CATEGORISING AREA MODELS FOR STORMWATER FEES AT PROPERTY LEVEL: A LITERATURE REVIEW

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ABSTRACT
Worldwide, the increasing challenges due to stormwater run-off in urban areas are well known. Authorities need to be prepared for emergency situations and have plans for preventive measures to avoid flooded properties and public grounds. Several studies highlight that homeowner's knowledge and awareness of their own flood risk, will lead to better protection and less damage. What is probably less focused is that preventive-measures within your own property will also help to reduce the flood risk for your neighbours settled at a lower site. Stormwater fee derived from the area model can be seen both as an instrument to motivate property owners to manage rainwater in a more sustainable way, and a way of financing public infrastructure related to stormwater. Many cities and states worldwide have already introduced area models as a basis for calculating stormwater fee at property level. There are many models which range from very simple and rough calculations to more complex and detailed. In some countries, e.g., USA, differentiated stormwater fees have been used for decades, while for example in Norway this is still a controversial topic. In this study, we will conduct a literature review of area models, which aim to describe what a single property should pay in stormwater fee. Which model is best, depends entirely on the goals you want to achieve. Based on the literature review, our understanding is that more attention will be paid on area models if there is a clear connection between instrument and goal. In this article we aim to categorize and group the different models and describe for which goals they are best suited.
Keywords: stormwater fee, barriers, incentives, values, criteria, policy making.

1 INTRODUCTION

Urbanization continues to be the driving force for global growth [1]. The battle for space, which functions to be taken care of within the urban areas, is constantly increasing. At the same time as the urban building density and proportion of impermeable surfaces increases, we face the consequences of climate changes, among others more frequent torrential rainfall, that demands increased local management of stormwater. Large and small cities are struggling on how to deal with this continuously increasing stormwater problems, caused by climate change and decades of urbanization [2]–[8]. In many countries, we observe that local authorities have adopted stormwater fees as a source of revenue to finance maintenance, operation and costly upgrading of stormwater infrastructure [9]–[13]. In the United States, the first municipalities introduced stormwater fees in 1964, and today at least 1,851 local governments in 41 states have this [14]. The emergence of the implementation of stormwater fees across the United States over the past five decades reflects a significant shift in fiscal responsibility for the operation, maintenance, and improvement of public infrastructure systems at the local level [15]. As a result changes in stormwater management policies can lead to intensifying conflicts between urban development and stormwater management [16]. Achieving sustainable urban development requires a balance between economic, social, and environmental assessments in the municipal decision-making processes. To choose good local strategies for sustainable urban development, it is important to understand the barriers that can be encountered in the design and implementation of the desired policies. The aim of this article is to provide an overview of the economic instruments used internationally aiming

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among others to reduce the risk of urban flooding and pollution. For this paper we have identified the following research questions: (1) When introducing stormwater fee; what kind of models at property level to choose between, and how to categorise them? (2) What are the barriers and how to choose model when introducing this fee?

2 CATEGORISATION METHODOLOGY

2.1 Purposes of introducing a stormwater fee

There will be various reasons for implementing stormwater fees, and we will evaluate the purposes described in the literature. It can be (1) to raise money to pay for the running costs, maintenance and the development of new stormwater measures; (2) stormwater fees can be used as incentives to change people's behaviour to manage stormwater on their own plot; (3) in places where there is a shortage of water, water fees can be used to encourage use of stormwater in a more sustainable way, for example for flushing toilets, irrigation of gardens and plants etc.

2.2 Principles on which models for stormwater fees may be based

In determining which considerations are to be prioritized for the choice of economic model for stormwater fees, several trade-offs must be made. The complexity of the models will also reflect the extent to which the different values can be considered. We have chosen to evaluate our findings in the literature according to the considerations and values shown in Table 1.

Table 1: Values on which stormwater fees can be chosen.

Values	Explanation
Simplicity	The calculation of the stormwater fees should be easy to understand for residents and easy to calculate and implement for the local municipality's administration.
Sufficiency	The fees collected must cover both investments, operating and maintenance costs, as well as ensuring that the long-term management of the system is sustainable.
Equity	If equitable revenue responsibility across customer class is important to a local government, moving away from a stormwater fee structure that charges flat fees to all customer classes would be advisable.
Legal	Implementation of the fees is legally justifiable.
Provenance neutrality	The total water and sewage fees should not be changed after the introduction of a separate stormwater fee. But the distribution between the various fees is changing.
Behaviour change	Incentives leading people to change their behaviour e.g. reducing stormwater runoff from their own property.
Polluter pays	In environmental law, the polluter pays principle is enacted to make the party responsible for producing pollution by paying for the damage done to the natural environment.
Precautionary principle	The precautionary principle is an approach to innovations with potential to cause harm when extensive scientific knowledge on the matter is lacking.

Criteria are often associated with values, but they are not synonymous. Criteria may be applied to any number of different levels of experience. Values, on the other hand, are at the same logical level as beliefs. From this perspective, values are similar to what are called "core criteria". Criteria can also be said to be a way of measuring the presence of a value. We have arrived at a conceptualization of values based on three propositions: (a) Values cannot be directly observed; (b) Values engage moral considerations; and (c) Values are conceptions of the desirable [17, p. 28]

2.3 Barrier types

In a comprehensive European study [18], seven types of barriers were identified, these are barriers that affect the ability to transfer policy to action in different ways. Barriers are also studied for spatial planning and policy integration [19], [20] and for climate change adaptation [21].

The barriers overlap to a certain extent and can therefore not be said to be mutually exclusive.

In 1991, economist Douglas North published an article entitled "Institutions" in the *Journal of Economic Perspectives* [22]. North defines institutions as "human-designed constraints that structure political, economic, and social interactions". Restrictions, as described by North, are designed as formal rules (constitutions, laws, property rights) and informal restrictions (sanctions, taboos, customs, traditions, codes of conduct), which usually help maintain order and security within a market or society. Another way of explaining the concept is that institutions are established and stable patterns of behaviour that define, control and limit action. With North's definition of institutions, we choose to classify all the barriers in Table 2, except the technological ones, as institutional barriers. The technological barriers, in this context, can be which parameters are to be included in the models and how accurate data are needed to calculate stormwater fees.

3 METHODS AND DATA

Research literature regarding stormwater fees has been found in various databases, available from the respective universities in which the authors are employed. Keywords in the literature search have been *stormwater fee*, *stormwater taxation*, *stormwater funding*. Alternatively, we have also combined the keywords *financing* and *stormwater*. The purpose of this study has also been to investigate barriers and opportunities which also have transfer value for the implementation of stormwater fees. We have also reviewed literature on local stormwater management and searched for articles which deal with *barriers*, *success factors* and *enablers* in general terms. Our inclusion criteria were peer-reviewed scientific articles from the last twenty years. We have read the articles that met these search criteria to find if they are of interest to our research on various principles for determining stormwater fees and if the articles are mentioning any barriers. After completing searches on these keywords, we have used "chain search" [23, p. 193] where we have studied additional literature mentioned in the articles' reference lists. This means that you find relevant literature in that one text leads to the next. The method has its strength in that it leads from a good reference to another, and in this way, you can follow the development of the arguments through the literature search. The weakness of the method is that you may miss references to other understandings and disagreements in relation to the one you started the chain by. These articles that we find in chain searches, may also be older than the «primary articles», which means that we do not continue with chain searches if the articles are older than twenty years. Our selection criteria

Table 2: Different barrier types and associated challenges.

Barriers	Policy formulation/design	Policy implementation
Cultural	Lack of acceptance and support from the public or affected actors	Lack of support from implementing actors. Low public acceptance
Political	Missing or unstable majority of interests in political choices. Internal tensions in key political parties	Political interference in the implementation phase. No political champion for stormwater fee policy making and implementation
Legal/ regulatory	Lack of or illegitimate legal basis for policy or action design	Missing or illegitimate legal basis for implementation of measures. Developing a new legal framework takes time
Organisational	Unclear and/or conflict-filled division of roles or cooperation between actors.	Unclear placement of responsibilities, lack of capacity or conflict-filled areas of cooperation
Knowledge	Unclear or conflict-filled perception of the connection between measures and goal achievement	Lack of knowledge about methods of implementation. Underestimation of the extent to which a new legal framework would be needed
Economic	Lack of or insufficient funding for political choices or measures	Lack of or insufficient financing of implementation despite formal commitments
Technological	Lack of necessary or mature technology for action	Implemented technology is inadequate or inefficient

also exclude all articles that are not written in English or Scandinavian languages. We have limited this review to articles from the last 20 years, with a few exemptions for articles that are characterised as "reference articles". These are journal papers which are regarded of such great importance that we have included them. With these subjective inclusion and exclusion criteria, we have reduced the number of relevant articles for this literature study to 113. This literature has been carefully reviewed to identify if they are relevant to our research, and finally we ended with 56 references.

4 RESULTS

4.1 Calculation basis for stormwater fees found in the literature

The equivalent residential housing unit [9]–[11], [13]–[16], [24]–[35] approach, uses the average impervious area of a property as a standard unit to determine the stormwater fee. Residential equivalent factor [10], [14], [29] calculates the average runoff volume for a selected stormwater event for properties with the same zone status (e.g., single dwelling), and all properties in this zone-category are charged the same fee. For the gross property area, a stormwater fee is imposed on the property's gross area. This model assumes that the entire property contributes to run-off or that all properties are equally developed. The distributed transportation alternative [10], [13] considers the stormwater management of municipal roads and calculates the toll based on the average mileage for a specific user. The hydrologic alternative fee [10], [11], [36] is based on the characteristics of the individual property, such as soil type, topography, impervious area, and requires detailed information about each plot. Incentive scheme is used to encourage residents to manage as much stormwater as possible on their own property [9], [12], [13], [32], [37]. To improve runoff quality [9], [25], to reduce the demand on the sewer infrastructure [37], to install LIDs [4], [9], [26] a discount scheme can be built in to compensate for this. In intensity of development [9], [14], [27], [35], [38] stormwater fee is usually very similar to the coefficient of runoff [35]. The gross area and the intensity of development methods assign factors for different land use types [31]. For the tier fee [29] fees are charged by classifying property plots in categories based on the rate of impervious area, land use purposes, etc. The flat fee is a funding mechanisms that charge a flat rate to users of a stormwater conveyance system [24], [29] and is based on the size of a property, and on the average stormwater burden their property type contributes [32]. Fee types that are easy to administer (e.g., flat fees) is not fully representing the stormwater contribution from the parcels [29]. The dual fee [24], [29] calculation method divides properties into residential or non-residential and burdens the classifications differently. For the water usage fee [29], [32] the fee level is according to the household water usage. Runoff volume and rates can be determined using a number of factors (usually the impervious area) [13]. The parcel area rates is based on the size of parcel [29]. The cap and trade [9], [15] evaluation is based on criteria quota trading with discharge limits for stormwater runoff. The municipality sets a limit for the discharge of stormwater on the main sewer system. The maximum permitted discharge is then distributed among residents. Quota trading is encouraged, where quotas give permission to release a certain amount of stormwater at the property level. For offset program [25] reimbursement of overpaid income tax that the landowner has paid in is set off against debt due for stormwater fee. The stormwater fee with fixed and variable component is a proposed method for taxation based on individual parcel assessment, described by Barton [36], Peterson et al. [39] and Godyń et al. [40]. For these models a fee specific for the property can be calculated through the combination of detailed land use maps, a hydrological model, estimates of current and expected costs of stormwater networks and treatment. For the Pigouvian instrument tax concept [12], [25], [33] one assumes that optimal tax on pollution should be a direct tax that corresponds to the marginal external damages caused by the pollution. Traditional "command-and-control" regulations set uniform standards for all sources, with the most common being technology- and performance-based standard. Command-and-control regulation sets specific limits for pollution emissions and/or mandates that specific pollution-control technologies that must be used [41]. Ad valorem tax [16], [21] is a tax whose amount is based on the value of a transaction of property. Funds are not dedicated and stormwater programs must compete with other programs for funding [32]. The parcel area fee is based on size of parcel.

Even though several of the articles reviewed discuss implementation challenges, we rarely find any discussions about which values, or barriers formed the basis for the model. Table 3 shows the evaluation and the criteria that seem to be emphasized for the different models. Some models are very common, which we interpret as being easy to understand for residents, they are politically acceptable and easy to administer. Such simple models, on the other hand, are not quite fair or sufficient, as they have simplified calculations of the individual parcels in terms of infiltration properties and stormwater load.

4.2 How to overcome the implementation barriers in a stormwater context

When planning to introduce a fee for local stormwater management, barriers among decision-makers, residents [52], [53] or the local administration may occur. Ngyen et al. [33, p. 157]

Table 3: Evaluation of stormwater fee models.

Fee models	Purpose of the stormwater fee models					Criteria for calculation				
	Economic goals		Environmental goals			Property			Hydrology/ stormw. vol.	
	Financing	Incentive – reduced fee	Reuse stormwater	Prevent floods	Prevent pollution	Total area	Impervious area	Stormwater runoff	SUDS measures	Terrain slope/ hydrolog. proc.
1 Equivalent residential unit [10], [11], [13], [14], [26], [27], [29], [38], [42]	x			x		x	x	x		
2 Residential equivalent factor [10], [14], [29]	x			x		x	x	x		x
3 Gross property area [31], [35]	x			x		x				
4 Distributed transportation alternative [10], [13]	x			x				x		
5 Hydrologic alternative [10], [11], [36]	x	x		x		x	x	x		x
6 Incentive scheme [4], [9]–[13], [25], [32], [35], [37], [43], [44]	x	x		x	x				x	
7 Intensity of development [31], [35]	x			x		x	(x)			
8 Tier fee [24], [29]	x			x		x	x			
9 Flat fee [11], [24], [28], [29], [31], [32], [39], [45]	x			x		x		(x)		
10 Dual fee [24], [29]	x			x		x	x			
11 Water usage fee [13], [24], [29], [31], [36]	x	x	x	x						
12 Cap and trade [9], [15], [46]	x	x		x				(x)		
13 Offset program [4], [9], [12], [29], [34], [47], [48]	x	x		x						
14 Pigouvian instrument [9], [11], [15]	x	x	x	x	x					
15 Command and control [9], [15], [41], [46], [49], [50]	x	x		x				x		
16 Ad valorem tax [27], [32]	x			x		(x)				
17 Parcel area [11], [12], [24], [29]	x			x		x				
18 Fixed and variable component [32], [36], [40], [51]	x	x	x	x	x	x	x	x	x	x

claims that "the close cooperation of various levels of government administration is a vital factor for successful implementation". Many of the barriers are difficult to overcome because they are systemic and embedded within organizational cultures, practices and processes [54]. Griggs writes "How programs are financed, depends on their scales of operation, how they are organized, and on the community's approach to taxation and use of fees. In a state with the enabling legislation and successful utilities in place, it makes sense to adopt stormwater fees if they are politically acceptable" [12].

Key *success factors* in implementing new policies and measures are described by Åkerman et al. [18]: *Cultural barriers*: Carefully prepare information and communication strategies. *Political barriers:* Having a project champion who is backing up the stormwater fee policy and manages to create legitimacy. A political leadership developing over time, with a network of policy makers and experts who is working intensively for successful policy implementation. *Legal barriers*: Having an existing legal framework that supports this kind of initiative. *Organisational barriers*: A clear pioneering spirit among key professionals involved in the preparations. Existing institutional framework with clear mandates, roles and responsibilities. *Knowledge barriers*: Preparatory work and expert knowledge exist and is easy to access and bring into the process. *Economic barriers*: Acceptable initial capital costs and financing. *Technological barriers:* Available technology that work well.

5 DISCUSSION

We have managed to identify eighteen principles for fee or tax determination in the reviewed literature.

When national laws refer to stormwater only as a pollution problem, the law is then probably based on the precautionary principle. If laws must be changed to allow the introduction of stormwater fees, i.e., stormwater is regarded as a quantity problem, then the law must be founded on the polluter pays principle. When municipalities emphasize the polluter pays principle, the calculation of the stormwater fee should ideally include the costs the stormwater run-off from each individual property potentially contributes to the surroundings. Furthermore, it should also include the costs this runoff will impose on the local authority working to prevent damages. The most common way of calculating the stormwater fee is to apply the equivalent residential unit model (ERU) where the fee is determined based on the proportion of permeable surfaces on each property. Basically, this is a fee for stormwater that occurs from sealed surfaces on the site, such as roofs, driveways etc. and from which the stormwater is led to the public stormwater system. In practice, it is hard to design a fee which is regarded as fair for all types of properties. To reduce the administrative costs and to make the fee easier to deal with, a fee which is scaled proportionally to the plot area has therefore been introduced. In Växjö in Sweden, the design of the fee is currently divided into three categories (detached houses, other buildings and plots without buildings) [44]. This could possibly challenge some landowners' view on what can be accepted as fair.

Some municipalities have enacted the principle that despite the introduction of a new stormwater fee, the total amount of charges should remain unchanged.

Our research reveals that all the previously mentioned barriers are important for local municipalities to have in mind when implementing storm water fee at a local level. Which barriers that are the major obstacles during the process will vary a lot and requires detailed knowledge of local conditions. The organization of the water sector can be fragmented, in that various administrative units have shared responsibility for e.g., stormwater management from the built environment. For example, in the literature we have found that in some cities the Road Department is responsible for the stormwater management [10], while in other cities this belongs to the Water and Sewerage Department. In addition to organizational barriers, we also find examples of financial barriers. This might be that the agencies responsible for stormwater management operate with insufficient budgets. To overcome these challenges the legislation must be changed so it provides the right to collect stormwater fees sufficient to cover the full cost of producing the services. For some landowners, the burden of a high stormwater fee may motivate them to set up preventive measures that can reduce the stormwater fee. This can be achieved by building more green infrastructure or reduce non-permeable surfaces on their individual property [29]. This can then lead to some unintended consequences for the municipality. If high number of landowners install measures that infiltrate, delay and/or detain stormwater on their own property, and thus pay a reduced stormwater fee, then the monthly income of the municipality can be reduced so that the municipality must increase the fee rates for stormwater management [29]. This possibility of fee reduction gives local politicians another dilemma; what about those properties that do not have the opportunity to install any green stormwater measures? In dense urban areas, there will be little space available for new stormwater measures, except green roofs and walls on some buildings. At the same time, when much of the older urban development was approved for construction permits in earlier times, it was not relevant to set any additional requirements for stormwater management at the individual properties. It may seem unfair for these landowners to be imposed a maximum stormwater fee, since it is not possible to have mitigating measures on their own property. An additional dilemma is related to the fact that the types of fees that are easy to administer will not fully represent the stormwater contribution from the individual properties. A consequence of introducing a model that more accurately represents the stormwater load from each individual property, will inevitably be more administratively demanding, and contain a larger number of factors that might be difficult or costly to obtain. Stormwater fees have not only been introduced to finance necessary measures, or to cover costs. Using low impact development (LID) approach to site development and stormwater management, the basic principle is to use nature for better source control. This is accomplished through sequenced implementation of runoff prevention strategies, runoff mitigation strategies, and finally, treatment controls to remove pollutants. Wilkerson et al. [55] mentions "awareness barriers" and explains this by saying that LID is a relatively new practice that most households are unaware of. At the same time, it turns out that achieving a voluntary development of LID on existing city properties only through the use of information campaigns has little effect. The incentive scheme is not intended to only provide funding for necessary stormwater measures, but it should also lead to actions to reduce runoff. The use of incentives may give more attention to the topic, but at the same time the fee level must be of a certain size to lead to a change in behaviour.

In practice, some models discussed here are little in use, such as The cap and trade and hydrologic alternatives. The latter is based on characteristics associated with the individual property such as soil type, topography, impermeable surfaces, and requires very detailed information [11], [36]. The purpose of using a stormwater fee may vary. About a third of the EU's territory is exposed to permanent or temporary water shortages. Thus, more sustainable water management can prevent water shortages. Rain water harvesting system can reduce water shortage during dry periods in arid regions, and a fee model that is linked to "water usage" may then be relevant [56]. Water consumption (and the fee level) can then be reduced by collecting rainwater and using it for example to cleaning, watering plants, and flushing toilets.

The Pigou instrument is a fee model based on payment for externalities. These are effects that you inflict on others that you do not include in your choices. An example that can be used, is when a property at the upper part of a catchment area cause flooding of the properties below. The landowner who resides at the top, neither knows that his actions affect others, nor knows that stormwater from his property causes problems for others who live further down. Economic theory defines this as a negative externality. Pigou's solution to the problem is to increase the private marginal cost by introducing a tax on pollution or inconvenience that the individual inflicts on others. At the same time, the environmental tax contributes to fulfilling a principle that polluters must pay, and the tax contributes to changing production and consumption patterns over time. Ad valorem tax is typically imposed at the time of a transaction, as in the case of a sales tax or value-added tax (VAT). Funds are not dedicated, and thus can be insufficient or erratic; stormwater programs must compete with other programs for funding. The taxpayer payments will in no way reflect stormwater burden, thus there is no incentive to modify actions [32].

When a municipality is planning to introduce a differentiated fee model, stakeholders should be involved through participation processes to identify values and barriers. Technical, economic, and environmental aspects as well as local knowledge could then be included in the planning processes at an early stage.

6 CONCLUSION

In this study, our focus has been to identify differences between calculation models of stormwater fees. To answer the research questions, we studied how stormwater fees were calculated in eighteen countries. We have identified 18 different models, that describes the calculation of stormwater fees. Some of these models are simple and widely used and therefore assumed accepted by both the population and local politicians as an appropriate tool for calculating stormwater fees. More sophisticated models that requires more detailed data about each property can be regarded as fairer but are more demanding to install and run. The main intention of this study was to identify fee models developed on property level and barriers associated with the implementation of such models. However, this study also included some fee models that are based solely on economic principles and not on characteristics on individual property. When implementing stormwater fee there exists both technical and institutional barriers. For successful implementation these barriers are important to identify at an early stage.

In recent years, stormwater management has evolved from a site-specific, technical issue mainly handled by engineers and water professionals to be an interdisciplinary field including engineers, landscape architects, urban planners, and citizens. This entails decision-making across different norms, values and work-practices that sometimes be challenging.

When implementing stormwater fee, the fee must be comprehensible and fair to citizens. But at the same time, it must be reliable and easy to set up. Essential basis data for calculating the fee, e.g., property conditions, precipitation and investment costs should be simple to collect and maintain for municipalities. The model must also be possible to manage for smaller municipalities with limited time, human resources, and expertise.

If local authorities emphasize a model that can be regarded as fair and simple, a stormwater fee structure where the property owners pay a fee proportional to the plot area, should be chosen. To motivate citizens to reduce or delay rainwater from their own property, permeable surfaces, ponds etc. should be included in the model. The ERU-model can then be the starting point for developing a fee structure. Although the intention is to create the model as fair as possible, it will soon become difficult for the citizens to understand as well as complicated for professionals to maintain. If the main goal for the fee is to generate revenue to cover running costs and maintenance of the storm water system based on a simple model, flat fee is preferable. Furthermore, tier fee is an option if you still want to keep the model simple, but at the same time differentiate the payment from properties to some extent.

In preparation for the introduction of stormwater fee, local politicians, municipal staff, and landowners should be involved at an early stage in order to map which values and barriers are important to emphasize when designing the fee model.

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REFERENCES

[1] UN-Habitat, *World Cities Report 2020: The Value of Sustainable Urbanization*, United Nations Human Settlement Programmen (UN-Habitat): Nairobi, Kenya, 2020.

[2] Abebe, Y., Adey, B. & Tesfamariam, S., Sustainable funding strategies for stormwater infrastructure management: A system dynamics model. *Sustainable Cities and Society*, **64**, 102485, 2021.

[3] Boguniewicz-Zabłocka, J. & Capodaglio, A.G., Analysis of alternatives for sustainable stormwater management in small developments of Polish urban catchments. *Sustainability (Basel, Switzerland)*, **12**, 10189, 2020.

[4] Carlson, C. et al., Storm water management as a public good provision problem: Survey to understand perspectives of low-impact development for urban storm water management practices under climate change. *Journal of Water Resources Planning and Management*, **141**(6), 04014080, 2015.

[5] Jotte, L., Raspati, G. & Azrague, K., *Review of Stormwater Management Practices*, Klima 2050. SINTEF Building and Infrastructure, 2017.

[6] Lu, G. & Wang, L., An integrated framework of green stormwater infrastructure planning: A review. *Sustainability*, **13**(24), 2021.

[7] Van Oijstaeijen, W., Van Passel, S. & Cools, J., Urban green infrastructure: A review on valuation toolkits from an urban planning perspective. *J. Environ. Manage.*, **267**, 110603, 2020.

[8] Veiga, M.M., Castiglia-Feitosa, R. & Marques, R.C., Analyzing barriers for stormwater management utilities. *Water Supply*, **21**(4), pp. 1506–1513, 2021.

[9] Parikh, P. et al., Application of market mechanisms and incentives to reduce stormwater runoff. *Environmental Science and Policy*, **8**(2), pp. 133–144, 2005.

[10] Fisher-Jeffes, L. & Armitage, N.P., Charging for stormwater in South Africa. *Water S. A.*, **39**(3), 2013.

[11] Tasca, F.A., Assunção, L.B. & Finotti, A.R., International experiences in stormwater fee. *Water Sci. Technol.*, **2017**(1), pp. 287–299, 2017.

[12] Grigg, N.S., Stormwater programs: Organization, finance, and prospects. *Public Works Management and Policy*, **18**(1), pp. 5–22, 2013.

[13] Tasca, F.A., Finotti, A.R. & Goerl, R.F., A stormwater user fee model for operations and maintenance in small cities. *Water Sci. Technol.*, **79**(2), pp. 278–290, 2019.

[14] Campbell, W. & Bradshaw, J., *Western Kentucky University Stormwater Utility Survey 2021*, Western Kentucky University: Bowling Green, Kentucky, p. 80, 2021.

[15] Chalfant, B., Resistance is (sometimes) futile: The diffusion and (occasional) demise of stormwater fees in the United States. *Proceedings of the Water Environment Federation*, **2018**, pp. 1015–1036, 2018.

[16] Bertram, N.P. et al., Synergistic benefits between stormwater management measures and a new pricing system for stormwater in the city of Hamburg. *Water Science and Technology*, **76**(6), pp. 1523–1534, 2017.

[17] Deth, J.W.v. & Scarbrough, E., *The Impact of Values*, Oxford University Press: Oxford and New York, 1995.

[18] Åkerman, J. et al., How to manage barriers to formation and implementation of policy packages in transport. *OPTIC. Optimal policies for transport in combination – 7th framework programme: Theme 7 transport*, p. 73, 2011.

[19] Stead, D. & Meijers, E., Spatial planning and policy integration: Concepts, facilitators and inhibitors. *Planning Theory and Practice*, **10**(3), pp. 317–332, 2009.

[20] Oukes, C., Leendertse, W. & Arts, J., Enhancing the use of flood resilient spatial planning in Dutch water management: A Study of barriers and opportunities in practice. *Planning Theory and Practice*, pp. 1–21, 2022.

[21] Oulahen, G. et al., Barriers and drivers of planning for climate change adaptation across three levels of government in Canada. *Planning Theory and Practice*, **19**(3), pp. 405–421, 2018.

[22] North, D.C., Institutions. *Journal of Economic Perspectives*, **5**(1), pp. 97–112, 1991.

[23] Rienecker, L. et al., *Den gode oppgaven: håndbok i oppgaveskriving på universitet og høyskole*. Fagbokforl.: Bergen, 2006.

[24] Aladesote, O., Stormwater management utility fees: A review. *International Journal of Research Publications*, **40**(1), pp. 1–13, 2019.

[25] Chouli, E., Aftias, E. & Deutsch, J.-C., Applying storm water management in Greek cities: Learning from the European experience. *Desalination*, **210**, pp. 61–68, 2007.

[26] Cousins, J.J. & Hill, D.T., Green infrastructure, stormwater, and the financialization of municipal environmental governance. *Journal of Environmental Policy and Planning*, **23**(5), pp. 581–598, 2021.

[27] Cyre, H.J., Stormwater management financing. *International Public Works Congress*, American Public Works Association: Houston, Texas, 1982.

[28] Environmental Commissioner of Ontario, *Urban Stormwater Fees: How to Pay for What we Need*, Environmental Commissioner of Toronto: Ontario, Canada, p. 34, 2016.

[29] Fedorchak, A., Dymond, R. & Campbell, W., The financial impact of different stormwater fee types: A case study of two municipalities in Virginia. *Journal of the American Water Resources Association*, **53**(6), pp. 1483–1494, 2017.

[30] Grigg, N., Is a stormwater fee a rain tax? *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, **11**, 04519017, 2019.

[31] Kea, K., Dymond, R. & Campbell, W., An analysis of patterns and trends in United States stormwater utility systems. *JAWRA Journal of the American Water Resources Association*, **52**(6), pp. 1433–1449, 2016.

[32] Keeley, M., Using individual parcel assessments to improve stormwater management. *Journal of the American Planning Association*, **73**(2), pp. 149–160, 2007.

[33] Nguyen, T.T. et al., Implementation of a specific urban water management: Sponge City. *Science of The Total Environment*, **652**, pp. 147–162, 2019.

[34] Roy, A.H. et al., Impediments and solutions to sustainable, watershed-scale urban stormwater management: Lessons from Australia and the United States. *Environ. Manage.*, **42**(2), pp. 344–359, 2008.

[35] Tucker, S. et al., *Guidance for Municipal Stormwater Funding*. epa.gov, p. 140, 2006.

[36] Barton, D.N., Overvannsgebyr: internasjonal erfaring og muligheter i Norge. *Fagtreff i Norsk Vannforening: Nytt vann i gamle byer – Forskning og nye muligheter*, Streaming video: NINA, 2021.

[37] Brears, R.C. (ed.), Copenhagen becoming a blue-green city. *Blue and Green Cities: The Role of Blue-Green Infrastructure in Managing Urban Water Resources*, Palgrave Macmillan UK: London, pp. 99–126, 2018.

[38] Cyre, H., Developing and implementing a stormwater management utility: Key feasibility issues. *International Public Works Congress*, American Public Works Association: New Orelans, Louisiana, p. 7, 1986.

[39] Peterson, K. et al., A Review of funding mechanisms for US floodplain buyouts. *Sustainability (Basel, Switzerland)*, **12**, 10112, 2020.

[40] Godyń, I., Muszyński, K. & Grela, A., Assessment of the impact of loss-of-retention fees on green infrastructure investments. *Water (Switzerland)*, **14**(4), 2022.

[41] Schoeman, J., Allan, C. & Finlayson, C.M., A new paradigm for water? A comparative review of integrated, adaptive and ecosystem-based water management in the Anthropocene. *International Journal of Water Resources Development*, **30**(3), pp. 377–390, 2014.

[42] Olstad, F. & Thuve, M., *Vurdering av finansieringsmodeller for overvann. Rapportutkast*, BDO: Oslo, p. 52, 2015.

[43] Milon, J.W., The polluter pays principle and Everglades restoration. *Journal of Environmental Studies and Sciences*, **9**(1), pp. 67–81, 2019.

[44] Paus, K.H. et al., *Overvannsarbeid i utlandet. Virkemidler for å redusere nedbørbetinget oversvømmelse i urbane områder*, COWI: Oslo, p. 43, 2015.

[45] Cameron, J. et al., User pay financing of stormwater management: A case-study in Ottawa-Carleton, Ontario. *Journal of Environmental Management*, **57**(4), pp. 253–265, 1999.

[46] Petersen, B. & Ducos, H. , Justice in climate action planning. *Strategies for Sustainability*, eds R. Lozano & A. Carpenter, Springer: Cham, Switzerland, p. 310, 2022.

[47] Hirschman, D. & Battiata, J., *Urban Stormwater Management: Evolution of Process and Technology*, Springer International Publishing, pp. 83–120, 2016.

[48] Niu, H. et al., Scaling of economic benefits from green roof implementation in Washington, DC. *Environ. Sci. Technol.*, **44**(11), pp. 4302–4308, 2010.

[49] Dhakal, K.P. & Chevalier, L.R., Urban stormwater governance: The need for a paradigm shift. *Environmental Management*, **57**(5), pp. 1112–1124, 2016.

[50] Grigg, N.S. (ed.), *Purposes and Systems of Water Management*, in *Integrated Water Resource Management: An Interdisciplinary Approach*, Palgrave Macmillan UK: London, pp. 33–66, 2016.

[51] Barton, D.N. et al., Brukerfinansiert klimaberedskap? En beregningsmodell for overvannsgebyr i Oslo. *VANN*, **56**(04), pp. 341–358, 2021.

[52] Pierce, G. et al., Environmental attitudes and knowledge: Do they matter for support and investment in local stormwater infrastructure? *Society and Natural Resources*, **34**(7), pp. 885–905, 2021.

[53] Kollmuss, A. & Agyeman, J., Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, **8**(3), pp. 239–260, 2002.

[54] O'Donnell, E.C., Lamond, J.E. & Thorne, C.R., Recognising barriers to implementation of blue-green infrastructure: a Newcastle case study. *Urban Water Journal*, **14**(9), pp. 964–971, 2017.

[55] Wilkerson, B., Romanenko, E. & Barton, D., Modeling reverse auction-based subsidies and stormwater fee policies for low impact development (LID) adoption: A system dynamics analysis. *Sustainable Cities and Society*, **79**, 2021.

[56] Musz-Pomorska, A., Widomski, M.K. & Gołębiowska, J., Financial sustainability of selected rain water harvesting systems for single-family house under conditions of eastern Poland. *Sustainability (Basel, Switzerland)*, **12**(12), p. 4853, 2020.

[57] Kvamsås, H., Addressing the adaptive challenges of alternative stormwater planning. *Journal of Environmental Policy and Planning*, **23**(6), pp. 809–821, 2021.