Rainwater fees for a fair and sustainable rainwater management

Summary: *This paper gives an insight into the mechanism of introducing a municipal rainwater (stormwater) fee and its various levels of application in some European countries, particularly in Germany, to achieve and promote a sustainable rainwater infrastructure. Differences in rainwater fee structures in several large German cities are also elaborated and recommendations for a fair and sustainable rainwater fee for "rainwater harvesting" and utilisation are also presented.*

1. Introduction

Species decline and regular fish mortality in lakes and rivers following summer rain events have been recorded for many years now, even if the media hardly takes notice of them. The damage caused by increasingly extreme weather conditions, with a concurrent increase in the sealing of built-up areas and traffic surfaces, cannot be ignored any longer. The recent flooding of the Ahr River in the summer of 2021 in the federal states of North Rheine-Westphalia and Rhineland-Palatinate (with 134 deaths and over 30 billion euros in material damage) made this very obvious. As a result of population growth and longer dry periods in cities water consumption will also increase, which, in some cases, will also drastically reduce the groundwater reserves. The damage caused by this can be already observed in the dried vegetation and desiccated trees, and not just in urban areas.

Figure 1: A dried-up boat trail in the Mecklenburg Lake District in North Germany in September 2019 (left); desiccated trees in Berlin, August 2020.

As a result of increaseing surface sealing, decline of green spaces and reduced evaporation, cities are also becoming increasingly hot, resulting in negative impacts on the health of city dwellers. For 2018, the Robert Koch Institute reported 490 heat-related deaths in Berlin and 740 alone in the State of Hesse[1]. From a water management perspective, the principle of

[1] https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2019/23/Art_01.html

draining rainwater from built-up areas as quick as possible and away from its point of origin is no longer acceptable and up-to-date, both ecologically and economically.

The European Water Framework Directive (WFD)[2] defines the protection and improvement of aquatic ecosystems and the sustainable use of water resources as its core objectives. The goal is to achieve a good ecological and chemical status of all European water resources.

Therefore, the requirements for sustainable urban rainwater management are growing and they pursue today the aim of balancing out the water cycle in built-up areas back to the level of previously existing natural conditions (DWA 102-2)[3]. Similarly recognising that the construction of expensive rainwater retention basins and storage sewers is not expedient, decentralised measures are becoming increasingly more important.

2. Sustainable rainwater management

To manage rainwater (stormwater), municipalities build and maintain rainwater management systems to move rainwater out of inhabited areas in order to mitigate its impacts on the environment and pollution of water bodies. These are traditionally separate sewer systems, which collect rainwater separately from the municipal sanitary sewer system and rely on the quick discharge of excess water away from the affected areas. With the increase in the frequency and intensity of flood events due to climate change, these systems are becoming more expensive to design, construct and maintain and are showing more flaws.

Sustainable solutions for (decentralised) rainwater management, also referred to as Best Management Practices (BMP), Low Impact Development (LID) or Sustainable Urban Drainage Systems (SUDS) are primarily based on restoring the natural (local) water cycle, maximising water retention on site and preserving green infrastructure to ensure infiltration. These systems can also be used in conjunction with traditional rainwater management techniques. Nature based systems (NBS) such as green roofs, vegetated swales or wetlands offer alternatives to the traditional rainwater management systems with multiple benefits in terms of climate change mitigation such as flood control, runoff reduction, increase groundwater recharge, reduce urban heat island effect and increase evapotranspiration, thus improving urban ecosystems and quality of life.

Worldwide, local governments are looking for mechanisms to respond to the increasing challenges of urban rainwater management by establishing efficient policies and programmes. One of these mechanisms is the introduction of a **rainwater (stormwater) fee**. A rainwater fee or charge, also called user fee, is practiced at varying application levels in several countries such as the USA, Australia, Canada, Denmark, England, Germany and Poland. Rainwater fees are considered dedicated funds and not subject to competition from other municipal programmes. It is based on each property's contribution to the total runoff and is an ideal way to fund rainwater management adequately and fairly and offers a steady and long-term funding opportunity based on the actual burden an individual property places on the sewer system.

[2] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy 327/1, 22.12.2000 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32000L0060

[3] Worksheet DWA-A 102-2/BWK-A 3-2 - Principles for the management and treatment of stormwater runoff discharged to surface waters - Part 2: Emission-related assessments and regulations - December 2020; Status: corrected version October 2021

The adoption of a rainwater fee is becoming more popular and an important method for obtaining revenues to promote and sustain rainwater infrastructure. Revenues collected can cover the costs associated with rainwater management including the costs of regulatory compliance, planning, construction, maintenance and improvement of rainwater systems.

3. Rainwater fees in selected countries

In Germany, most municipalities have a rainwater fee since the 1980s. In most states, fees for the collection of rainwater via the rainwater sewer system are calculated based on the size of the built-up area (impervious surface) from which the water drains into the rainwater sewer (annual fee per m^2 of surface area draining into the sewer). These fees are generally based on the “polluter-pays” principle.

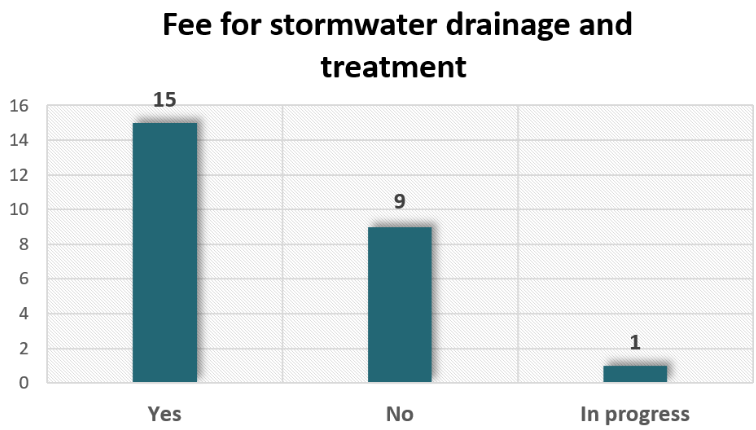
In Poland, rainwater fees function at two levels (Godyn et al., 2020)[4]. On the national level, there are fees for rainwater drainage into rivers while on the municipal level, there are fees for rainwater drainage from a property into the sewer system. The fee is calculated for 1 m^3 of discharged rainwater or for a measurement unit of impervious surface. The monthly municipal fee can be reduced, if rainwater retention techniques are implemented on site. These fees have so far been implemented in several Polish municipalities (approx. 3 –5 % of the total number of Polish municipalities) including Bydgoszcz, Bytom, Elblag, Głogów, Kónskie, Koszalin, Morag, Poznan, Radom, Siedlce, TarnowskieGóry, Zielonka and Zory and range between 0.38 and 2.31 €/m^3. However, these fees are not clearly stipulated in the regulatory policies.

A comprehensive survey on stormwater-related legislation was carried out in 10 Baltic Sea Region (BSR) countries, of which 8 are EU Member States (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden) and two partner countries (Norway and Russia). Structured interviews were also carried out in 25 medium and large-sized cities of the BSR to assess their progress in introducing sustainable and integrated urban stormwater management governance and practices, implemented improvements as well as needs and future development prospects (Kondratenko et al., 2021)[5].

The majority (64%) of the cities indicated presence of municipal regulations concerning stormwater management of some kind. They, however, differ in scope, ranging from stormwater treatment requirements for specific areas in local planning documents to guidance documents or formal regulation. Similar number (60%) of cities have implemented a stormwater fee, which can be a connection fee (e.g. Aalborg, Copenhagen, Helsinki, Stockholm), a fee per m^3 of discharge to combined sewer (e.g. Liepāja, Daugavpils, Riga, St. Petersburg), a fee per m^3 of discharge to separate sewer (e.g. Kaunas, St. Petersburg), a variable annual fee per m^2 of surface area, which may be differentiated by the type of property (e.g. Elbląg, Helsinki, Kuopio, Lahti, Stockholm) and fixed annual fee per type and size of property (e.g. Stockholm, Turku). Some cities apply fee discounts for disconnection

[4] Godyn, I., Grela, A., Stajno, D. & Tokarska, P. (2020) Sustainable Rainwater Management Concept in a Housing Estate with a Financial Feasibility Assessment and Motivational Rainwater Fee System Efficiency Analysis. Water 12 (151)
5 Kondratenko, J., Kotoviča, N. & Reča M. (2021). Regional and national policy recommendations for implementing the integrated stormwater management in the Baltic Sea Region. Deliverable 4.4 of the BSR WATER project, co-funded by the European Development Fund. Riga City Council www.bsrwater.eu/sites/bsrw/files/stormwater_report_v1.pdf

from the city's stormwater management system or application of SUDS on site (e.g. Stockholm), whereas other cities do not (e.g. Turku).



Application of stormwater fee in 25 BSR municipalities (Kondratenko et al., 2021).

The USA is the most progressive country in stormwater funding mechanisms and the most commonly used fee system is the **Equivalent Residential Unit (ERU)** followed by the flat fee (Aladesote, O., 2019)[6]. The ERU is the average impervious area of a single-family residential parcel in a given jurisdiction, which can be determined through random sampling within that jurisdiction and which is based on the "polluter pays" principle. Increases in impervious area result in more stormwater runoff which causes flooding, erosion and water quality problems. Municipalities often calculate a representative value to represent the runoff from their residential properties. This is done by measuring the impervious cover from a sample of typical single-family residential parcels to determine a median area measured in square metres. This value is the ERU.

The ERU essentially represents a base billing unit. Properties with very little impervious area may be charged some fraction of an ERU, whereas properties with a large impervious area may be charged multiple ERUs. Municipalities take many factors into account when setting their base ERU billing rate, but the basic process involves two steps: add up the impervious area totals for each of the properties in their community and divide this number by the ERU size they calculated earlier to determine the total number of ERUs in their service area, and then dividing their estimated annual stormwater budget by the total number of ERUs to reveal how much they need to charge per ERU to cover their annual stormwater costs. State law prohibits communities from charging more than this amount.

Base ERU rate = total anticipated stormwater expenses /number of ERUs in a municipality

For example, if a shopping center contains 3.4 ERUs of impervious area, its fee would be calculated by multiplying the per-ERU fee by 3.4. The purpose of the ERU is to create a standard unit of measurement that can be applied across all properties in a city.

Though it is less labour-intensive for the municipality, the flat fee does not reflect the rainwater impact of each parcel. The flat fee is a fixed charge in which each parcel pays a

[6] Aladesote, O. (2019) Stormwater Management Utility Fees: A review. International Journal of Research Publication, Volume 40 (1)

similar amount of fees, regardless of property characteristics and how much they contribute to the runoff. In this respect, a flat fee may seem unfair.

Tasca et al. (2019)[7] developed a rainwater fee based on the ERU system in Santo Amaro da Imperatriz, a small city in the southern region of Brazil. The simplified ERU is based on the amount of impervious area and the fee considers the operations and maintenance costs, besides having a single class of billing. The value of the Simplified ERU (294.32 m^2) was similar to the average impervious area in the United States (269.42 m^2) and equivalent to 0.25 € per square meter, which was in the range of other countries' fees. This method proved to be a feasible and rapid technique for funding stormwater services and its simplicity allows its application in different locations. The authors also emphasised the need to open a discussion about the methods for designing a rainwater fee in the academic community, which is still incipient.

Rainwater fees should be set high enough to cover the full cost of operating the rainwater management programmes. Cities planning to create rainwater fees can take steps to avoid fiscal shortfalls by setting rainwater fees at the right level from the start. In addition, cities that have already established rainwater fees should regularly reevaluate the appropriateness of their rates (NRDC, 2018)[8].

To ensure that the fee is as fair as possible, municipalities should structure their rainwater fees to include all property types, including government properties. Since the rainwater fee is a user fee and not a tax, tax-exempt entities need also to pay their fair share. In sum, the fee structure should include any property that contributes rainwater to the local sewers and water bodies.

Initiating a new rainwater fee requires advance planning, research and outreach. Proactive and positive messaging should form a central component of a municipality's strategy for adopting a rainwater fee.

4. Rainwater fee reductions through rebates

One measure to curb public opposition to the rainwater fee (which is still seen by some as another tax to pay!) is to offer incentives in form of rebates (discounts) for onsite rainwater management and green infrastructure implementation measures. Such an approach complements and encourages the growing trend in rainwater management towards decentralised control measures to reduce rainwater flow into the combined sewer or green infrastructure (Kertesz et al., 2014)[9].

A rainwater fee can be reduced by rainwater rebates. Many municipalities provide financial incentives which encourage developments with less runoff-producing impervious area. This will promote the potential for innovative approaches to rainwater financing, such as direct subsidies or incentives for private property owners to manage their own rainwater on site.

[7] Tasca, F.A., Finotti, A. & Goerl, R.F. (2019) A stormwater user fee model for operations and maintenance in small cities. Water Science & Technology 79 (2)
[8] NRDC (2018) Making it rain: Effective stormwater fees can create jobs, build infrastructure and drive investment in local communities. Natural Resources Defense Council (NRDC) Issue Brief April 2018 (IB: 18-03-A)
[9] Kertesz, R., Schuster, W. & Green, O.O. (2014). Modeling the hydrologic and economic efficacy of stormwater utility credit programs for US single family residences. Water Science & Technology 70 (11):1746-1754

Property owners who implement approved practices and measures to reduce impervious area, such as desealing, construction of rain gardens, rain barrels and cisterns, vegetated swales, green roofs and other measures to manage rainwater on site may qualify for long-term or permanent reductions in their rainwater fees. These features can reduce the amount of rainwater runoff leaving the property and/or treat the runoff to improve water quality.

5. The case of Germany

5.1 Rainwater fees

According to various court rulings, the costs for rainwater management in Germany can no longer be cross-financed through the drinking water and wastewater charges, as has been the case in previous years. These costs have to be shared according to the polluter-pays principle, which is undoubtedly not an easy task.

From the customer's perspective, the calculation procedure of the rainwater fee is not always transparent. Before regulating how a "polluter-pays" rainwater fee is levied, it should be previously determined what the actual costs of rainwater management are. This calculation is not only dependent on various technical and accounting criteria and the respective system boundaries. As long as the calculation of rainwater management costs is left to the municipality, where very different framework conditions can be found in each, it is not surprising that the charged rainwater fees are by no means uniform.

The following table shows the rainwater fees in 13 large German cities with an average of 1.03 €/m²/a. it remains questionable, how these differences can be justified in each individual case.

Table 1: Comparison of rainwater fees in 2020 for 13 large German cities, sorted by their number of inhabitants ([1]Destatis 2020).

City	Area (km²)[1]	Inhabitants[1]	Rainwater fee (€ /m²/a)
Berlin	891.12	3.664,088	1.81
Hamburg	755.09	1.852,478	0.73
Munich	310.70	1.488,202	1.30
Cologne	405.10	1.083,498	1.27
Frankfurt a.M.	248.31	764,104	0.50
Bremen	318.21	680,130	0.79
Stuttgart	207.32	630,305	0.73
Düsseldorf	217.41	620,523	0.98
Leipzig	297.80	597,493	0.94
Dortmund	280.71	587,696	1.43
Essen	210.34	582,415	1.78
Dresden	328.48	556,227	1.56
Potsdam	188.24	182,112	1.23

In the municipal wastewater fee statutes, it can be read how the rainwater fee, and where applicable, rebates for public and private properties have been calculated. However, it does not state whether or to what extent, for example, certain sectors such as the road construction authorities discharging rainwater into the public sewer from public traffic surfaces, which are usually contaminated by tyre abrasion residues, microplastics, heavy metals, oils, etc. are charged, which is often justifiably criticised.

5.2 Rainwater fee models

Oelmann and Roters[10] elaborated in detail the development of rainwater fee models in Germany using the example of North Rhine-Westphalia. The first part of their publication provides an overview of the assessment criteria, whereas the second part focuses on the assessment criteria for green roof rebates.

According to the authors, rainwater fees basically finance the costs of rainwater management. This includes the collection, conveyance, treatment, discharge, infiltration, and trickling of rainwater for irrigation. It should be noted that these do not include the costs resulting from the impacts of inadequate rainwater management (e.g. fish mortality, silting of water bodies, heat damage, etc.). Sustainable rainwater management must also be oriented towards preventive environmental protection, taking into account the overall problems associated with climate change, increased sealing and its consequences.

Even though the evaluation from North Rhine-Westphalia may not be representative for all federal states, it shows, however, the many different variants that are encountered in practice. Of the 396 fee models examined, 375 charge a user fee and a further 21 models additionally charge a basic fee. The majority of these models use the built-up/built over/sealed/drainage area as the basis of assessment, although it is not mandatory for the area to be connected to the sewer. In these cases, it is assumed that rainwater enters the sewer system via sloping surfaces.

Green roofs are the most frequently rebated rainwater control measures, followed by partially sealed surfaces, rainwater harvesting systems for domestic use as well as systems for infiltration and retention, whereby in 65 of the above-mentioned models there is no rebate whatsoever. It is unclear how high the rainwater fee and the rebate should be in order to decouple more properties, including already existing ones, from the sewer system.

Although Berlin charges the highest rainwater fee compared to other large cities in Germany and has set itself in 2017 the goal to decouple 1% of the stock annually, no success has yet been achieved in this direction. Berlin relies mainly on rainwater infiltration and the use of green roofs in its rainwater management concept and aims at becoming a "sponge city". With the new fee regulations, which apply since 2022, partially sealed areas will also be discounted for the first time, extensive green roofs will be rewarded a discount of 50%, which can increase to 80%, if intensive green roofs (layer thickness of ≥ 30 cm) are used[11].

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[10] Oelmann, M., Roters, B. (2021) On the development of stormwater fee models. Part 1: Overview and evaluation criteria. In KA Correspondence Wastewater, Waste, 2021 (11): 931-936. Part 2: Exemplary application of the evaluation criteria to the green roof rebate. In KA Correspondence Wastewater, Waste, 2021(12): 1020-1023.
[11] Berliner Wasserbetriebe. Statutes on the levying of fees and reimbursement of costs for central public wastewater disposal (Wastewater Fee Statutes - AGKS). Status: 09.12.2021

Furthermore, a funding guideline for the "1,000 green roofs" programme had been adopted in 2019[12] for Berlin.

Prof. Mathias Uhl criticises the buzzword "sponge city" and calls instead for an intelligent soil policy and recommends, in accordance with the saying "rain brings blessings", to look at rainwater as a resource that is used and not drained[13]. Water-conscious urban development should be nothing exceptional, but something completely normal. No challenges exist in terms of planning and technology, as can be experienced by many examples of successful water-conscious urban development, according to Prof. Uhl.

In the planning practice, the respective boundary conditions of properties and their uses differ widely. It is always recommended to carry out a comparison of variants of the different technical measures for rainwater management in order to obtain an optimal planning result. It is important that the monetary and non-monetary goals and their relative weightings are defined beforehand with the involvement of all planning participants[14,15].

5.2.1 Evaluation criteria for sustainable rainwater fee models

Oelmann and Roters[4] refer to 4 sustainability dimensions: ecological, financial, economic and social goals (Table 2). In the case of a factual emergence of conflicts between the different forms, the goal of the fee modeling should be to take all sustainability dimensions adequately into account.

Table 2: Sustainability dimensions and forms for a rainwater fee model [Oelmann and Roters, 2021].

<u>Ecological sustainability</u> ➢ Preservation/improvement of the natural (local) water cycles and the ecological functions of water bodies through fee model-induced incentives ... for the implementation of near-natural rainwater management measures ... for the use of rainwater, provided that environmental costs can be saved ... against the pollution of usable rainwater and against the infiltration of polluted rainwater	<u>Financial sustainability</u> ➢ Application of the cost covering principle to the business costs (including an adequate return on equity) Revenue stabilisation through accrual (re-) financing
<u>Economic sustainability</u> ➢ Fee model ... sets incentives to activate wastewater customers to implement cost-efficient, decentralised measures to reduce the life cycle costs of rainwater ... ensures that the costs are distributed according to the “polluter-pays” principle	<u>Social sustainability</u> ➢ Fee model also allows low-income customers to have access to rainwater management services ➢ Fair distribution of rainwater management costs between customers and across generations

[12] https://www.berlin.de/sen/uvk/_assets/natur-gruen/stadtgruen/stadtgruen-projekte/1-000-gruene-daecher/foerderrichtlinie_gruenedaecher_senuvk_2019.pdf
[13] Interview Mathias Uhl: "European cities are not sponges" (2022) In fbr-wasserspiegel 1/22: 13-18
[14] Nolde, E., Reichmann, B. Leitfaden für Wirtschaftlichkeitsuntersuchungen zur Bewertung von Maßnahmen der Regenwasserbewirtschaftung. Download at: https://nolde-partner.de/downloads/
[15] Nolde, E. Rainwater harvesting and economic efficiency. https://nolde-partner.de/downloads/

Social sustainability claims to distribute the costs of rainwater management fairly between customers and generations. **Environmental sustainability** aims at incentive functions within the fee model, for example, the use of rainwater as a resource to better encounter the effects of dry periods.

While **financial sustainability** looks at the purely business costs of the rainwater management services, **economic sustainability** calls for an efficient fee structure which provides economically useful incentives for investment decisions on the part of the customer. According to Oelmann and Roters, incentives for rebates are then useful, for example, if they lead to the implementation of decentralised measures that are more cost-effective in macroeconomic terms than measures taken by the disposal utility, which can be just as effective.

It should also be mentioned that the comparative analysis should not be only limited to the investment costs, but must take into account all other costs and savings that are related to the measure and which (presumably) arise in the course of its life cycle. For this, cost transparency is imperative.

On the part of the wastewater disposal utilities, there is certainly not always sufficient knowledge regarding the decentralised range of measures for rainwater management, and barely an expert planner of decentralised measures can estimate the costs incurred by a municipality to render a comparable service. In this respect, it is not always easy to put economic sustainability into practice.

In order to lay the foundation for a "polluter-pays" rainwater fee model with a sustainable rebate, more transparency is hence required. To assess the costs and benefits of individual measures, several prerequisites must be met on the part of the municipality and on the part of property owners.

For the municipality, this means

- that the current costs of rainwater management, as well as costs incurred for wastewater drainage and treatment, should be known and presented in a transparent manner. The same also applies to the costs for damage repair, which is to be estimated, for example, if untreated or insufficiently treated rainwater is discharged into a water body (e.g. lake restoration, fish mortality, decline in biodiversity, etc.), and
- that the revenues collected in the context of rainwater management are exclusively earmarked for rainwater management services and programmes.

The sum of the costs would have to be updated annually and passed on to the customers in an appropriate form.

From the customer's property, it must be known

- which surface areas discharge into the sewer system
- what rainwater quantities are expected from the individual surfaces
- which pollutants, if any, are also discharged from the property with the rainwater runoff
- what costs are incurred in connection with decoupling, and
- for which purposes and to what extent can rainwater be used on the respective property.

5.2.2 Comparison of rainwater fees in different German cities

Berlin is 1.85 times larger than Hamburg in terms of area, but has almost twice as many inhabitants and charges 2.5 times as much for rainwater discharged into the municipal sewer system compared to Hamburg.

Common features in terms of rainwater fees can be presented as follows:
In none of the two cities

- does the amount of fee differ depending on whether rainwater is discharged into the combined sewer or into the rainwater sewer;
- are basic charges levied for the provision of the sewer infrastructure, as is the case, for example, for the drinking water supply or wastewater disposal infrastructures;
- are differences made with regard to the quality of the rainwater runoff;
- is a reduction in the rainwater fee granted for the throttled discharge from ponds, storage shafts and rainwater retention basins;
- are fees for the road construction authorities shown;
- is the use of service water rewarded with reduced wastewater charges.

The rebate in Hamburg depends on whether areas are fully sealed (no rebate), partially sealed (50 % rebate) or unsealed (100 % rebate)[16]. Here, once again, it is decisive whether the surfaces are predominantly impermeable (fully sealed), partially permeable (partially sealed) or predominantly permeable (unsealed) in the event of heavy rainfall. Only if surfaces are predominantly or partially water-permeable during heavy rainfall, are rainwater and combined sewers significantly relieved from rainwater discharges, such that a "rebate" in the rainwater fee is justified.

In Berlin, the regulation is similar, but it does not refer to heavy rainfall events. Examples of fully sealed, partially sealed and unsealed surfaces and their approach in determining the fee-relevant area are given for both cities.

While Hamburg grants a flat-rate reduction of 50 % for green roofs with a structure thickness > 5 cm, which does not increase for higher structure thicknesses, Berlin rewards green roofs with a substrate structure ≥ 10 cm with a 60% rebate, while ≥ 30 cm structure thicknesses are rewarded 80 %.

Both cities increasingly complain about shortages in the water supply during the dry summer months, but at the same time place no special emphasis on rainwater harvesting and reuse.

In Hamburg, the storage capacity for rainwater harvesting systems must be ≥ 2 m^3 in order to claim a surface deduction of 20 m^2 per cubic metre of storage volume. At the same time, no distinction is made whether the rainwater is used for irrigation or in the building.

In Berlin and in accordance with the wastewater fee statutes (Annex 1), a reduction in the rainwater fee by 10% is provided for storage tanks for garden irrigation, provided that a specific storage volume of ≥ 0.02 m^3/m^2 (which corresponds to a cistern that can absorb 20 mm of precipitation) is available and its use is plausibly described. The use of service water in the building is not mentioned in the statute. In this respect, customers who use rainwater

[16]Reduction of chargeable areas when levying rainwater charges
https://www.hamburgwasser.de/privatkunden/service/gebuehren-abgaben-preise/sielbenutzungsgebuehren/niederschlagswassergebuehr/

for washing laundry or flushing toilets and whose cisterns are connected to an emergency overflow to the sewer system are subject multiple times to fee payment. It is incomprehensible that for relatively clean roof runoff, of which only a small proportion is discharged into the sewer, the full rainwater fee has to be paid and in addition to that, the full wastewater charge for the indoor use or rainwater.

In both cities, additional water metres must be installed, maintained and regularly read for the used rainwater, making rainwater harvesting and utilisation, especially for small systems, unreasonably more expensive.

For large units in excess of a certain roof size and correspondingly high service water demand, a metre solution as shown in Figure 2 may be justifiable. However, if the expenditure for the two additional meters is too high, which also need to be replaced after 6 years, and since the annual invoicing procedure may reduce the revenues, especially with smaller rainwater harvesting systems, the metre solution is clearly counterproductive for sustainable rainwater management.

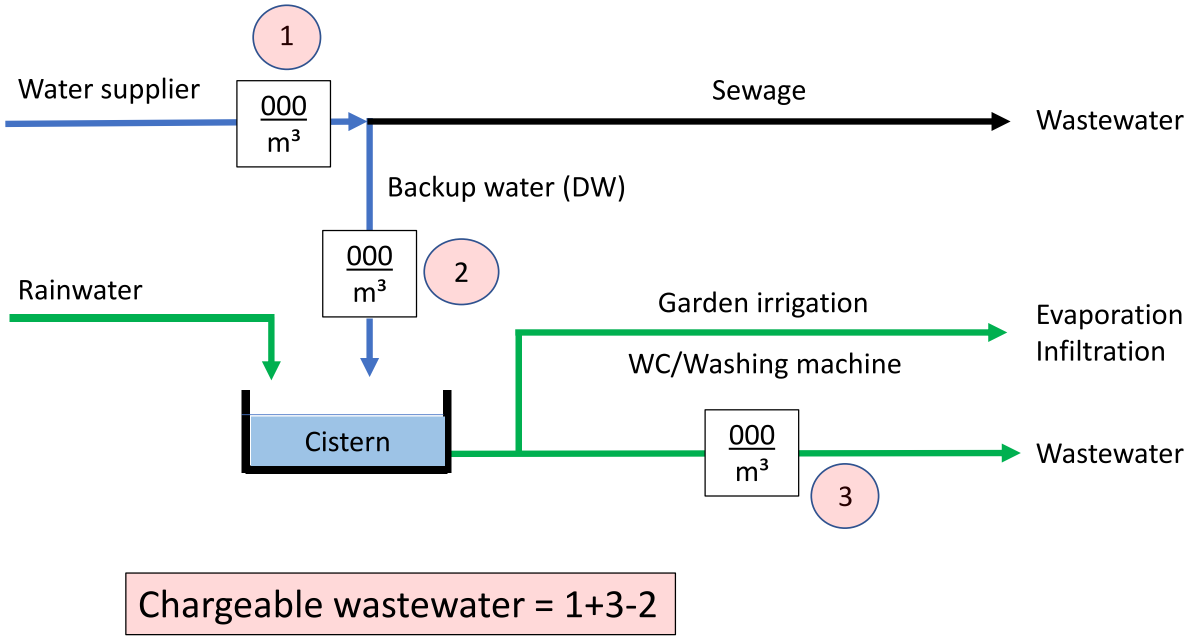

Figure 2: Proposed fee for rainwater harvesting.

Especially green roofs, which are desired in every respect and largely contribute to the preservation of biodiversity, are also dependent on additional irrigation in summer, which will further aggravate the urban water supply situation. Therefore, rainwater harvesting and utilisation should be promoted instead of being financially hindered.

The **City of Metzingen**, a medium-sized city in Baden-Württemberg at the foot of the Swabian Alb, has recognised this problem. There are no "consumption costs" for rainwater utilisation in single or two-family houses[17] . The Municipality of Metzingen, on whose behalf the wastewater fees are charged by the water utility, refrains from measuring wastewater generated by the cisterns. According to the water utility, nothing is likely to change for single or two-family houses on the medium term, since the expenditure for the separate recording of the cistern wastewater would not be in proportion to the revenues.

[17] https://www.stadtwerke-metzingen.de/de/Unsere-Angebote/Wasser/Regenwassernutzung

The city of Völklingen, a medium-sized city on the Saar with a population of about 40,000 follows a similar approach by offering a discount on the rainwater fee for rainwater utilisation systems depending on their use. It does not levy a wastewater charge for the rainwater, which is used as service water[18] .

In the **Hanseatic City of Bremen,** rainwater cisterns with overflow or emergency overflow and connection to the public sewer, 20 m^2 per cubic metre of storage volume is deducted from the sealed area connected to the cistern. However, only permanently used (year-round) cisterns with a minimum storage volume of 2 m^3 are considered for rebates. Furthermore, Bremen also extended its funding programme for rainwater utilisation and greywater recycling[19] .

Other cities, like the **Federal City of Bonn,** may order pre-treatment of the rainwater (onsite by property owner constructed treatment facility or in any other facility) prior to its discharge into the public sewer, if the pollution of the rainwater triggers a pre-treatment obligation by the municipality. This pre-treatment obligation also applies to road authorities who discharge road runoffs into the public sewer system[20].

Rainwater harvesting is particularly important in densely populated innercity areas. Especially there, it represents a particularly suitable decoupling measure, since suitable infiltration surfaces are rare in urban areas and underground garages are often located under the scarce green spaces, thus precluding the realisation of infiltration measures on these properties.

The often practiced throttled drainage of rainwater instead of rainwater harvesting is a negative example of ecological and economic sustainability. The use of rainwater, on the other hand, would lead relatively to the quick emptying of cisterns, especially in multi-storey residential buildings, due to the relatively high-water demand for indoor uses such as washing laundry and flushing toilets, thus effecting a reduction in the drinking water costs and conserving the scarce water resources.

5.2.3 Rebates on rainwater harvesting

A long as a rainwater harvesting system is connected to the sewer system via an emergency drain, a rainwater fee will be charged for the use of the sewer.

Rainwater harvesting systems, like green roofs and infiltration systems, are suitable measures for rainwater management. They reduce or delay surface runoff, which, unlike the other two measures, can relieve the burden on the sewer system and the drinking water supply infrastructure during rainfall events and prolonged dry periods. Moreover, rainwater harvesting helps reduce groundwater abstractions and should therefore be charged at a discounted rate. Since rainwater harvesting systems, similar to green roofs, first retain and then use the rainwater, the following recommended rebate structure in Table 3 shows clear parallels to the rebates for green roofs presented by Oelmann & Roters.

[18] https://www.voelklingen.de/presse/detail/neue-gebuehr-auf-den-voelklinger-grundbesitzabgabenbescheiden-ab-2021/
[19] https://www.bremer-umwelt-beratung.de/Foerderprogramme-Regenwassernutzung.html
[20] https://www.bonn.de/medien-global/amt-30/ortsrecht/bauen/60-2__Entwaesserungssatzung_ab_25-07-2019.pdf

Table 3: Recommendations for rebates for rainwater harvesting systems (based on Oelmann & Roters, 2021).

Ecological sustainability	Financial sustainability
1.1. Cost-covering financial incentives for investments in rainwater utilisation systems by setting appropriately high discount factors 1.2. Differentiation of discount factors depending on the proven retention and use of rainwater 1.3. Proof of the ecological effectiveness as a prerequisite for the granting of a discount	2.1 Introduction of a basic rainwater fee with a basic fee component corresponding to the fixed costs component 2.2 Short-term: Discounting of the user fee only and not the basic fee 2.3 Long-term: Discounting of the basic rainwater fee, if contingency costs can be saved by the wastewater utility
Economic sustainability	**Social sustainability**
3.1 Introduction of a basic fee (see financial sustainability) 3.2. Introduction of rebate factors based on the amount of rainwater used 3.3. If necessary, further differentiation of the rebate factors depending on the storage dimensions, taking into account the associated costs 3.4. If necessary, increase the rebate if there is an external benefit (e.g. if polluted rainwater from the rainwater sewer is treated before use) 3.5. Integration of other financial sources to determine the level of rebate 3.6. No upper limit on the area to be rebated and, on a case-by-case basis, no lower limit	4.1. Introduction of different discount factors at neighbourhood level also depending on the social structure of the neighbourhood 4.2. No lower limit for the area to be discounted

An improved balance with regard to economic and ecological sustainability as well as lower costs for the general public may result from special forms of rainwater utilisation, if, for example, in addition to the use of the roof runoff, polluted rainwater is taken from the separate sewer system (e.g. the "first flush" from traffic surfaces), stored in cisterns and treated to produce high-quality service water, instead of discharging the polluted "first flush" untreated into surface water bodies[21] .

[21] Nolde, E.: Dealing with rainwater from polluted surfaces - A plea for rainwater harvesting in densely populated areas. Wasserspiegel 1/12. Download at: https://nolde-partner.de/downloads/

6. Conclusion

Rainwater that falls from heaven is likely to be the cleanest water that is potentially available to us. It contains no pharmaceutical residues, heavy metals or nitrates, etc.. To define this water as wastewater should be urgently revised against the background of increasing long periods of drought and water shortages in urban areas, and in view of the Water Resources Act § 5 (WHG)[22], which obliges us to use the resource water sparingly.

Viewing the rainwater fee solely in terms of "wastewater" disposal and from the perspective of the disposal utility as a purely business activity, is too short-sighted. The economic criteria for rainwater management need to be disclosed. The levying of a rainwater fee must not serve to generate additional revenue for the municipality, but should ensure that all costs for rainwater drainage and treatment, and particularly the costs of highly polluted road runoffs and other rainwater sources, are fairly distributed among the polluters and that the charges are earmarked for measures aimed at the sustainable use of rainwater as a resource.

The introduction of a rainwater fee requires technical, political and legal efforts. In this context, Geyler et al. (2019)[23] rightly pointed out that the implementation of coherent rainwater strategies at municipal level is hindered by the following factors:

- limited decision-making within the municipalities
- diverging interests of the actors, and
- the need for more robust institutional design under conditions of uncertainty.

It is possible that decision-making power within municipalities is distributed among many actors, which can lead to inefficient coordination. This may be due to the unequal access to information and different interests. Another explanation could be that decision-makers pursue their own interests and these are not necessarily compatible with the above-listed "social" goals and strategies of sustainable rainwater management.

The authors also found out that the level of rainwater fees is often very low and probably insufficient to create incentives for the adoption of decentralised measures. On the other hand, the willingness of property owners to adopt decentralised measures only increased with an increasing number of discounts on high rainwater fees, leading to a reduction in the connected drainage areas through decoupling measures, and subsequently a reduction in the amount of rainwater runoff.

The fact that the level of fees and rebates will ultimately determine which rainwater measures are promoted or hindered is exemplified by Berlin's wastewater fee statute.

With an annual rainfall of approx. 500 mm, approx. 3.60 € is paid for the discharge of one cubic metre of generally clean roof runoff. If this water is used in the building for washing laundry or flushing toilets, the full wastewater charge of 2.15 €/m^3 and the costs for metering will be also incurred. Although Berlin complains about water shortages and tries to mitigate this by promoting more blue-green infrastructure, the existing fee structure will discourage citizens from saving water and reducing wastewater. As long as the use of

[22] Wasserhaushaltsgesetz (WHG) § 5 Allgemeine Sorgfaltspflichten. https://dejure.org/gesetze/WHG/5.html

[23] Geyler, S., Bedtke, N. & Gawel, E. (2019) Sustainable Stormwater Management in Existing Settlements - Municipal Strategies and Current Governance Trends in Germany. Sustainability 11: 5510-5533

rainwater, which is a highly sustainable resource in densely populated innercity areas with a high demand for service water, is further hindered, no one should wonder why the annual decoupling target set for Berlin is not achieved, why groundwater levels continue to drop and the city climate is increasingly becoming hostile to life.

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This article was written within the framework of the City Water Circles (CWC) project of the Interreg CENTRAL EUROPE programme.

More information on the CWC project:
www.interreg-central.eu/Content.Node/CWC.html

Images

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