

Economic analysis of drinking water services, case of the city of Souk-Ahras (Algeria)

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Abstract

Water Supply and Sanitation Services (WSSS) face various constraints that hinder their development. The application of sustainable economic instruments may help WSSS policymakers improving the quality of service provision for their clients. This study shows the role of these economic instruments in WSSS management for the case of the city of Souk-Ahras (Algeria). A detailed analysis of expenditures and revenues, focusing on the tariff structure and subsidies, has been carried out. The results obtained show that WSSS in Souk-Ahras suffer from a relevant budget imbalance influenced by the high level of non-revenue water and the application of pricing that does not achieve cost recovery.

Key words: Algeria, economic analysis, Souk-Ahras, water price, water supply and sanitation services

INTRODUCTION

Water supply and sanitation services (WSSS) face different challenges, of economic, environmental, social, technical and political natures (Pinto & Marques 2017). Different constraints hinder the development of WSSS, such as (i) water scarcity, (ii) rapid population growth, (iii) strong economic development, and (iv) inefficient management. This may lead to a state where the revenues received are not sustainable, particularly the revenue from water pricing.

The operation of WSSS is based on costly infrastructure, where managers need sustainable financing and economic viability to promote the required investments and improve performance. However, there are important trade-offs when ensuring the sustainability of water services, particularly considering both improvements in efficient cost recovery and measures of affordability (e.g. development of a social tariff able to avoid an increase in prices that may affect the most deprived households). In this context, the water tariff structure design may be an important tool that requires the balancing of three different objectives, which are usually in conflict: economic efficiency, financial self-sufficiency for the WSSS provider by applying the cost recovery principle, and equity among clients (Nauges & Whittington 2017).

In theory, pricing policies can be an effective tool to improve the economic viability of WSSS (Hoque & Wichelns 2013), allowing the provider to recover costs (Chun 2014) to ensure accessibility and equity among customers (Farolfi & Gallego-Ayala 2014). However, in practice, tariffs rarely cover the full cost of service, resulting thereby in an unsustainable water service (Zetland & Gasson 2013),

perhaps not allowing additional investments, which may be required to improve performance (Monney & Antwi-Agyei 2018). Finally, with respect to affordability, the question of whether users are able and willing to pay more if extra costs (e.g. investments, operating costs and externalities) affect their water bills should also be addressed.

To evaluate the economic sustainability of WSSS, the costs of running both water supply and sanitation services have to be considered. These costs should mainly be borne by consumers, being important to address who pays what. Eventually, WSSS managers need to recover their costs while seeking an equilibrium with the principles of social responsibility to achieve affordability (Kumasi & Agbemor 2018). Therefore, it is important to consider an adequate mix of water revenue sources, with a relevant focus on water pricing (Pinto *et al.* 2014), to allow for a suitable design of water tariffs (e.g. in the articulation of prices, subsidies and the implementation of social tariffs) and WSSS revenue (Mastaller & Klingel 2017; Pinto *et al.* 2018).

Water Supply and Sanitation services in Algeria are managed by the Algerian drinking water company (ADE) and the National Sanitation Office (ONA) respectively. ADE and ONA are national public industrial and commercial institutions, created by Executive Decree n° 01-102 of 21 April 2001. By the late 90s, the Algerian State implemented a new strategy of development of the water sector by the implementation of a national water policy. Then, a new Law n° 05-12 enforcing a Water Code was adopted.

Both ADE and ONA have been facing financial difficulties due to the underpricing of water supply and sanitation services (Hamchaoui *et al.* 2015; Boukhari *et al.* 2017). This considerable fiscal imbalance is influenced by the application of pricing that does not encourage sustainable cost recovery (a low water tariff that is far from the actual cost of production) and high rates of non-revenue water (NRW), which had a significant influence on future rates (Kanakoudis *et al.* 2011). As revenues have been significantly lower than service delivery costs, the government had to provide annual grants for both services. This situation led decision-makers to reorient their priorities towards the efficiency of economic instruments (Boukhari *et al.* 2011), and thus to seek more efficient pricing policies. The use of economic instruments to promote sustainable management of WSSS, namely by ensuring economic efficiency, is a relevant point throughout the literature (Murrar 2017; Shen & Wu 2017).

The objective of this study is to assess the role of economic instruments in improving the management of WSSS in Algeria. This assessment is developed, in a first step, through the identification of constraints to the application of economic instruments for the viability of WSSS in Algeria, particularly the challenges for sustainable tariff setting. To this end, there is an assessment of costs, revenues and subsidy rates associated with the WSSS of Souk-Ahras. Afterwards, in a second step, key challenges (such as NRW) and tariff reforms are assessed considering the characteristics of Souk-Ahras. In a last step, willingness to pay is used to fine tune the tariff reform developed in the previous step.

This study presents a methodological tool for the economic analysis of WSSS in the city of Souk-Ahras (Algeria). Indeed, to the authors' knowledge, there is no study in the literature dealing with the implementation of the principle of sustainable cost recovery of WSSS in Algeria and its relationship with the price of water and its influence on the economic sustainability of both water supply and sanitation services.

This paper is organized as follows: following this brief introduction, we set a framework to assess the role of economic instruments for WSSS in Algeria. Afterwards, the water supply and sanitation services in Algeria are introduced, alongside a detailed description of the case study. Subsequently, the results obtained are discussed and key recommendations are proposed in order to improve the management of WSSS.

METHODS

The methodology applied in this research follows a decision support lens. It aims to help WSSS managers in Algeria to find sustainable solutions for the economic viability of WSSS by seeking new alternatives able to improve financial autonomy (reduction of state subsidies and increase of revenues by applying the principle of sustainable cost recovery). These solutions must promote a balance between operating expenses and revenues. Expenses shall be covered by sustainable cost recovery through the application of suitable pricing and long-term revenue stability by minimizing NRW (Zyoud *et al.* 2016). The methodology applied in this research is illustrated in Figure 1. The proposed model covers three strategic and hierarchically related steps to improve the WSSS financial situation.

The **first step** is to define the problems faced by WSSS decision-makers and managers. In this step, a technical-economic diagnosis is made to highlight the technical and economic constraints that

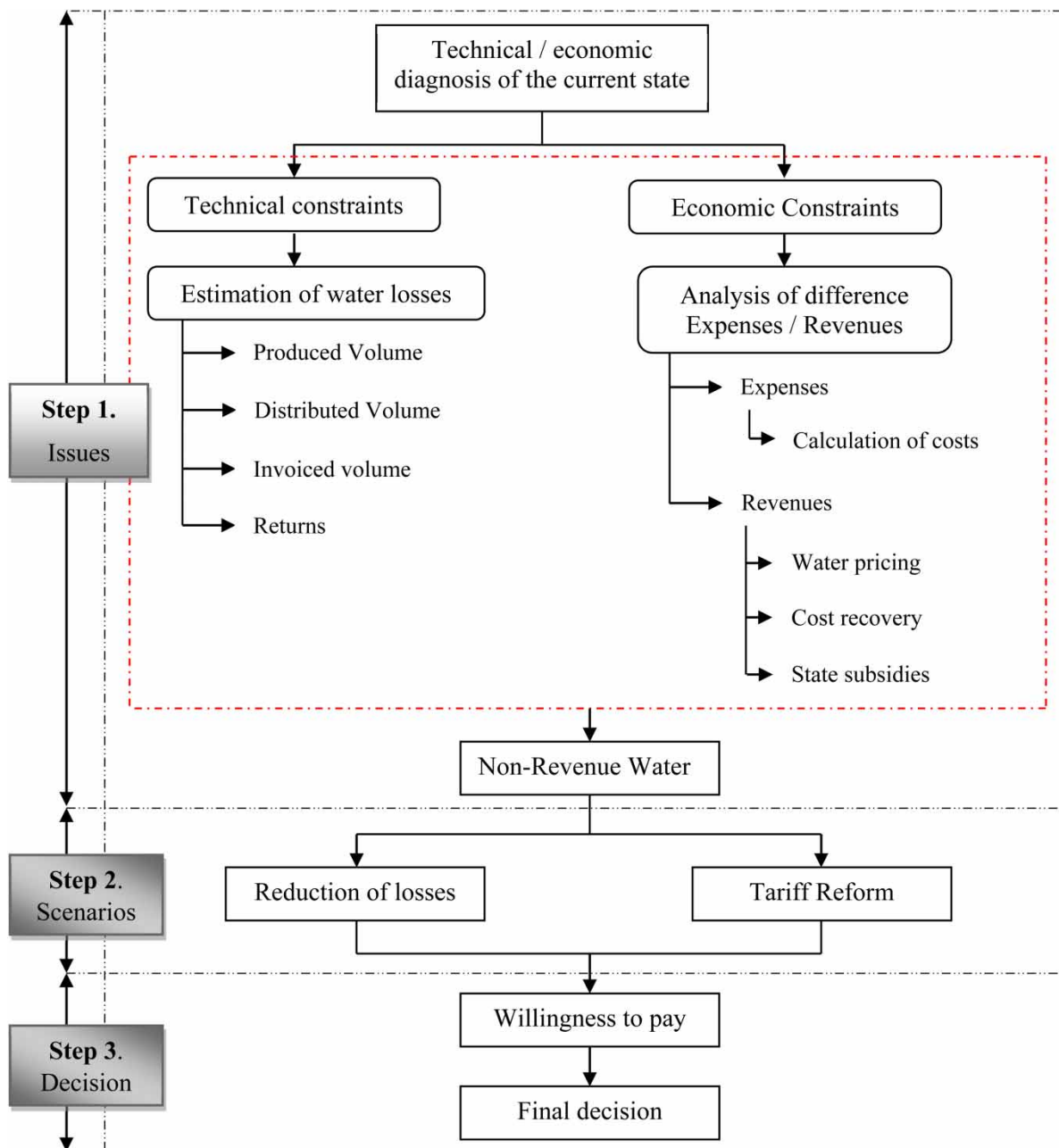


Figure 1 | Proposed method.

negatively impact the performance of WSSS. Once the constraints are defined, scenarios are established in the *second step* to improve the WSSS management. Following these two steps, the final decision is approved by seeking new/redefining sources of revenue to fill the gap in revenue requirements. In the third step, the new rates will be calculated according to specific objectives and constraints. For the case of Souk-Ahras, to avoid an over-complex approach that would undermine policy implementation, some characteristics of the current water pricing are kept (number of blocks, multiplying coefficients, royalties).

As shown in [Figure 1](#), key variables (e.g. current water pricing, cost recovery, subsidy rates, NRW) that affect the economic sustainability of WSSS are identified. Once selected, these variables will be evaluated. Then, different alternatives and scenarios are examined (e.g. tariff policy reform and reduction of water losses) according to the constraints defined in the first step. In the final stage, also known as the ‘final decision phase’, new sources of income are also considered to balance expenditures and revenues.

CASE STUDY

The case of WSSS in Souk-Ahras, Algeria

This research attempts to analyze the difference between the operating expenses and the revenues of the ADE and the local ONA as well as the difference between the volumes of water produced and invoiced. The study also examines the current pricing of water and sanitation and estimates the operating costs of the water and sanitation services in Souk-Ahras City. Based on this analysis, a new tariff for water supply and sanitation is defined. The research depends mainly on technical and commercial data, collected from the operating reports of the two local units of ADE and ONA between 2010 and 2018. Available empirical data, obtained from the annual reports of WSSS, were processed and adjusted in the analysis. However, it was not feasible to estimate and quantify all the costs due to data constraints.

Since 1st July 2006, the delivery of water services in Souk-Ahras has been managed by ADE while the management of sanitation services has been ensured by ONA. In 2018, the ADE of Souk-Ahras counted 34,546 domestic subscribers ([Figure 2](#)) and managed 220 km of water supply network ([ADE 2018](#)). On the other side, ONA managed 194 km of sewerage network.

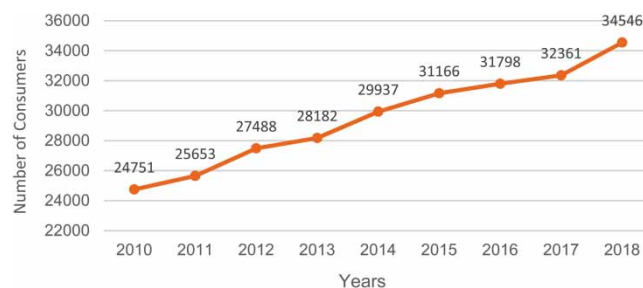


Figure 2 | Number of domestic water supply subscribers.

Application of economic instruments

In this section, we propose an economic analysis (gap between expenditures and revenues; evolution of volumes produced and invoiced, and water pricing) to examine the performance of the WSSS in Souk-Ahras City.

According to the Algerian legislation on water, the WSSS are industrial and commercial public services, which must have a statutory balanced budget in revenue and expenditure. Operating revenues come from the water bill at the expense of users. Expenditures include operating, maintenance and administrative costs of services, but not the cost of investment of hydraulic structures or networks (Boukhari & de Miras 2019).

This section presents the financial position of both ADE and ONA units of the department of Souk-Ahras. The evolution of prices, revenues, expenses and subsidies of both services over the period 2010–2018 is also examined.

Analysis of water volumes

Figure 3 shows that there are large differences between produced and invoiced water volumes. These differences are the results of the large loss rates in adduction and distribution networks and other components of NRW. The figure also shows that there is a decrease in volume produced for the two years 2017 and 2018, perhaps due to lack of precipitation in this period and the rehabilitation works carried out in the distribution networks to counter leakage issues. On the other hand, there is a small improvement in the volume invoiced for the same period following an increase in customers/subscribers.

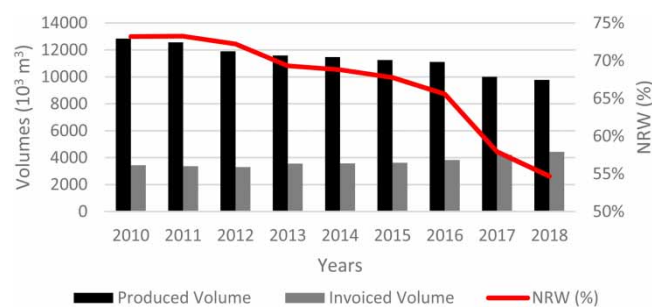


Figure 3 | Evolution of volumes produced and invoiced (2010–2018).

Expenses and revenues of WSSS in Souk-Ahras city

WSSS in Algeria are public utilities, which may not foster efficiency to maximize profits, as with the quantity of water produced. Moreover, ADE managers cannot change the water tariff. Water pricing is regulated by the state (political decision). Following these two constraints, the WSSS in Algeria may have difficulties in reaching a balanced budget. The expenses are related to the water charges paid for the operation of the service. To this end, and to help WSSS managers balance revenue and expenditure, it is necessary to identify and recover associated costs, and to seek revenue requirements (Pinto & Marques 2017).

The expenses of WSSs in Souk-Ahras Department are calculated from the operating costs of both ADE and ONA units. The average cost¹ of water and sanitation for Souk-Ahras Region is 0.882 €/m³ (Boukhari *et al.* 2011), with a selling price that does not exceed 0.129 €/m³. Data on water and sanitation services of Souk-Ahras Department cover only operating costs of ADE and ONA; the investment costs of water and sanitation infrastructure remain the responsibility of the Ministry of Water Resources (MRE). The operating costs which determine the accounting balance include the following expenses: staff wages; electricity expenditure; purchase of raw water (dam); chemical products and other expenses, including expenses for repair and maintenance and overall costs

¹ This cost includes investment and operating costs (water supply and sanitation).

(e.g. vehicles, buildings, management, and laboratory equipment). WSSS managers have to pay all the expenses mentioned above, as this is essential for the provision and proper functioning of the WSSS (Pinto & Marques 2017).

RESULTS AND DISCUSSION

Difference between expenses and revenues

Figure 4 shows that operating expenses are not covered by the tariffs billed and collected by water utilities. Therefore, the budget of the WSSS of the Souk-Ahras City is not balanced. Declined revenues and increased expenses resulted in an economic imbalance of WSSS, which led the authorities to support operators (ADE and ONA) through the allocation of grants. If we consider, for instance, the year 2018, the difference between operating expenses and revenues is 1,385,411 €. This difference had to be recovered in order to balance the budget.

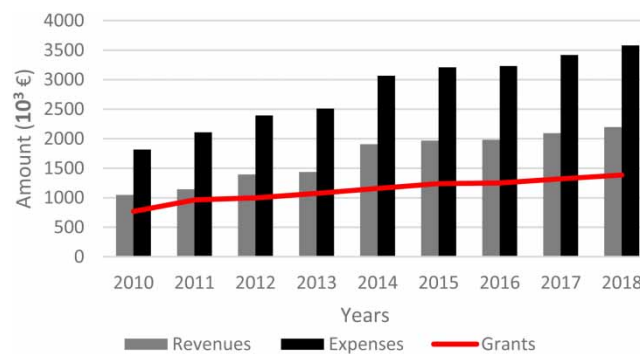


Figure 4 | The gap between revenues and operating expenses.

According to this analysis, the hypothesis stating that water is underpriced under current pricing in Algeria is confirmed. According to the available data and the proposed analysis, it appears that the two local units (ADE and ONA) are far from cost recovery due to low prices (social policy of the State) and mass expenses. Based on this observation, the following question arises: how do water utilities ensure the economic viability of their services?

Subsidies, grants and other transfers

The state, through its administration (MRE) or via public enterprises (ADE and ONA), gives users a drinking water priced at an amount lower than its production cost. As customer bills cover only a part of the expenses, other sources of funding, in particular subsidies, must be sought. General grant mechanisms represent a form of assistance to the water sector, which can lower production costs (subsidies for energy costs). This will also substantially increase the available resources of WSSS (direct subsidy to ADE and ONA).

Based on the analysis presented in the previous sections, the WSSS management system requires a large public budget support to make major investments in the water sector. Similarly, significant direct grants must be allocated to improve the operation of the ADE and ONA balancing account.

It is important to note at this stage that the first block of current water pricing in Algeria allows the implicit subsidy to cover the non-poor, as all subscribers benefit from this social slice. However, if the poorest households have more elements than the average household, because of individuals per family or more families live together in collective housing with a single water meter, the price increase

may end up penalizing low-income households. To this end, and to compensate for the negative impact of subsidizing water tariffs, better mechanisms for designing targeted subsidies are needed (Angel-Urdinola & Wodon 2012).

Calculation of the new unit price

According to the ADE subscriber file of Souk-Ahras, the average consumption rate is 28 m³/quarter and the average water bill is 5.435 € (equivalent of 1.812 €/Month). As a result, the average selling price of water in Souk-Ahras is 0.129 €/m³.

In this section, a new water and sanitation tariff is calculated. This new tariff is calculated on the basis of average consumption (28 m³/quarter) and the willingness to pay for service improvements in the city of Souk-Ahras, which is 7.112 € (Boukhari & Djebbar 2013). The calculation steps are presented in Appendix A₁. The new tariff level for the 1st block in the case of drinking water is 0.074 € while the sanitation tariff becomes 0.029 €. The results of these new tariffs are presented in Table 1.

Table 1 | The proposed new pricing of water supply and sanitation

Categories of users	Quarterly consumption brackets	Multi Coeff.	Water tariff (€)		Sanitation tariff (€)		
			Current	New	Current	New	
Category I: Domestic	1st Block	Up to 25 m ³ /quarter	1	0.047	0.074	0.017	0.029
	2nd Block	26–55 m ³ /quarter	3.25	0.152	0.241	0.057	0.094
	3rd Block	56–82 m ³ /quarter	5.5	0.257	0.407	0.096	0.156
	4th Block	Better than 82 m ³ /quarter	6.5	0.304	0.481	0.113	0.189
Category II: Administrative, Commerce and services	Uniform	5.5	0.257	0.407	0.096	0.156	
Category III: Industry and tourism	Uniform	6.5	0.304	0.481	0.113	0.189	

The difference between the proposed new pricing and current water pricing is illustrated in Figure 5.

According to Figure 5, the change between the new and the current unitary pricing does not much affect the first block (social tranche), but it exceeds 60% for the remaining blocks.

Even with the new calculated water tariff, affordability for low-income households is still assured:

- Figure 5 shows that the first (social) block remained almost the same for both the old and the new pricing (less than 8 m³/month);

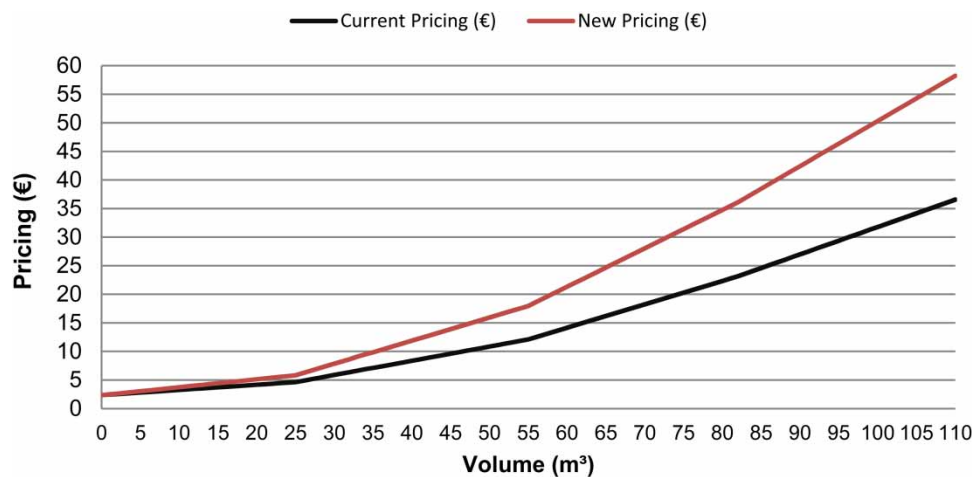


Figure 5 | The difference between current and new water pricing in Algeria.

- When making a decision to increase the household rate, it is necessary to assess the affordability of the tariffs for various groups of households. The existing literature on the subject is limited and concerns mainly the affordable percentage of a household budget devoted to WSSS. It generally varies from 3 to 5% for developing and developed countries respectively (Damme *et al.* 1984; World Bank. 2015). With the new tariff, a household that earns one national minimum salary pays on average 2% of its disposable income each month. Households where the share of water supply and sanitation payments exceeds 3% generally need targeted social support. A cross-subsidization scheme is considered necessary to reduce the burden of water expenditures for the poorest people (Smets 2009).

According to Figure 4, the difference between the revenue and the charges equals 1,385,411 € for the year 2018. On the other hand, Figure 3 shows that NRW = 56%, which corresponds to a cost for the unbilled water equal to 775,830 €. This shall result in a new income of 609,581 (€/year). The impact of the new tariff on the new WSSS revenues is identified as follows: we first broke down the 34,546 subscribers by consumption band, and then calculated the corresponding water bills (with both current and new rates). The difference was found to be 301,810 € per year. The remaining amount of 307,771 € must be supplemented by state subsidies and optimization of operating and maintenance costs.

CONCLUSIONS

Despite the large state investments allocated to improve access to safe water and sanitation in Algeria, the water utility units (ADE and ONA) continue to have difficulties managing, operating and maintaining these services. Financial deficits of both public companies are mainly related to the very low prices of WSSS and the high rates of NRW.

This study, which evaluated the financial performances of these public services, showed that sustainable cost recovery is achieved through tariffs and royalties, which is considered an important factor in the economic and financial viability of WSSS. Nevertheless, economic viability may not be achieved solely by tariff changes, but also through limiting costs via improved efficiency of operations and management, as is the case of NRW reduction. .

WSSS will be sustainable only if there are sufficient financial resources to cover at least the cost of repair, rehabilitation, replacement and investment. These latter were shown to be insufficient in the case of Algeria.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this paper is available online at <https://dx.doi.org/10.2166/wpt.2019.082>.

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