physical injury, health risks and heightened vulnerability to harassment and violence, while also limiting girls' education and women's participation in paid work and community life. Currently only 66% of the global population has piped water access at household level, leaving 1.8 billion people having to collect water. Piped water has the greatest health benefits and lowest drudgery costs, so extending the reach of water grids to underserved communities is an important priority.

However, progress is constrained by persistent underinvestment in water and sanitation systems. The water sector faces a massive financing shortfall: \$6.7 trillion needed by 2030 and \$22.6 trillion by 2050, with current annual investment at only ~\$300 billion. Closing the \$700 billion annual funding gap to achieve SDG 6 requires prioritizing gender-responsive infrastructure that reduces women's unpaid labor burden. [1]

2. Impact of Industrialisation on Water and Health

In the nineteenth century in the developed world, it became clear that technical solutions to provide population-wide clean water for the whole population were more effective in combating diseases than individual health interventions [4]. The advent of steam as a new energy source catalysed the creation of innovative drinking water systems and sanitary sewer networks, significantly improving wastewater collection and treatment. These technological advancements played a transformative role in reducing the prevalence of waterborne diseases such as cholera and typhoid fever [5], thus reducing the caregiving roles that are undertaken by women, and their exposure in water collection.

Progress in microbiology and medicine was essential to identify and isolate pathogens, paving the way for engineering breakthroughs like water disinfection in the late 19th century. These innovations drastically reduced disease transmission, improving the health and quality of life for communities at large.

3. Impact of Technology Today

The challenges of water pollution driven by industrialisation, urbanisation, and agricultural chemicals continue to impact public health, and drawing from historical lessons, advancing water treatment technologies remains critical—not only to control emerging diseases but also to alleviate the disproportionate burden on women.

Engineering plays a central role in providing water infrastructure, including dams, pipelines, pumping stations and treatment plants. Recent technological advances, particularly in sensing, monitoring and data systems, have improved how these networks perform by reducing water losses, increasing efficiency and supporting disease surveillance. Engineering approaches now also include nature-based solutions for rivers, aquifers and urban drainage, the protection and restoration of water-related ecosystems, the development of alternative water sources such as treated wastewater, stormwater and desalination, and measures to reduce the impacts of floods and droughts on people and economies.

To maximise these benefits, gender considerations must be embedded within engineering choices, not added after designs are complete. This includes who engineers consult, what performance measures

are used, and how trade-offs between cost, coverage, reliability and safety are evaluated. In practice, gender-responsive engineering should be treated as a quality standard that improves service outcomes for everyone

Emerging technologies such as artificial intelligence, internet of things, and data-driven systems are transforming the monitoring and governance of our water systems, and advances in satellite and remote sensing technologies also provide critical insights into water cycles, aiding in climate change impact assessments.

All of these engineered solutions will have a positive and often disproportionate impact on women, and so engineering responses should be seen as a valuable lever to address the impact of water-related issues on women.

3.1. Practical Interventions

The following examples illustrate that engineering interventions can reduce gendered burdens through both high-technology systems and low-cost changes in practice. They also show the importance of combining technical design with enabling measures such as training, finance, local ownership and inclusive decision-making.

Hydroponic Crops

One new technology which will be advantageous for women is the development of hydroponic crops, particularly when compared to traditional farming methods that are often water-intensive and require much greater irrigation. These crops are cultivated in controlled environments without the need for soil, but instead use nutrient-rich water solutions, and generally use 90% less water than traditional farming. Hydroponics eliminate the need for soil preparation and require less time for maintenance, making this farming much less labour-intensive, thus allowing faster crop growth and higher productivity, providing women with opportunities to generate income more efficiently, leading to greater financial independence. They expose women to fewer harmful chemicals such as pesticides, and create safer and more controlled working environments, exposing women to fewer health risks, and they are suitable for small and urban spaces, enabling crops to be grown more readily in urban environments without access to as much land.

These benefits not only improve the quality of life for women but also contribute to their empowerment and inclusion in sustainable agricultural practices.

Cooking

Advanced technology is not always necessary to have an impact on women and water: changes to traditional cooking practices on open fires using simple solutions can significantly reduce the amount of water required, for example by using lids on cooking pots to prevent water loss, by pre-soaking beans or grains—which can reduce cooking time for up to four hours per day—and by using energy-efficient cookstoves which retain heat for longer as the food cooks, and significantly reduce the amount of water required. These practices not only conserve water but also reduce the amount of time and labour women spend collecting water and firewood, contributing to better health, safety, and overall quality of life.



Women cooking on open fires, and with cookbags in Lesotho courtesy of Ken Dunn of Eternal Flame

3.2. The Need for Sex-Disaggregated Data

Where we could make faster progress, however, is in our understanding as an engineering sector of the gender-differentiated impacts of our engineering solutions on men and women, and encourage interventions which address these gendered requirements further and more intentionally.

For example, the lack of consistently measured gender-specific indicators and sex-disaggregated WASH data would improve our understanding of the impact of technology interventions on women and girls[4], and it is important that household surveys go beyond water quality assessments to include assessments

of the collection burden for households without water, to help improve the global picture of gender roles in water collection and treatment.

Sex-disaggregated data should also be used as an accountability tool, not only a research input. Clients and delivery partners can require gender-responsive indicators in contracts and monitoring frameworks, including measures of time saved, safety, access and usability. This would help ensure that infrastructure and service upgrades deliver measurable outcomes for women and girls, rather than assuming benefits will follow automatically.

The accessibility of gender-responsive sanitation facilities, including toilets and menstrual hygiene provision in public settings—such as schools, transportation hubs, publicly accessible government offices, health clinics, markets and workplaces—facilitates freedom of movement and access to opportunities for women and girls, and should be included in data collection metrics [6].

Note that when providing sanitation facilities in a disaster response situation, the need for privacy must be carefully balanced against potentially dangerous isolation that may increase the risk of violence and harassment, and infrastructure guidelines can ensure that engineers and built environment professionals comply with best practice guidance when designing and building disaster and conflict relief infrastructure.

4. Climate Impact, Flooding and the Energy Transition

Flooding is becoming a much more frequent event around the world due to increased global warming and much heavier rainfall events, causing rivers to burst their banks, sewers to overflow, and excessive surface water to flood properties much more frequently. Flooding will inevitably cause damage to homes and properties, and the burden of these flood events very often falls on women in a number of ways. Not only are women generally responsible for cleaning and refurbishing their homes, but they will often also have the additional burden of addressing the administrative cost of flood events, as well as the emotional cost of loss of personal and family possessions, and their home environment. Any interventions that prevent property-level flooding, including Early Warning Systems tailored to particular audiences for maximum effectiveness, in order to create resilience to flood events will have a disproportionately positive benefit for women. Early warning systems are most effective when women are involved in their design, testing and communication pathways. This helps ensure that warnings reach those who manage

household water, sanitation and caregiving responsibilities, and that protective actions are feasible in practice. Gender-responsive disaster risk reduction should therefore be treated as part of core water infrastructure planning, rather than a separate humanitarian add-on.

New technologies associated with climate mitigation and the renewable energy transition, such as the move away from oil and gas towards battery technology using lithium for example will also have an impact on water and biodiversity globally, as many of these technologies will be water-depleting, having the knock-on effects for women that have been identified elsewhere in this report. The impact of any new technologies that are being considered should be disaggregated for gender-related impact, and it is the job of the engineer and policy setters to incorporate this analysis.

In addition, the supply chains for new technologies can shift water demands geographically and socially, with differing impacts on women's workloads, livelihoods and local ecosystems. Gender impact assessment should therefore extend beyond the operational phase of new technologies to include material sourcing, manufacturing and end-of-life considerations where these affect local water availability and quality.

5. Strengthening Meaningful Participation in Decision Making and the Engineering Workforce

The disproportionate responsibility that women and girls bear as primary users, providers and managers of water, sanitation and hygiene (WASH) in households is not matched in decision-making on 'big water' issues—such as large-scale infrastructure investments, water allocations or water trading that would result in better services for themselves. Decisions remain largely gender-blind.

Including women as decision-makers is not only an equity issue, it can improve system performance. Women's operational knowledge of household and community water use can strengthen choices about siting, service levels, maintenance arrangements and safety features. This also requires moving beyond consultation to support women's paid roles and leadership in co-design, operation and maintenance, so that participation is meaningful and sustained.

The water industry is subject to the same gender imbalance as the engineering and technology sectors, where women are significantly under-represented, particularly in technical and managerial roles [3]. Less

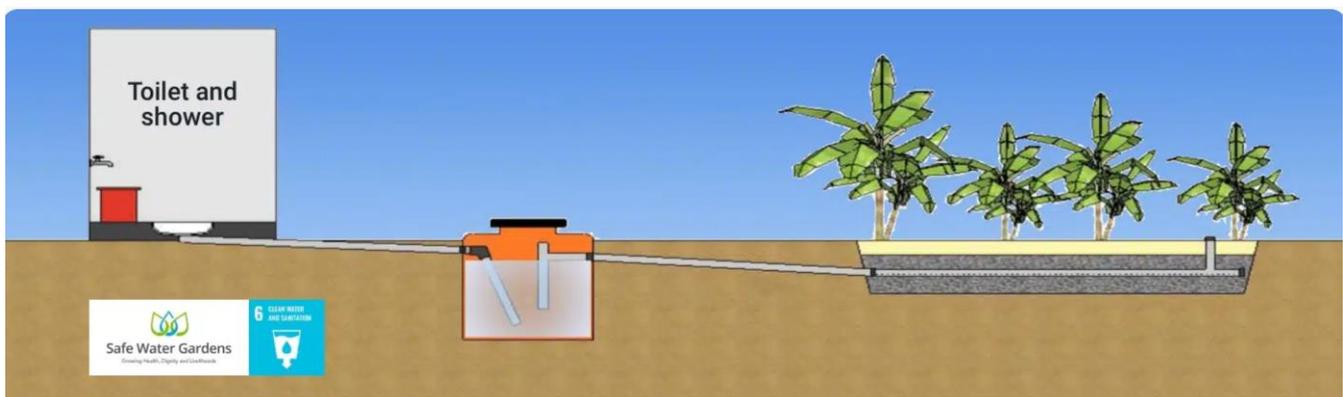
than 20% of water sector workers are women, and only about 23% of licensed engineers and managers in water utilities are female. In some cases, one-third of utilities have no female engineers, and 12% lack female managers entirely [3]. Many interventions are in place to increase the number of women in engineering more generally, but progress remains slow or static, and in some cases gains have recently been reversed, in spite of much emphasis and effort to improve the situation.

6. Case Studies

6.1. Safe Water Gardens (Indonesia)

'Safe Water Gardens' in Indonesia [8] provide easy-to-build water and sanitation solutions to villages in Indonesia through community ownership and small loan systems. Their 'Train the trainers' initiative enabled the starter village to power a regional rollout, leading to flourishing, healthy and sustainable village communities and WASH+, leverage on WASH gains to promote micro-farming and healthy living, enabling high-quality jobs and micro-enterprises. Survey results from 3 villages in response to the WASH+ education are:

- 97% now understood the importance of plant-based diets
- 100% wanted to start a micro-business
- 100% felt that all Indonesian women should receive more of such education
- More than 80% of village families report they are interested in starting a micro-business



Basic schematic model of a Safe Water Garden, <https://safewatergardens.org/>

6.2. Cyclone Idai Recovery (Zimbabwe)

Post-disaster recovery provides an opportunity to rebuild infrastructure with better safety and inclusion outcomes. Following Cyclone Idai in 2019, the Zimbabwe Idai Recovery Project included gender-responsive water and sanitation interventions. [9]

Key measures included:

- Safer latrines and water points located to reduce travel distance and exposure to risk for women and girls
- Improved lighting in community areas to support safer movement at night
- Training and employment opportunities for women, including village pump minders and latrine builders
- Latrine design improvements such as locks, privacy screens and hygiene kits
- Gender-balanced staffing approaches for sanitation services, and supportive employment policies including menstruation-related sick leave

This case illustrates how gender-responsive design choices can be embedded within standard delivery processes when they are treated as requirements rather than optional enhancements. It also shows that employment policies and workforce choices form part of delivery quality, because they influence whether services are designed, built and maintained in ways that meet women's needs

7. Recommendations for Engineering Action

The evidence and examples in this report point to a consistent message: engineering solutions deliver the greatest benefits for women and girls when gender considerations are integrated from the outset, supported by appropriate governance, and measured through robust data. The recommendations below therefore set out practical actions across design, delivery, finance, governance, workforce participation and climate resilience.

Overarching Recommendation: Engineers must recognize that gender inequality in water access is simultaneously a technical AND social issue. Infrastructure solutions must be co-produced with women

as active decision-makers, not merely consulted stakeholders. Neither SDG 5 (Gender Equality) nor SDG 6 (Clean Water and Sanitation) can be achieved without the other.

1. **Close the Water Infrastructure Investment Gap** - The global water sector faces a severe financing shortfall that threatens progress on SDG6, clean water and sanitation. Investment must be scaled up and directed towards infrastructure that reduces women's unpaid labour and time poverty.
2. **Prioritise Piped Water as the Highest Level of Service** - Piped water should be the universal ambition wherever feasible. Reliance on water collection disproportionately affects women and girls, leading to health impacts, lost education and reduced economic participation.
3. **Mainstream Gender in Engineering Design** - Gender considerations must be routinely integrated into the technical design of water systems. Engineers and field staff should be equipped to understand and respond to the needs of women and girls.
4. **Design Water, Sanitation and Hygiene Infrastructure for Dignity and Safety** - Water, Sanitation and Hygiene (WASH) facilities, including in disaster relief, must include privacy, security, lighting, accessibility and menstrual hygiene management as baseline requirements. Failure to do so limits use by women and girls and undermines health, education, safety, and employment outcomes.
5. **Integrate Gender Across the Infrastructure Lifecycle** - Gender considerations should be embedded across planning, procurement, construction and service delivery. This should be reinforced through codes, standards, contracts and employer policies so that inclusive practice becomes routine.
6. **Combine Centralised, Decentralised and Community-Led Solutions** - Water systems are more effective when centralised infrastructure is complemented by decentralised technologies and community-driven approaches, which are more sustainable when women are involved in their design and decision-making.
7. **Scale Nature-Based Solutions Where Appropriate** - Nature-based solutions such as reforestation, rainwater harvesting and ecosystem restoration can improve water security, reduce costs and strengthen resilience. Women's knowledge of local water systems should inform their design and management.
8. **Build Climate-Resilient Infrastructure That Addresses Gendered Risk** - Climate-resilient water infrastructure, including gender-responsive disaster risk reduction and early warning systems, eliminate the disproportionate risks women face during water-related disasters.
9. **Use Sex Disaggregated Data to Inform Decisions** - Sex disaggregated data should be routinely collected and used to understand intra household inequalities and differentiated impacts.

10. **Use Technology to Reduce Gender Barriers** - Digital tools, automation and monitoring techniques can reduce physical demands, improve system performance and expand opportunities for women in water management and engineering roles.
11. **Design Agricultural Water Systems for Equitable Access** - Many women work in agriculture but do not own the land they farm. Irrigation and water systems should be designed and managed so that women can use them despite not having land ownership.
12. **Support Women's Leadership and Paid Roles in Water Systems** - Women should be supported into leadership and paid technical roles in co design, operation and maintenance of water systems.
13. **Increase Women's Participation in the Engineering Workforce** - The engineering profession must recruit, retain and progress more women, particularly in water utilities and infrastructure delivery, which requires addressing workplace culture and ensuring safe, inclusive working environments.

8. Conclusions

Engineering has delivered major public health gains through safe water and sanitation systems, and remains essential to achieving SDG 6 [1]. Because women and girls often face greater time, safety and caregiving burdens linked to inadequate water and sanitation, well-designed engineering interventions can deliver disproportionate benefits and help advance gender equality. To maximise impact, engineering organisations and delivery partners should embed gender-responsive design, strengthen inclusive participation, and improve the availability and use of sex-disaggregated WASH data.

This requires explicit expectations within standards, procurement and employer policies, so that gender-responsive outcomes are delivered consistently at scale.

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- [10] Royal Academy of Engineering Africa Prize for Engineering Innovation, <https://africaprize.raeng.org.uk/>

Annex: Africa Prize for Engineering Innovations

The entrants, finalists and winners from the past ten years of the Royal Academy of Engineering's Africa Prize - the biggest fund to support engineering entrepreneurs in Africa - has supported a number of innovations related to water. [10]

Mobi-Water from Kelvin Gacheru in Kenya is a solar-powered system that allows the millions of people who use water tanks to ensure that water is not wasted. It monitors water levels, leaks, valves and pumps via a mobile phone app.

Aquaset from Obed Zar in Ghana is a smart water management system that prevents waste and enables consumers to manage their consumption. Ghana's cities have irregular water supply and frequent power failures. Many households supplement their municipal water provision using boreholes, with underground water pumped into a storage tank. But groundwater sources often dry up when tanks are filled faster than they can be replenished.

Rainwater Harvesting App from Aline Okello in Mozambique helps users navigate through complex rainwater harvesting solutions to find the equipment that suits their location, budget and needs. It allows users to calculate how much water they could harvest based on the type of roof they have, their location and available tank types in the area.

Majik Water from Beth Koigi in Kenya harvests moisture from the air to provide affordable, clean drinking water to off-grid communities. The all-in-one system harvests, stores and then dispenses water. Custom-built water dispensers—or water ATMs—will allow communities to pay only for as much water as they need.

Smart Water Tech by Allen Chafa from Zimbabwe is a real-time water quality monitoring and control system designed to address poor water quality which results in the spread of waterborne diseases. Chafa created Smart Water Tech in response to a 43% increase in cholera cases in Zimbabwe between 2018 and 2020, and 3.5 million fatalities reported annually in Africa due to unsafe drinking water[5].

Affordable AMD Solution by Boitumelo Nkatlo in South Africa is a technology to treat acid mine drainage (AMD), using industrial waste to recycle contaminated water for human consumption. AMD water is a byproduct of metal and coal mining produced when sulphide minerals come into contact with air and water to form sulphuric acid and dissolved iron which pollute rivers, lakes and water supplies.