Potential and barriers to cooperative rainwater management on non-publicly owned land: the case of the city of Rostock

Potentiel et obstacles à la gestion coopérative des eaux pluviales sur des terrains non publics : le cas de la ville de Rostock

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RÉSUMÉ

La pression exercée sur les systèmes de drainage urbains augmente en raison de l'urbanisation et du changement climatique, rendant la gestion décentralisée des eaux pluviales et le concept de ville éponge de plus en plus pertinents. La ville de Rostock vise à devenir une ville éponge d'ici 2080. En collaboration avec l'université de Rostock, elle a lancé un projet visant à utiliser des analyses SIG pour identifier les emplacements appropriés pour des mesures d'infiltration. Les cinq sociétés immobilières participantes possèdent collectivement une part importante du territoire urbain, dont 57,84 % se prêtent à l'infiltration. Bien que plusieurs zones contiguës très appropriées aient été identifiées, des obstacles à la mise en œuvre sont apparus, notamment un engagement limité des partenaires, des données géoréférencées insuffisantes, des coûts de cycle de vie peu clairs et les contraintes structurelles des bâtiments existants. Des analyses hydrologiques et hydrauliques sont en cours afin de quantifier les effets des mesures décentralisées. Ce projet jette les bases d'un développement urbain sensible à l'eau à Rostock, tout en soulignant la nécessité de stratégies contraignantes pour soutenir la mise en œuvre sur les terrains privés.

ABSTRACT

The pressure on urban drainage systems is increasing due to urbanisation and climate change, making decentralised rainwater management and the sponge city concept increasingly relevant. The city of Rostock aims to become a sponge city by 2080. Together with the University of Rostock, it has initiated a project to use GIS analyses to identify suitable locations for infiltration measures. The five participating housing companies collectively own a significant proportion of urban land — 57.84% of which is suitable for infiltration. Although several highly suitable contiguous areas were identified, implementation barriers emerged, including limited partner engagement, insufficient georeferenced data, unclear life-cycle costs and the structural constraints of existing buildings. Ongoing hydrological and hydraulic analyses aim to quantify the effects of decentralised measures. This project is laying the groundwork for water-sensitive urban development in Rostock, while also highlighting the need for binding strategies to support implementation on private land.

KEYWORDS

Decentralised Rainwater Management, GIS Analysis, Implementation Barriers, Sponge City, Urban Infiltration

1 INTRODUCTION

Due to global urbanization and the advancing effects of climate change, which include both, more frequent prolonged dry periods and more frequent heavy rainfall events, rainwater management and urban drainage are becoming increasingly important (Chocat et al., 2001; Fletcher et al., 2013; EEA, 2025). One form of rainwater management is the sponge city concept, which follows similar approaches and concepts to the Low Impact Development Approach in the US or the Bluegreen Cities Approach in the UK (Chan et al., 2018).

Decentralised rainwater management measures are now a priority in many laws, regulations and guidelines on urban drainage, as set out in the EU Urban Waste Water Treatment Directive, for example. However, in addition to implementation in public areas, implementation in non-public areas is also necessary for comprehensive, water-conscious urban redevelopment. Non-public areas usually constitute the largest proportion of a city. Furthermore, studies demonstrate that implementing small-scale measures across various catchment areas can mitigate the risk of flooding (Chen et al., 2021). In areas affected by heavy rainfall or flooding, private individuals view the sponge city concept very positively, and expect an increase in property value as a result of construction (Zhang et al., 2018). Nevertheless, few measures have yet been implemented on private properties, mainly due to unclear life cycle costs, including operation and maintenance (Li et al., 2017).

Like many other cities, Rostock aims to become a sponge city, with 2080 set as the target year. Urban redevelopment is progressing thanks to the establishment of a municipal working group responsible for inland flood protection and sponge city initiatives, the development of a guiding strategy to be decided by politicians and citizens, and the initial implementation of measures on municipal land. To include non-public areas in urban redevelopment, the joint project 'Establishment of a city-wide land pool for cooperative precipitation water management' has been launched by the University of Rostock and the City of Rostock. Funded by the Federal Ministry for the Environment, Climate Protection, Nature Conservation, and Nuclear Safety as part of the funding guideline 'Measures for Adaptation to the Consequences of Climate Change', the project will run from January 2023 to the end of March 2026.

This project is unique in that it involves the five biggest housing companies based in Rostock as cooperation partners. The research project's main objective is to use geographic information analyses to identify suitable locations for rainwater management measures on the partners' land. Funding will then be available for the further planning of a suitable location. The potential analysis is supplemented by analyses of the effects of measures at suitable locations on the water balance, for example. Barriers have arisen during the project, particularly on the part of the housing construction companies, and these will be briefly explained.

2 MATIERALS AND METHODS

2.1 Identification of suitable locations for rainwater management measures

The first step in identifying suitable locations for rainwater management measures was to compile a list of the areas owned by the participating housing companies. These areas were recorded in the GIS. The measure selected for the study was swale infiltration. The potential for swale infiltration was determined in the GIS using exclusion criteria. If any of these criteria are not met, infiltration is not possible. The criteria were developed on the basis of German worksheet DWA-A 138-1, which covers the planning, construction, and operation of facilities for the infiltration of precipitation water. The criteria were derived from public geodata.

Following the completion of the potential analysis for the entire urban area of Rostock, an evaluation was conducted for the areas of the participating housing companies. This evaluation was performed at parcel level and for contiguous areas, which were analysed collectively. Based on these two analyses, suitable contiguous parcels were identified as focus areas for further consideration. Profiles containing all relevant information about these areas were created and provided to the participants, to inform joint discussions about which location the project’s available preliminary planning funds should be allocated to.

2.2 Identification of barriers to rainwater management measures

As part of the project, the barriers encountered by the cooperation partners with regard to rainwater management measures were continuously documented. These were specified and categorized through discussions in small and large groups as well as through on-site appointments at the cooperation partners' properties.

2.3 Further analysis

No comprehensive analyses are yet available on the effects of implementing rainwater management measures in Rostock. For this reason, the effects on the local water balance, runoff in the sewer system, and surface runoff during heavy rainfall events are currently investigated using GIS technology.

3 FIRST RESULTS AND DISCUSSION

3.1 Identification of suitable locations for rainwater management measures

The housing companies involved as cooperation partners collectively own around 4.3% of Rostock's land. When considering only areas classified as residential development, this figure rises to 18.2%. Exemplary criteria for infiltration potential are shown in Table 1 with a brief explanation.

Table 1 Criteria for infiltration potential with explanation

Criteria	Explanation
Distance to buildings	Selected: 5 m
Distance to groundwater table	Selected: 1.3 m. The distance to the groundwater table was determined from geodata, e.g., data from the state drilling data repository of Mecklenburg-Western Pomerania, water levels, and the digital terrain model
No drinking water protection area	
Hydraulic conductivity	Selected: min. 1 x 10^{-6} m/s. The hydraulic conductivity was determined from several GIS data sets and literature.
No impervious surface	Determined from digital orthophotos using automatic detection of impervious surfaces.
No trees	Determined from digital terrain model, digital surface model, and digital orthophotos.

The evaluation of the infiltration potential shows that a total of 31.97 percent of the area in the city of Rostock is suitable for infiltration. Areas owned by the participating housing companies are 57.84 percent suitable for infiltration. A total of seven areas were identified as particularly suitable. These areas offer an extremely good ratio between the available infiltration area and the potential connection area (roof areas). The size of these contiguous areas ranges from 19,300 to 34,500 m². The identified areas were presented to the cooperation partners and the positive effects of on-site rainwater management were explained. However, the housing companies decided not to draw on the funds available in the project for one of the focus areas. The reasons for this are explained in the following chapter.

3.2 Identification of barriers to rainwater management measures

During the project period, barriers repeatedly arose that affected either cooperation with the participating housing companies or the possible implementation of rainwater management measures. Some of the barriers are specific to the city of Rostock, but others are also transferable to other cities in Germany, Europe, or worldwide:

- Only three of the five housing companies that had originally agreed to participate as cooperation partners attended the project meetings. Despite repeated enquiries, no renewed interest was expressed.
- The housing companies only keep a small portion of their data georeferenced in a GIS, which meant that even identifying the locations of the participating partners was time-consuming.
- Due to a lack of financial support from the housing companies, the contact persons had to carry out their project work alongside their regular duties. This resulted in low overall support from the housing companies.
- The funds available for further planning of suitable sites can only be used for preliminary planning. In the opinion of the housing companies, this is not specific enough. Funding for implementation measures would have been desirable.
- The costs and other expenses, especially those relating to maintenance and upkeep, are cited as the biggest barrier to implementing measures. Overall, such measures do not yet pay for themselves, as the

saved fees for rainwater discharge and drinking water are lower than the estimated investments.

- Residential development in Rostock is characterised by buildings from the 1970s and 1980s. According to housing construction companies, these buildings have low-quality underground sealing, which is why infiltration measures are viewed very critically.
- In many districts, residential development consists of large blocks with flat roofs. On the one hand, the flat roofs are not strong enough to support green roofs. On the other hand, the flat roofs have internal drainage systems that are routed outside between one and two meters belwo ground level. Due to this depth, it is only possible to implement infiltration measures in these buildings in combination with internal adaptions of the in-house installations.

3.3 Further analysis

At the time of submitting the abstract, only provisional results are available, yet. However, by the end of the project in March—and thus also by the date of Novatech—the analyses will have been completed.

4 CONCLUSION

The research project has established important foundations that are already being utilised, primarily by Rostock city administration employees. Thanks to the infiltration potential analysis, it will soon be possible to quickly determine whether an area is suitable for infiltration when renovating or constructing buildings. Combined with the products developed as part of the analysis, such as the new method of determining groundwater levels, the transformation of Rostock into a sponge city can be accelerated.

The identified barriers indicate that “good will” from the cities’ side to implement rainwater management measures in Rostock is not sufficient. To increase pressure, a binding strategy for water-sensitive urban development has been developed and shall be passed through the city council.

The ongoing hydrologic and hydraulic analyses are expected to highlight the positive effects of the measures. This will further reinforce the potential of the measures and drive their implementation forward.

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